

**A STUDY OF
AN INDIVIDUALIZED MATHEMATICS PROGRAMME,
SMP 7-13,
IN SELECTED GREEK PRIMARY SCHOOLS.**

EVANGELIE MILONAS

**Submitted for the degree of Ph.D at the
University of Leicester**

Education Department October 1988

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GLOSSARY

P.G.C.E. :	Post Graduate Certificate in Education.
L.E.A. :	Local Educational Authorities.
SMP:	School Mathematics Project. SMP has been used in place of SMP 7-13 throughout the whole text.
9th, 11th, 41st	The schools that participated in the research, like all schools in Greece, have no special names, but are simply enumerated.
HMSO	Her Majesty's Stationary Office.
HMI	Her Majesty's Inspectors.
APU	Assessment of Performance Unit.
T. Th. I	Bruner's book: <i>Towards a Theory of Instruction</i> .
D. P.	Bruner's book: <i>Diadikasia tis Pedias</i> .
Note	<i>She</i> has been used throughout the whole text when referring to teachers, whereas <i>he</i> in reference to pupils.

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CHAPTER I

Introduction. - Aims and objectives of the study.

The two World Wars, at the outset of this century, gave rise to radical sociological reclassifications, created new needs and promoted the progress of technology. The new needs and demands of society affected in their turn the educational matters in most countries and dictated the need for innovation in education. Thus, the philosophy underlying primary education changed slowly but radically. It had been for the most part authoritative and totally instructive ignoring the child, his needs, peculiarities or wishes and gradually, it became progressive with a deep respect for the child, who was placed at the centre of the educational process. The importance of experience and environment on learning were recognized and stressed by many educationalists.

Developmental psychology also flourished influencing primary education and the development of the primary curriculum. The work of Piaget and Bruner which focused on the understanding of the evolution of the child's thought processes recognized the uniqueness of each individual child's cognitive development, and it provided a stage theory that the acquisition of concepts does not occur simultaneously and in an identical way for all children of the same chronological age.

A natural consequence of those changes in primary education and the evolution of the theory of Mathematics was an equally radical change in the content of the mathematical syllabuses as well as the teaching methods employed in primary schools. The child-centred educational approach which introduced the notion of individual differences in ability, needs and interests contributed to the abolition of the assumption that every child was capable of understanding every subject to which he was exposed.

Curriculum makers were deeply influenced by Piaget's views concerning the various ways and speed each child needs in passing through the gradual stages of cognitive development, and the

time each individual takes in order to acquire and conserve mathematical concepts.

Bruner also drew attention to the existence of individual differences and their importance to the planning of Mathematics teaching. He argued that individual differences "exist in massive degree - in the extent to which children have problem-solving pre-dispositions, in the degree of their interest, in the skills that they bring to any concrete task, in their preferred mode of representing things, in their ability to move easily through any particular sequence and in the degree to which they are initially dependent upon extrinsic reinforcement from the teacher. The fact of individual differences argues for pluralism and for an enlightened opportunism in the materials and methods of instruction." (Bruner, 1966, *TTT*, p. 71).

According to the new philosophical and psychological perspectives concerning education, in general, and the teaching methods and learning processes, in particular, the Mathematics curriculum should be so designed as to allow pupils to proceed according to their personal abilities, and so reach the same goal, only by following different paths.

Naturally, this change in primary education on the one hand, and in the teaching of Mathematics on the other, did not occur without being challenged and severely criticized from time to time. Furthermore, it was not realized simultaneously or to the same degree in the various countries. Thus, while in England the new progressive theories found fertile fields, and its primary education, as well as curriculum development, received a boost, especially after the publication of the Plowden Report, in Greece, the situation in the corresponding areas changed very little. The sociological, but mainly political situation which prevailed in Greece after the Second World War did not favour any progressive or innovative schemes. A reference to the literature concerning the changes that occurred in primary education, and particularly in Mathematics' teaching and learning during the last decades is attempted in chapter II of this the-

sis. A brief account of the evolution of primary education in the last years in England, as well as in Greece, is given in the same chapter.

The fact that educational matters in Greece had been stagnant for years intensified my personal desire to attend, as a Mathematics specialist, a post-graduate course in primary education in England. Thus the progressive theories I had only got to know through books, were seen being put into practice inside an "open" educational system. This is how I came to enrol in a post-graduate certificate course in Education at Leicester University, in 1981-82. During my practical experience in a number of schools, I became familiar with several of the most commonly employed English mathematical projects, which, as my experience taught me, compared with Greek educational standards, would seem very progressive, allowing considerable freedom to both pupils and teachers. It was a real challenge, therefore, to attempt the application of a research programme, the main purpose of which would be to examine the possibilities of success an English project of Mathematics might have in the Greek primary school. Thus, the present research was decided upon. At the time the research was being planned, clear reformatory attitudes began to be formulated in the Greek primary education area, which had been strictly traditional up to that time. The prospects then seemed favourable for the introduction of a more flexible, card-based individualized programme of Mathematics in a number of Greek primary schools.

At that time, a good number of English schools employed SMP 7-13 for Mathematics teaching. Impressed by the programme's success in England, I decided to use its first unit for second class pupils (7-8 years old), in a number of Greek primary schools. The aim of the research was to explore the applicability of the project in the present Greek primary educational system. The changes it would necessitate either to the project itself or to the teaching of Mathematics in Greece would also be examined. Furthermore, the children's reactions to the innovative approach and their progress, as well as the attitudes of teachers and

parents towards the teaching methods and strategies could be observed. The procedure followed during the application of the research is described in chapter III.

Throughout the application of the study difficulties stemmed from, either the Greek school environment and function, or from the project itself. Also, the children who participated in the investigation were confronted with difficulties mainly originating from the way the various mathematical concepts were presented through the use of the cards. The pupils' progress was measured by the use of a number of tests: the reactions, as well as the aspects of the teachers and parents involved in the research towards the introduced innovation were recorded through the use of questionnaires. The findings yielded by both the questionnaires and the given tests are discussed in chapter IV.

The field work of the present study was by necessity very limited. The fact that the research was conducted by one person only, without any control group, dictated the choice of a small sample and only one city of the country. Since, on the one hand, the sample was very small and on the other, the children were taught simultaneously through both the SMP cards and their Greek manual, no definite conclusions could be drawn concerning the positive influence of the project on the children's progress. The results of the tests, however, and a comparison of the pre- and post-test data allows the formulation of certain suggestions regarding the relation between the card-based teaching of Mathematics and the progress achieved by the children of all three schools involved in the research.

A discussion of the data drawn from the attainment tests, as well as from the topics that proved to be most difficult for the majority of the children, and of boys/girls separately is attempted in chapter V. In the same chapter, the pupils' attitudes to the project and the teachers and parents' comments on the teaching material and method are described and discussed. Moreover, continuing in the same chapter, after discussing the possibilities of applying SMP in the Greek primary school, sev-

eral suggestions are offered regarding the way in which it could or would be introduced in schools of different areas - namely rural, working and urban - of the country.

Of course, the present research does not profess to be anything but an exploration of the field called Mathematics teaching in primary schools, a preliminary investigation of a large scale, extensive and more systematic research that could be carried out by a group of experts in many and various parts of Greece. Nevertheless, the specific research offers the chance to except certain solutions that initially had been considered workable, to form views about certain possibilities, so that the most appropriate and promising procedure for the suggested innovation could be followed in the future. The conclusions drawn from the application of the research, along with the proposals for a further pursuance of the particular issue, and for the changes that might be attempted in both the Greek educational system and the project itself are formulated and presented in chapter VI.

It was hoped that this investigation would yield some indications as to the prospects which an English individualized, card-based Mathematics system would have in the Greek primary school under the existing educational conditions, and to what degree children of different abilities and from different socio-economic backgrounds would benefit from such an innovation. Were this type of information available to decision makers and curriculum planners, it would be hoped that a more progressive, flexible and promising mathematical programme for children could be designed and carried out successfully in Greek primary schools.

CHAPTER II

Related Research

AN EXAMINATION OF THE EVOLUTION OF THE ENGLISH AND GREEK PRIMARY EDUCATION SYSTEMS.

In the years after the Second World War, many changes, mainly technological and sociological occurred¹ which transformed the scene in the Western countries. Communication among people of the same, as well as different countries was facilitated by the modernization of the means of transport and this, along with the flourishing of the mass media, promoted the communication of ideas, beliefs and culture.

Pluralistic societies which nurtured a variety of cultures, religions, attitudes and freedom to express themselves were bound to promote a variety of educational systems as well. Authoritarianism, and word instruction in schools gave way to learning situations based on cooperation and active participation. New educational theories were developed, theories that re-evaluated the teacher - pupil, pupil - school relationships and introduced new teaching methods and attitudes that brought about a revolution in the history of primary education. Notions such as "learning through experience," respect of children's individual differences and needs," "education for today's children and tomorrow's adults" were heard for the first time and called traditional schooling into question. The primary school scene changed not only in its physical environment, but, most importantly, in its underlying philosophy. The traditional educational models, largely based on Plato's and Aristotle's philosophies started to fade in favour of a progressive model deeply influenced by the ideas of Rousseau and the theories of Dewey.² Educators, such as Froebel, Pestalozzi and Montessori had probably been influenced by Rousseau's ideas and in turn their educational practices, both theoretical and practical had been transferred through their own ideas. Developmental psychology was elaborated by Piaget and Bruner with a view of a reappraisal of the primary school curriculum and the teaching methods used. Theory and practice were bridged when theory was put to practice

and problems, difficulties or gains were identified and seriously examined, so that theories were enriched and improved. Subject or knowledge-centred, education was gradually modified, at least for the larger part of the school curriculum and a more child-centred, progressive type of schooling was established in primary schools of many countries.

Of course, these changes were not realized in a day. It took a lot of time, effort and struggle to accomplish them and naturally, they were not accepted in all countries equally readily, to the same degree or in the same form. Thus, for example, while in England the child-centred philosophy permeated through the primary education curriculum, as early as the nineteen twenties, in Greece, the philosophy underlying the primary education curriculum is still subject-centred. Only recently, a tendency has begun to be formulated towards a child-centred primary education, nevertheless, it still employs a subject-oriented curriculum.

Before appreciating the reasons dictating the application of an individualized approach in Mathematics teaching (if, that is, the value of individualization is accepted a priori), it is judged necessary to refer very briefly to the facts which stand out as landmarks in the history of primary education evolution in both England and Greece. This concise, historical account aims at outlining the traditional, conservative trends prevailing and affecting primary education in the two countries. The tendencies, reformations, reactions and struggles involved in the evolution of primary education might provide an insight into the spirit and attitudes prevailing today and the prospects being created in the primary education sector. Such a discussion would answer the question posed at the beginning, under which conditions an individualized scheme of work that was introduced and accepted into a large number of schools in England could - if it were characterized as applicable - be applied in Greece.

a. **The English example:**

By the publication of the *Education Act* of 1918 the pressing need of a reorganization of the schooling offered to children up to eleven years of age was brought to the attention of educators and others interested in educational matters. Education became compulsory up to the age of fourteen. From then onwards, attention would be continuously directed to the education of young children up to the age of eleven as the upper age of eleven seemed to be the most suitable age that could mark the division of education between the "junior" and "senior" sectors.

Eight years later, in 1926, the first *Hadow Report* (Report on the Education of Adolescent) set out an educational scheme according to which primary education should finish at the age of 11+ when the second stage of education should start. For several pupils, there was provision for a post-primary stage, which normally finished at the age of 14+ or 15+ but in certain cases went on to the age of 16 +, 18 or even 19.

In 1931, the *Consultative Committee* dealing with the primary school (the Hadow Report) conceived a vision of primary education and the role of school. It stressed the importance of "activity and experience" and considered primary education as having a character of its own. It envisaged it not as an interlude between infant school and the later stages of schooling and it argued that its evaluation should not be based on its efficiency to prepare children to proceed to the next stage of education. It also stated that the main concern of the primary sector should be to cater for children while they were still children; in this way, it would "best serve their future by a single minded devotion to their needs in the present,"³ as the important matter is not what children will be, but what they are. Thus, a new scope for the curriculum was created:

"It is not primarily a question of so planning the curriculum, as to convey a minimum standard of knowledge, indis-

pensable though knowledge is, and necessary, as is the disciplined application by which alone knowledge can be acquired. The essential point is that any curriculum, if it is not to be purely arbitrary and artificial must make use of certain elements of experience, because they are parts of the common life of mankind. The aim of the school is to introduce its pupils to such experiences in an orderly and intelligent manner, so as to develop their innate powers and to awaken them to the basic interests of civilized existence. If the school succeeds in achieving that aim, knowledge will be acquired in the process, not indeed without effort, but by an effort whose value will be enhanced by the fact that its purpose and significance can be appreciated at least in part, by the children themselves."⁴

The Consultative Committee envisaged a unified curriculum the different subjects of which would be commonly relevant to the growth of children and to their stages of development. Each of the different elements of the curriculum, they contend, in Language, Mathematics, Geography, Art, Environmental studies, etc., occupies a sphere of different specialization and demands, different techniques of teaching, but they also note that "divergent streams spring from a common source in human experience."⁵ They did not regard the different subjects of the curriculum as isolated and independent one from another, but as classifications of a general field of knowledge which are not themselves an end, but the means through which the children systematize the complex intellectual demands. Thus, the Committee formulated the view that each element of the curriculum should be considered as a separate discipline, but at the same time those experiences that included and connected them all should also be stressed. They admitted that certain subjects of the curriculum, such as reading, writing and arithmetic required regular practice, as they were of great importance to education, but they implied that learning, in general, as well as the acquisition of new knowledge had to be motivated by the children's interest and their exploration of a particular subject. They

imagined the curriculum not as much as separated compartments of knowledge to be taught, but as activities to be attempted, experiences to be gained and interests to be created. Although they accepted the need for different school work, according to the place, area, or district in which the school was situated, as well as according to its natural, social and cultural environment, nevertheless, they rejected the idea of the existence of a special curriculum for rural schools.

They emphasized the need to secure the continuity of education and the consolidation of good relationships between teachers of primary with those of infant school, on the one hand and the secondary school, on the other. At the same time, however, they claimed that each stage of the educational system should maintain its independence, so that it was not converted into a preliminary, preparatory stage of the next. They regarded the primary school as important as the secondary, so, they held the view, that the size and accommodation of the primary classroom should not be inferior to that of the secondary school.

Keeping in mind the division at the age of 11⁺ (introduced by the first Hadow Report), it was suggested that a classification of children according to their abilities should be maintained, so that slow learners could receive immediate and effective treatment and simultaneously, the bright ones could proceed according to their intellectual capacity. They agreed with the "triple track" system of organization, according to which the pupils in large schools could be divided into three groups, "A" for the very bright ones, "B" for the average and "C" for the retarded provided an easy transfer could be secured from one group to the other as soon as children of a group showed any improvement.

Concerning the examination system, the Committee suggested the implementation of intelligence tests (modelled by Binet-Simon Series), but for children leaving infant school their school record should also be consulted. In relation to the children's

transition from primary to secondary school, the Committee considered their examination in English and Arithmetic sufficient. They drew attention to the fact, however, that along with assessing their capacity, their attainment should be measured, too.

The Hadow Report could be estimated as a friendly move and a firm step towards a more progressive view of education. Nevertheless, the balance between the traditional and progressive methods was maintained, considering the former vital for certain areas of the curriculum and being cautious as to the effectiveness of the latter, since they had not been put yet through serious evaluation and analysis.

In 1937, the *Handbook for Suggestions for Teachers*⁶ showed the rationale of the junior school, which was the final stage of primary education - children from seven to 11⁺ - and the aims of which were the provision of an education suitable for children of that age and also their preparation for the next stage of education.

The philosophy underlying the Hadow Report, then, was maintained, since it was stated that the main concern of the junior school should be to provide pupils with those activities that best suited their stage of development and their interest and which would offer them the motivation to explore the various subjects in depth.

With the *Education Act* of 1944⁷, a Minister of Education was appointed who had the responsibility to establish an appropriate educational system, in England and Wales. The Minister held the Local Educational Authorities responsible, "under his control and direction," for the execution of the national policy in education. By the 1944 Education Act, the role of a central authority was emphasized and the tendency to establish a rather centralized system was made quite obvious. It was then that primary education was formally established as the first of three

stages of education - primary, secondary and higher - and the age of compulsory schooling was to be from five to fifteen, with provision to be extended to sixteen, when practicable.

From then onwards and until 1967 no spectacular changes were witnessed within the primary sector. The various training schemes introduced and the reports published referred mainly to secondary and tertiary education. And in 1967, the *Plowden Report*⁸, a landmark in the development of primary education in England, was published. This Report not only approved and promoted the progressive spirit of the Hadow Report, but it also led English primary education quickly and steadily towards greater progressiveness. The Plowden Report suggested the partnership between parents and school for the education of young children. Parents should be informed about what went on in their children's school, its organization, size of classes, aims and objectives, as well as their children's progress. They should also be encouraged to visit the school, meet the teachers and help, if they were willing and asked to do so.

A national policy of "positive discrimination" for the schools in deprived areas was formulated. It suggested that the buildings and organization within the schools in the deprived areas should be as good as the best in the country and the improvement of the teacher/children ratio should take place.

Referring to the system of punishment, it stated that "the infliction of physical pain as a method of punishment in primary schools should be forbidden."⁹

The organization of schools in classes was approved, but it was also suggested that pupils should be in contact with more than one teacher. It recommended a combination of class and group work and welcomed individualized learning. It advised unstreaming in infant schools, in the hope that it would spread into junior schools, too.

It considered one of the main aims of school was to help children fit in the society they would live in. Thus, the school must take care to fulfil the future needs of today's children, so that they grow up to be adaptable, able to live with other people by appreciating their differences, accept their obligations and be aware of their rights. It stressed the fact that the aim of the school should not be to treat children as future adults, but as children and to allow them to develop in their own time.

It promoted learning through discovery, experience and creative work. It insisted that "knowledge does not fall into neatly separate compartments and that work and play are not opposite, but complementary. A child brought up in such an atmosphere at all stages of his education has some hope of becoming a balanced and mature adult, and of being able to live in, to contribute to and to look critically at the society of which he forms a part" ¹⁰

The publication of the Plowden Report was not received without criticism. It was severely criticized not only from the so called "educational conservatives", but also from educators who were sceptical of the common belief that the Plowden recommendation could be the panacea for all the problems of primary education. In 1969, when the first of a series of "Black Papers" was published, a growing polarization of educational attitudes became apparent.

In extreme cases, the progressive education fostered by the Plowden Report was associated with "the growth of anarchy," with the students' protests, or the growing number of mentally disturbed people. It was accused in a large number of articles of promoting a permissive ethos in schools, because the notion of progressive education¹¹ had apparently been misinterpreted. The writers warned against the danger of turning children into anarchist adults, since their school environment nurtured the notion of absolute freedom, did not enforce any compulsory tasks,

so that pupils did not feel obliged to participate in an activity, if they found it boring or difficult. Thus, progressive education was presented as a movement of romantics and it was characterized as highly hazardous for today's children who would be the adults of tomorrow.

In 1974, the *Department of Education and Science* announced the establishment of the *Assessment of Performance Unit*, which monitored the performance of primary children in Mathematics, Language and Science.

The public pressure and criticism over the new teaching methods in primary education and the concerns expressed about falling reading standards resulted in the appointment of a Committee of Inquiry, mainly into Reading. In 1975 the *Bullock Report*¹² was published. Its first principal recommendation was that "a system of monitoring should be introduced which will employ new instruments to assess a wider range of attainments than has been attempted in the past and allow new criteria to be established for the definition of literacy." (p. 513).

The criticism on progressive education remained unending. Articles were published where the danger of falling standards was stressed. In late 1975 criticisms reached a peak with the outbreak of the well-known William Tyndale junior school case.¹³ The dispute within the school staff resulted in a public inquiry, which in its turn brought about the existence of a number of educational problems. The William Tyndale junior school case, despite it being an isolated incident, provided an opportunity for progressive education to be challenged. Only two years later, in 1976, the results of research conducted by Bennett¹⁴ and his colleagues were published, which raised doubts about the efficiency of progressive primary education. According to Bennett's findings, the progress of pupils having been taught Reading, English and Mathematics through traditional, formal methods was higher than the progress of pupils who had been taught the same subjects through mixed or informal teach-

ing. Even if the validity of Bennett's research was questionable, the commotion it raised and the publicity it received were indicative of the problems highlighted in primary education. However, the social aspects associated with primary education were preferable as seen within an informal approach and the pupil-teacher relationships were of a happier nature. The progressive movement, despite its more liberal, less authoritarian, child-centred spirit did not manage to gain support and acceptance over the traditional methods.

In the *Green Paper* of 1977, published by the *Department of Education and Science*¹⁵ an attempt was made to settle the matter. The Department did not withdraw its support of progressive education, avoided severe criticism, but it conceded that a number of mistakes had happened, which should be avoided in the future, while the profits from a child-centred education should be reflected upon.

In 1978, a *survey* conducted by *HMI Inspectors*¹⁶ showed a different picture of primary education from that presented by Bennett. According to the Report, the change that happened in primary education was more of an organizational mode than one of curriculum. It was maintained that although primary teachers believed they applied group or individualised methods of teaching, in effect, they made very little use of the flexible progressive, new curriculum suggested by Plowden. It was also revealed that pupils who were taught through a combination of exploratory and didactic approaches scored in NFER tests in Reading and Mathematics higher than those who were taught through one approach only. In fact, the higher scores were achieved, when the comparison was made with children taught mainly through exploratory approaches. The survey of HMI's proved to be illustrative and informative of the situation prevailing in primary schools and it led to a deep, professional discussion and a thoughtful assessment of progressive, primary education.

In 1980, *The findings of the ORACLE Report* were published¹⁷. The *ORACLE* (Observational Research and Classroom Learning Evaluation) study was based on observational data in contrast to Bennett's research, which was based on the filling-in of self-reporting questionnaires by the teachers. The findings of the *ORACLE* research suggested that the differences between "the 'Plowden type teacher' or for that matter her 'traditional counterpart' are few and far between. The links between classroom organization, curriculum planning and what in the *ORACLE* study are called teaching tactics . . . appear to be complex that simple descriptions in terms of progressive and traditional labels hardly do them justice."¹⁸

According to the study results, the typical pupil spends 75% of his time on the task in hand, but although he devotes one fifth of a lesson session to interaction with his peers, only one-third of this interaction concerns the task itself. Concerning the curriculum, *ORACLE*'s findings confirmed those of *HMT*'s survey of 1978, that the traditional curriculum, that is, remained nearly unchanged for Language and Mathematics, where it was rather exceptional to find pupils working in groups. It was also clarified that, although classes were organized in groups, very little group work actually took place, as pupils mostly worked individually.

In the 1983 report of *HMT*¹⁹ it was shown that Middle schools for 9 to 13 year olds provided well for their pupils and their pupils, in turn, responded well to the education offered. Nevertheless, it argued that enough demands were made of the able minority, while the less able pupils were in general better provided for and it claimed that a bigger and better effort should be made in order to cater effectively for the full range of the pupils' abilities in a class. It was also found that larger schools achieved higher standards and that, where a more extensive use of subject-teaching was made, better work was achieved.

It becomes obvious, therefore, that primary education, which was formally established by the 1944 Education Act, went through numerous difficulties in order to form its identity as well as to establish its philosophy and practices.

Especially in the seventies, the state primary education received very severe criticism on the part of the conservative division of education. Under cover of potential anarchy and falling standards, the conservative educators suggested a re-evaluation of the old, tested and thus unfailing, traditional teaching methods. Positive criticism was exerted after extensive research had been conducted in schools, not only by those who questioned the necessity of the change, but also by the ones who supported it. The contradictory views and attitudes in the primary education sector created the need for conducting a more systematic research, so that the validity and efficiency of the new methods were tested. New tendencies seemed to form in the educational field. Demands for the assessment, evaluation and accountability of the primary curriculum, pupils' standards, the teacher's role seemed to create a new perspective in education.

In November 1985, the Minister for Education Sir Keith Joseph, on addressing a conference on the evaluation and appraisal of teachers and schools, expressed his hope that teachers' appraisal would be introduced voluntarily. At the same conference, the Senior Chief Inspector, Eric Bolton also claimed that "the key to developing patterns of assessment, evaluation, testing and appraisal that together act constructively to improve educational achievements, lies in reaching agreement nationally about the objectives of the curriculum five to sixteen."²⁰

Fears were expressed that through these trends a re-establishment of control and pre-determination of objectives was promoted, a monitoring of pupils' attainment was attempted and the planning of a national curriculum framework was intended.²¹

In the June's 1987 General Election manifesto of the Conservative party on educational policy, it was stated that they would establish a National Core Curriculum in order to ensure the study of some basic subjects, such as Mathematics, English and Science for all the pupils of the 5 to 16 age range. They also stated that syllabuses of these basic subjects would be published and levels of attainment would be set to facilitate the assessment of the pupils' progress.²²

It seems that in this decade, primary education is going through a new phase of development which could mean either its move towards a more centralized system and a "back to basics" trend, or the definite consolidation of progressiveness.

b. The Greek example.

A parallel report concerning the evolution of Greek primary education was considered necessary in an effort to depict the innovations realized in our century, the reasons for introducing them and how they affected the Greek educational system. As far as possible, an attempt was made to juxtapose the chronologically related facts.

It should be mentioned from the very beginning that in Greece, as well as in other countries, education is related to a lesser or greater degree to the political situation of the country and the various changes that have been attempted or have occurred in this area reflect the respective political tendencies or innovations of the times.²³ An examination of the evolution of Greek primary education, therefore, would inevitably lead to a reference to some political attitudes of that time. It is in no way the intention of the present study, however, to express political views, these references are simply made, because they are directly connected with the issue in question.

The first significant attempt at progressiveness was made in 1908 by Alexander Delmouzos in a school for girls in Volos.²⁴ Delmouzos tried to connect school to every day life, to introduce learning through experience, thus, condemning passive and sterile rote learning. He attempted to support his pupils' self-esteem, helping them to replace fear with confidence, uncertainty with self-assurance. Delmouzos promoted a new liberal spirit in education, but it could not be characterized as revolutionary. Nevertheless, it raised a storm of protests, receiving severe criticism by all the conservative forces of the time. The school where Delmouzos taught was shut in 1911 and Delmouzos himself was brought to Court²⁵ charged with disrespect, impudence and communism.

In 1917 (1918: *Education Act* in England) a second attempt at innovation was made. The law of 1917 established the demotic language²⁶ as the official language to be used throughout the primary school. Moreover, care was taken to establish a better education, in-service training and salary of teachers. New books which expressed the liberal spirit in education were published. Their texts did not refer to mythical heroes, but to everyday, common, human characters. It became possible for the Ministry of Education to approve limitless numbers of books and new books were provided for special schools and different areas of the country. Two new positions of Higher grade Inspectors were created in the Local Educational Authorities. They were assigned to coordinate their actions in order to succeed in realizing the innovation, decentralize and modernize the Local Authorities.

The educational innovation, or rather the attempt at educational innovation,²⁷ did not last beyond 1920, namely as long as the country was governed by the Liberal party. Then the Conservative party came to power and the reformation was checked. The new government formed a Committee with the duty to examine the educational matters, especially the teaching of Language in the primary school.

In 1921, after the Committee had submitted the findings of their examination, a counter-innovation started. The new books of elementary schools (Language manuals) were condemned and buried and a competition was proposed for the writing of new ones. Furthermore, it was decided that the primary curriculum should be re-appraised and a general change in school administration should be attempted. The books, therefore, were accumulated and burnt, the liberal conceptions were banned from primary schools and the old, conservative practices returned.

In 1923, when the government changed again, a fresh start for innovation in the primary educational system was made. The political happenings, though, and the enforcement of martial law in 1926 cancelled the attempt for a change.

In 1929, the Liberals returned to power and new educational reforms were attempted. New buildings were provided and the six-year primary schooling (6 - 11⁺) was established. The use of the demotic language in the elementary school became compulsory and for the first time, the goal of preparing children for life was set in primary education.

From 1929 until 1944 the continuous interchange of Conservative and Liberal governments and the enforcement of martial law by Metaxas directly affected educational matters. The few, diffident steps forward were annihilated by giant steps backward. One cannot fail, but notice, that is, that up to 1944, the attempts at educational innovation in England (1918: Education Act, 1926: first Hadow Report, 1931: second Hadow Report) had been followed by some corresponding efforts in Greece, only they were not fruitful due to the lack of political stability and the acute political confrontations.

From 1944 (1944: *Education Act* in England) and up to 1949, during the Second World War and the Civil War that followed it in Greece, the educational system of Greece was practically paralysed. The Civil War, apart from the material and human

tragedies it inflicted on Greece, it also intensified the already acute political and ideological conflicts. This friction between the Conservative and Liberal forces in Greece was destined to play a very decisive role in the evolution of educational matters almost up to our time.

From 1952 to 1963 that the Conservatives were in power, primary education was almost totally ignored, in favour of secondary education. In 1963, the Liberals came to power and in 1964, they promoted and applied the innovation that had been attempted, but failed in 1924. Apparently, changes planned to meet needs in 1924 could hardly have been effective forty years later. Nevertheless, even that small-scale effort was relentlessly attacked by conservatives. The 1964 innovation established free education in all educational sectors and compulsory education was extended from six to nine years, six of which in elementary and three in secondary school (nine years in all). Entrance exams for the secondary school were abolished, the use and teaching of demotic Greek was enforced in the primary school and attendance at the Teachers' College increased from two to three years. This attempt at reformation was strongly criticized by the conservative forces and particularly by the Department of Humanities of the University of Athens.

From 1965, when the Liberal government fell and until 1967, the political situation was very unstable and the country was ruled by a series of fickle governments. In 1967 and up to the summer of 1974, martial law was enforced in Greece once more. Within those years, most of the changes of 1964 were rendered obsolete and the climate of fear, suspension and authoritativeness returned. Naturally, no progressive thoughts concerning education were spoken at the time.

In 1976, two years after the re-establishment of democracy in Greece, a new attempt at innovation was made, this time initiated by the Conservative government, in power at the time. The basic features of that reformation were the establishment of de-

motric Greek in every educational sector and of obligatory education of nine years. The changes suggested by the 1976 innovation were so similar to the ones introduced in 1964, that several people called it a "revival" of the 1964 spirit. The economic, social and political changes which had been realized during the twelve years that intervened, as well as the new educational needs that had emerged in the meantime were not taken into consideration. The attempt at innovation was destined to fail once more, "in a short time, the innovation is attacked by almost every sector, except for the governmental party."²⁸

The opposition against the "new books" of elementary school, mainly Language and Mathematics books, kept growing. The books were accused of being irrelevant to children's psychology and real needs, especially to children of "small schools and schools accepting pupils from the poorer strata of the Greek people."²⁹ Besides, it was emphasized that the aim of primary education should not be the preparation of children for secondary education, but the satisfaction of needs and interests at their current age. Finally, clear objections were expressed as to the way those manuals had been written and it was further suggested that the tradition that had produced no positive results for years should be abolished. Views were also formulated concerning the teachers' education: teachers should receive university education, and to this effect, new departments should be established at the universities in the country, while the Teachers' colleges should be gradually closed down.³⁰

Newspapers, almost daily, referred to the governmental measures on education, nevertheless, their comments were mostly negative, since the proposed innovation invoked nothing but opposition.³¹ From 1976, when the new measures on education were voted upon, indeed without serious oppositions from the parties³², up to 1981, the innovation had been continuously criticized unfavourably "a political criticism which, to a large extent, is directed towards the intentions of New Democracy (the right wing party)."³³

It becomes obvious, therefore, that education has moved within a framework of action and reaction in the course of this century.³⁴ Whenever a reform has been attempted, anti-reformist powers have been developed to cancel it. Whenever the various political groups interchanged in their hold of power, reformist and anti-reformist tendencies in education prevailed.

Experience has taught us that conservative powers have always supported a traditional and classical education, whereas liberal forces a progressive, child-centred schooling. All innovations, except that of 1976, were initiated by the Liberal parties and most of the anti-lobby started from the Conservative political groups. Every single attempt at innovation has been received by a storm of opposition. For almost the whole century no attempt at innovation has been successful. No change managed to meet the actual needs of the child, to help him participate actively in learning, to provide him with practical knowledge, that he could actually apply in his future life. Every attempt at innovation, feeble as it usually was, had hardly been realized before it was methodically eliminated by the conservative forces of the country.

Only recently, from 1982 onwards, a really serious attempt at innovation has been made. Progressive educational conceptions have been promoted, new curricula developed, initiative and collaboration favoured, new teaching procedures suggested. The new curricula do not consist simply of syllabuses, as they had traditionally been. Now the aims and objectives of learning are set, the curriculum is divided in units, "learning procedures are indicated, as well as the teachers' course of action and pupils' activities, the material that can be used and finally, the assessment of children's work."³⁵

The characterizations A, B, C used to denote the children's progress and having only recently replaced marking at primary school, are now completely abolished. The logic behind this ac-

tion is that children should be internally motivated to learn, furthermore, they should be given fair and equal chances to achieve success.

The basic theoretical principles underlying the innovation are mainly Piaget's and Bruner's theories and the teaching procedures and approaches proposed are those of child-centred education.

This effort for innovation has already passed to the stage of application; nevertheless, it has also received some opposition and criticism. Talks of a disastrous outcome of the innovative effort have spread gradually, but methodically. People have been warned that children are inclined to be lazy, the teaching material is disorganized, that standards, especially in relation to Language, have been falling. Little by little, but steadily, the climate that gave birth to the anti-reforming attempt is being created, thus, perpetuating the eternal scheme of action reaction re-appearing once more.

After this brief report of the evolution of primary education in England and in Greece, it becomes quite apparent that the re-evaluation of the aims, objectives and policies and the gradual liberation of primary education from its tradition in favour of more progressive and flexible forms followed different rates of development in the two countries.

In England, the interest in the primary education sector started in the 1930s and it reached its peak in the sixties when a real innovation took place which reformed the character and philosophy of the field completely. New aspects were expressed, fresh policies were adopted, modern methods were tested. Decentralization was achieved in schools and teachers were authorized to shape policies concerning organization and curriculum. The notion of individualized and group instruction prevailed over traditional class teaching. The prospects but also the fervour for change excited, nevertheless, it unavoidably raised strong oppo-

sition. Enthusiasm often led to mistakes, but, on the other hand, opposition became more pronounced since it was mostly sterile and it did not contribute to an objective evaluation and constructive criticism of the innovation.

The period of excitement was followed by a period of scepticism when assessment of the results and consequences of the change became possible. It was an era when education was not an objective but a fact, educational matters were viewed through a more unbiased perspective and new trends were shaped towards a national character of the curriculum, which, without being uniform, had however to contain certain common elements.

In Greece, in the respective years no radical changes occurred in primary education. The peculiar political situation of the country erected barriers to the educational innovation and until recently kept it down, attached to the traditional knowledge-centred system. The 1980 decade is marked by changes, perhaps the first in the history of Greek primary education which were realized and retained for so long a period.

The history of the Greek education system and the example of the English educational innovation may contribute to a more efficient planning of the change in Greece and to the avoidance of mistakes in its application. It appears, therefore, that a cautious examination of the literature concerning the innovation in primary education in other countries along with a systematic and in-depth exploration of the field of application may guarantee the successful conduct of the so badly needed change in the sector.

PHILOSOPHICAL PERSPECTIVES IN TWENTIETH CENTURY EDUCATION.

The changes realized in the social, technological, economic structures of society affected education deeply. The traditional model of education based upon the theories of the Greek philosophers Plato and Aristotle changed. Almost up to 1930, education, after Plato's theories, mainly aimed at providing man with the means to transcend his boundaries of time and space, due to his biological structure which confined him to a specific moment and space, where he had to live his life.

Concerning the model of education, the school's objective was to prepare children for facing their future, no provision was made for their current needs. Time spent on practical activities was considered wasted, practical knowledge was considered appropriate for the less able pupils. The teacher's authority was unquestioned, as she was regarded as the person who would encourage children to absorb the appropriate knowledge.

It was not before the 18th century that new, almost revolutionary tendencies in education appeared (J. J. Rousseau's *Emile*, 1762).³⁶ In his book *Emile*, Rousseau suggested radical educational changes, which were supposed to focus on the child's needs (who is taught) and not on the subject-matter (what is taught). Rousseau's suggestion could be conceived as the first decisive movement that could signal the shift from a traditional (subject-centred education) to a progressive (child-centred) one.

Furthermore, Rousseau could be considered the first supporter of individualization in education, since he argued that public education, the main concern of which was to convert children into good citizens was unnatural and should cede its place to individualized education, which would treat children as individuals who were allowed difference of needs, interests and abilities. It could be argued, too that Rousseau introduced the concept of learning through activities and practical experiences.

In "Emile," book II, which deals with primary years (from 2 to 12), Rousseau mentioned that the child of these ages is not yet ready for purely mental activities, but he still needs to be engaged in concrete operations.

Despite the commotion, Rousseau's theories caused, education remained attached to traditional models until the end of the 19th century. It was only in 1916, with the publication of Dewey's book *Democracy and Education*,³⁷ that hopes for innovation were re-awakened. Profoundly affected by Charles Darwin's theories on the evolution of living organisms, Dewey regarded them as offering an understanding to the development of knowledge. Thus, he considered knowledge as a process of continuous evolution. New data, experiences and information contributed to a constant modification of knowledge already acquired. Dewey's conception of knowledge promoted the notion of learning through discovery and experience. Activity was also one of Dewey's favourite terms. According to him, man acts steadily to maintain continuity of life. Thus, if education is viewed as the process of developing the individual's experience, then it should not be imposed from outside. A teacher should not be the authority, but the guide who would help the child gain his own experiences and merge these experiences into the appropriate body of knowledge. Dewey holds that the philosophy of education does not prepare for life, it is life itself. "When it is said that education is development, everything depends upon how development is conceived. Our net conclusion is that life is development, and that developing, growing is life. Translated into its educational equivalent, this means i. that the educational progress has no end beyond itself; it is its own end; and that ii. the educational process is one of continual reorganizing, reconstructing, transforming."³⁸ Nevertheless, Dewey's philosophy included a structured approach defined clearly by the teacher, only the pupil's reactions were of an individual nature.

In summary, it could be claimed that the bases for individualization in education were put by Rousseau's and Dewey's theo-

ries. It was then that the child was seen for the first time as growing through continual stages, an idea that was refined later on by Piaget and Bruner, who regarded each individual child unique with his own needs, abilities, potential and interests and as needing personal experiences, concrete activities and play in order to build up knowledge.

Another philosophical contribution was made by Peters in 1973.³⁹ Peters presented an original theory of education written from a philosopher's point of view. He considered education as being valuable in itself and not as a means of gaining benefits or prestige. He tried to find a middle solution between the traditional and progressive aspect of education, thus, he formulated his theory of education as "initiation." Peters argued that "to be educated is not to have arrived at a destination; it is to travel with a different view. What is required is not feverish preparation for something that lies ahead but to work with precision, passion and taste at worth-while things that lie to hand. These worth-while things ... are acquired by contact with those who have already acquired them and who have patience, zeal, and competence enough to initiate others into them."⁴⁰ Peters' main criterion of education concerns the teaching and learning procedures that take place. Even if Peters recognized that Rousseau and Dewey had influenced and developed the educational philosophy, nevertheless, he believed that they had made the teaching methods proposed by their philosophies ends in themselves and thus, they had overvalued their importance. According to Peters, the progressivists placed much weight on the procedures followed to pass on to the subject-matter, so that they failed to give adequate stress on the context of education. Peters does not deny that teaching methods should consider children's abilities, interests and needs, but, he claims, the child should acquire a body of knowledge which will be organized in a conceptual schema and which could not have the form of randomly collected facts; this learning will be obtained by methods involving awareness and a degree of voluntariness on the child's behalf.

SOME ASPECTS OF INDIVIDUALIZED INSTRUCTION.

In the traditional philosophy of education, the teacher was supposed to be omniscient and commissioned to give the world to the child from her store of knowledge as if knowledge could be transferred in a mechanical way from outside.⁴¹

At the present time, in the progressive spirit of education, teachers are required to be well informed of the psychological elements of childhood, to be well aware of the child's stages of development, his needs and potential, they should not think of him as a "tabula rasa," but they should take into account the fact that the child brings his own personal world into the world where he lives and he has to investigate the latter with the powers he possesses within the first.⁴²

The child's strength, his differing capacities and needs are now taken into consideration and the special attention paid to the child as an individual has reinforced the trends towards individualized instruction. Exactly like parents consider their children unique individuals, the school must also treat children accordingly. Within this sphere of influence, the *Hadow Report* (1931) defined the purpose of education as follows: "what a wise and good parent will desire for his own children, a nation must desire for all children." (Hadow, p. xxix).

Individualized instruction has been received with enthusiasm by many educators and it has been recommended as it is or with alterations or in combination with other teaching approaches as the most effective method for child-centred primary education. At the same time, however, the system has been severely criticized. It has been accused of causing numerous problems in the classrooms in which it has been applied.

In the following part of this chapter, an attempt will be made to illustrate through the available literature the arguments for and against individualization in teaching.

In 1931, the *Hadow Report*, based on the new ideas on children's development introduced by scientists, talks about modification of teaching methods and ways of treatment, so that the needs of the individual child may be met (p. 22). It also accepts that mental capacity, which is one of the main factors determining intellectual progress, varies from child to child and from year to year for the same individual and it goes so far as to suggest the formation of at least three distinct groups of pupils up to the age of ten (p. 34-35). It emphasizes the opportunities that teachers have by suitably grouping their pupils according to their abilities to cater both for the very bright pupils and for the slow learners (p. 77). The Report also recognizes that the teacher should consider seriously the children's own natural interests, because the pupils work better and more effectively, when they are enthusiastically involved (p. 48).

The idea first formulated by the Hadow Report was later confirmed by the Plowden Report and it was introduced in primary education influencing its philosophy. The *Plowden Report* (1967), after having referred to the implications that child developmental psychology had on the theory of education assumes that any class must be treated as "a body of children needing individual and different attention," because children, even if they are of the same age, are never identical; they reach the various stages of development at a different rate and boys and girls present different reactions and rate of maturation.

The innovative movement initiated by the Hadow and Plowden Reports prompted the development of various ideas on educational matters. For example, Bernstein (1967),⁴³ even if he mainly refers to secondary education, nevertheless, he discusses the movement from formal ("closed") to progressive ("open") schools

and the shift this movement implies for the curriculum organization and the pedagogy of the school. Thus, he argues that concerning social control, there has been a move from a communication of common values based upon position or status to new forms of control, based mainly upon the recognition of existing differences between individuals. Now teachers and pupils confront each other as individuals and the relationships between pupils are mainly based on their educational differences.

Referring to the change happening in pedagogy' he notices that a move took place from "a pedagogy which . . . was concerned with the learning of standards, operations, tied to specific contexts - to a pedagogy which emphasizes the exploration of principles; from schools which emphasized the teacher as a solution-giver to schools which emphasize the teacher as problem poser or creator."⁴⁴

He admits that in the traditional system, individual choice did not exist and pupils were faced as homogeneous groups, according to imputed similarities. Today pupils are given choices concerning the subject to be learned and the depth to be achieved in it, the learning process to be followed and the way to work it out.

Apart from stressing the positive aspects of individualization, however, Bernstein points out the risk teachers and pupils run to face problems of continuity, order and boundary, because of the lack of structure resulting from the fact that schools adopt diversity at the expense of purity of categories.

Similarly, Sharp and Green⁴⁵ argued that progressive education in practice is not so markedly different from the traditional system, since, even if teachers believe that they are progressive, in fact, they apply the progressive theory in such a way, that, in effect, the hierarchical differentiations of pupils which characterized traditional education still exist.

Thus, according to them, although progressive education claims to care more and offer better opportunities to the individual pupil, what it really does is to disguise reality, namely, the selection and socialization of pupils into a stratified society.

Basset (1970),⁴⁶ referring to the innovation in primary education, gives a description of individualization observed in many classrooms (p.51). According to his observations, the method of individualized instruction is not applied all day through, but the day's work is varied between class, group and individualized teaching. Regardless of the class' organization, though, the individual pupil always remains at the centre of interest, whether he works at a task with the class, in a group or alone.

Individualization takes care of the children's varying working speed, as well as their interests and needs allowing the teacher to devote her time efficiently. The pupils are relaxed, but very few disciplinary problems appeared in the classroom. In his writings the words "chaos" and "disarray" are mentioned, but it is soon clarified that this is the first impression of a hasty look at any classroom and, in effect, children are very active and interested in what they are doing, cooperate willingly with their peers and teacher, who is always aware of the progress, weaknesses and potential of each one of her pupils.

Kay⁴⁷ considers the extent to which programmed learning can assess its own progress. He claims that, if we are to create a technology of teaching, the main question should then be how effective a teaching system we can produce, so that it may provide each student with the precise instruction he requires in order to meet his individual needs. He accepts that one of the major advantages of programmed instruction is that it allows pupils to proceed in their own pace, but he argues that it may also cause many difficulties when applied in a large class in which each individual sets his own pace.

The need to adopt progressive methods of teaching in primary education is also stressed by Mitchell⁴⁸ who believes that in a traditional lesson no attention is paid to the individual pupil, his needs and interests. He favours the individually-centred classroom, but he also accepts that a mixture of approaches could be effective, and frequent and necessary occasions arise when class teaching appears to be preferable. He concludes his article by mentioning that to report cases of schools where the progressive method is unsuccessfully employed does not prove the inefficiency of the system.

In Woods and Barrow's *Philosophy of Education*, (1975),⁴⁹ the need for a child-centred education which could provide for children's varying needs is again emphasized. They advocate an educational approach which will not treat the child as a means to an end, but as an end in himself, not as a miniature adult but as the child that he is. They also hold that a child-centred education is not only characterized in terms of what is taught, but in terms of how it should be taught, so as to correspond to the child's readiness, whether, that is, he is "able to do something or capable of doing something and of doing it with some degree of success."⁵⁰

Riding (1977)⁵¹ turns his attention to describing the psychological factors that affect children's learning, and argues that the learner's psychological mechanisms rather than teaching itself determine what is learnt and retained. He resorts to Bruner (1961) and Ausubel (1968) to gain support for his opinion that there exist different methods of learning. Riding claims, therefore, that children may learn either by discovering the necessary information themselves (discovery learning) or by being informed in a way readily acceptable according to their capacities (reception learning). He also mentions the differences that appear among pupils of the same age concerning their interests and abilities and he suggests that children would gain more benefits from education, if their varying learning mechanisms were also considered. He suggests that the teacher must be very

careful of the way he treats each individual child, so that the child is encouraged by being offered information in a way that best suits his learning style. On the other hand, the teacher must supply alternative methods of seeking information, so that the child is guarded against regarding his personal learning style as the only one open to him.

Even if in effect it has been proved that the "Plowden Revolution" has never been realized and recommendations have not been totally implemented, nevertheless its philosophy affected many educators and raised acute reactions on the part of conservatives (mostly through the Black Papers writers) who believed that progressive education prepared the "anarchists of tomorrow."

Throughout the decades 1970-1980, great pressure was exerted advocating that teachers of primary schools should return to "traditional values." The negative criticism about the progressive movement added dimensions to the already numerous problems teachers faced. Teachers found it difficult to formulate and exchange views, so as to reach a valid evaluation of the situation. Those who criticized child-centred education drew evidence from the findings of certain researches [e.g., Barker Lunn (1970), Neville Bennett (1976)] in order to support their views. According to these researches, pupils who were taught through informal approaches, mainly individualized teaching and learning, made the least progress in Mathematics and English. The package of the above researches is known as "the black box" as they were based on teachers' self-reporting questionnaires and ignored what happened in the classroom on a daily basis.

Contrasting with "the black box" model researches, "the glass box" model was created based on observational data. Bias-free researches were attempted which aimed at selecting information concerning the behaviour of pupils and teachers, the class atmosphere and the children's progress. These studies shed light on

the basis of the conservative attacks and helped teachers realize and face their problems or find alternative strategies.

The issue of individualization is also explored by Gibbons (1971)⁵² who describes different types of individualized programmes and holds that their application is practically ineffective. It is a theory which conceives a project, shapes it and suggests its application, only this suggestion is usually unfeasible and unrealistic. Gibbons also points out the difficulties individualized learning faces in practice and in attempting to make a fair assessment of the efficiency of the programme. He distinguishes between individualized programmes in which instruction is addressed to each individual pupil and those in which teaching is addressed to groups of children or the whole class. He claims that individualized approaches which are addressed to groups of children or the whole class, are directly connected with traditional class instruction ameliorating its image only and not its essence.

A large number of individualized programmes exist, he continues, differing only in the "elements of instruction they individualize and the degree of individualization in these elements." (p.54) He concludes that individualization is a liberal movement, which in its most conservative form could be the improvement of class instruction and in its most liberal form an adaptation of the task to the individual needs and abilities of children.

Boydell(1974)⁵³ draws attention to the difficulties encountered in individual attention methods. She indicates that the positive effects on children that such methods could have might be lost if no dialogue existed through which values and concepts are clarified and presented, past activities are reported, relationships are explained and proposals for problem solving are made. She finds that very few opportunities for teacher-child communication are created in individualized methods. A whole teaching session, or even an entire day may pass without any

purposeful teacher - child communication, since contacts are not work-oriented, but rather organizational arrangements which do not raise the child's intellectual level. Moreover, the child may be led to the conclusion that his teacher does not notice him at all, that she favours certain peers, while, at the same time, the teacher may surpass herself in her effort to contact each individual child in the course of a teaching session. Boydell suggests the implementation of a combination of both class and group teaching, where possible, so that the teacher saves some time during which she interacts with individual pupils.

The question of the effectiveness of both formal and informal teaching has also been explored by Bennett (1976).⁵⁴ Drawing conclusions from the research he conducted, he argues that, for example, in understanding Mathematics, the pupils' progress is better through formal teaching styles than through informal or mixed styles. Only in the case of very low attainers (boys), the informal teaching style was shown to be most beneficial. This may be due to the fact that class teaching may have been given at a level beyond those boys' capacities, but, on the other hand, he thinks that informal teaching failed to provide very able pupils with the appropriate experiences. And Bennett concludes that "in summary, formal teaching fulfils its aims in the academic area without detriment to the social and emotional development of pupils, whereas informal teaching only partially fulfils its aims in the latter area as well as engendering comparatively poorer outcomes in academic development." (p.162)

Richards and Bolton (1971)⁵⁵ to some degree supported Bennett's views. They found that pupils in the traditional school achieved a better performance in standardized tests than pupils in modern schools, but the pupils of schools using mixed methods had the best performance.

The reasons that contributed to the prevalence of individualization as a teaching style are examined by Galton and Simon (1980).⁵⁶ In their opinion, individual attention methods were

adopted following the abandonment of streaming, which was a result of the abolition of the eleven+ examinations. Thus, the progressive theory, which was introduced by the Plowden Report, legitimated, in a sense, individualization, which was the only practical solution to the newly formed mixed ability classes. They also noticed that one of the main problems of individualization in practice was the limited time the teacher could devote to each pupil separately. Thus, they concluded that absolute individualization should be ruled out as an option, because it was practically impossible under the existing circumstances of class sizes and because, according to ORACLE's findings, "individual monitors," young teachers in their majority, had the lowest percentage of teacher-pupil interaction. They also claimed that in a totally individualized situation it was impossible for the teacher to monitor the activities of each individual pupil in order to check whether he tackled work appropriate for his attainment level.

A similar view was expressed by Bennett, who in his later work (1984)⁵⁷ indicated that, in effect, teachers made a limited use of individualized instruction, as most of them preferred a mixture of different approaches.

In 1977 the Green Paper⁵⁸ was the first D.E.S. publication to criticize the effects of the progressive movement in primary education. The paper accepted that some of the criticism was fair but mostly was untrue as for instance the decline in educational standards. It acknowledged that child-centred education had not been always successful in practice and that certain teachers had misinterpreted the philosophy underlying child-centredness and in the name of individualization failed to achieve high standards in such basic skills such as Mathematics and Language.

Some reservations concerning the applicability of individualization were expressed by the researchers who had conducted the ORACLE project. The conclusions the ORACLE study (1980)⁵⁹

yielded suggested that individualization, both of work and attention was widely applied but in a sense not progressively oriented. The progressive theory promoted by the Plowden Report referred to the individual child's actual activity, placing the weight on discovery methods, exploratory tasks and a search for personal identity, while the teacher's role was to provide the appropriate stimulus at the appropriate time by questioning, discussing and guiding the pupil discreetly. ORACLE's findings indicated that no such individualization was actually practiced. The teacher's and individual pupil's interactions were factual, managerial and of a routine type. Besides, under the present reality of class size the Plowden type individualization was not feasible. ORACLE goes a little further to propose the organization of pupils into groups and to encourage group work. Two reasons are offered in support of this recommendation: the fact that total individualization of all work is impracticable and that through the work in groups children will gain in socialization, exchange of ideas and in development of their own interests working with their peers. Thus, in the researcher's opinion, individualization will be achieved through group organization and work.

The way that individualization works within the various school subjects is explored by Kirby (1981)⁶⁰ who in his discussion of individualization in teaching and learning notices that there are some school subjects that must be individualized and others that need to be socialized, that learning of many skills is by nature individual while learning of others could be achieved if shared only. Kirby points out the danger the child runs if he is to be isolated from his peers in the name of individualization. Thus, he cautions against over-emphasizing the need to care for children's individuality: children can be individuals but they also share many common characteristics, needs and interests with other children and this should be always kept in mind. In discussing the possibilities of applying individualized methods in particular subjects (i.e., Mathematics) he suggests that children could be introduced to the initial stages of

sequential work in a topic new to the whole class, easily followed by even low attainers. This could be followed by appropriate tasks challenging thinking as well as encouraging individual interpretation and expression.

Bennett (1984)⁶¹ in his study "on the nature and content of classroom tasks and the mediating factors which influence their choice, delivery, performance and diagnosis" found that although the teachers in his sample underpinned the philosophy of individualization they did not manage to match intention and actual demand. What they knew and supported as theory, they were unable to apply in practice. So although high and low attainers were exposed to different content within the curriculum, they were expected to fulfil similar task demands. It was also found that the bright pupils were less adequately catered for than their low attaining peers. Bennett concludes his findings with a carefully formulated critique of the philosophy underlying individual instruction. Although he does not deny the validity of the specific philosophy and the profits it brought to education (good learning environment, almost ideal use of resources, development of good relationships) he points out that teachers were not familiar with certain of the cognitive aspects of the learning environment.

In conclusion, it might be argued that the Plowden Report (1967) may not have brought an actual revolution but it has certainly influenced and it will continue to influence the theory of primary education. Every primary school has been made aware, to a greater or lesser degree, of the "progressive theory." New approaches have been tested and, group and individual teaching has limited, if not minimized, class teaching. For about twenty years progressiveness has endured the severe criticism and attacks from the researchers who foresaw falling standards, insufficient interaction between teacher and pupils, inconsistency and disruptiveness in the classroom. However, in contrast, "counter-researches" have been conducted that have challenged the findings of the former ones as inaccurate, concluding

that it should be recognized that the application of individualization is not successful in all circumstances. These conclusions along with progressivism and a "back to tradition" tendency have brought forth new educational policies. Thus despite the Plowden Report's advocacy of individuality in its different interpretations the recent trends have moved towards uniformity. Even if nobody could claim that modern thought is too far away from the Plowden Report's proclamations, yet in effect big changes have occurred. An attempt has become obvious to promote "a common curriculum framework" and to emphasize the need for "curriculum consistency."⁶²

The D.E.S (1980) tried to foster a national consensus on a desirable framework for the curriculum. In HMI (*A View of the Curriculum*, HMI series: Matters for Discussion, II, London, HMSO, 1980) a new curriculum policy is formulating a broad national structure of curriculum along with a local one.

An effort is being made to make school and teachers more accountable to assess and evaluate pupils' performance. Is one to suppose that these new trends may, if not challenged, result in a gradual return to a more traditional view of primary education and the subsequent limitation of individualized instruction?

THE DEVELOPMENT OF THE TEACHING OF MATHEMATICS IN PRIMARY EDUCATION.

As mentioned previously in this chapter, World War II signalled radical socio-economic and technological changes. Industry developed rapidly to help people recover from the war and build a world of peace. Society changed, its structures, relations, purposes demanded re-evaluation. Needs deriving from economic development, technological achievement, cultural and ideological changes dictated another demand: not only scientists, but even the general population had to be fairly competent in Mathematics, in order to be able to understand and cope with the technological world in which they lived. Society itself, demanded a reappraisal of an educational framework within the field of Mathematics. Education re-established its aims and objectives, reconsidered its content and started the application of new methods that could serve firstly its immediate, and secondly its long-term learning needs.

Mathematics had no other choice but to follow this trend. This need for innovation obliged University scholars to attempt an innovation of Mathematics education. Thus, the "New Mathematics" approach emerged based on the work of the Bourbaki⁶³ group and was concerned mostly with the reorganization and renewal of the content of Mathematics syllabuses and the methods of its introduction to the primary school. Several new topics were introduced, but the content of Mathematics for the primary school remained unchanged; instead, Mathematics was treated in a different way - by the introduction of the set theory and function.

The term "New Mathematics" was used in all the varieties of new teaching schemes, regardless of the big or small differences existing among the various programmes. The main direction of the innovation introduced by the new approach was "towards greater abstraction of thought."⁶⁴

The application of the "New Mathematics" approach in England was very limited, but in the U.S.A., where it was widely accepted and applied, it offered researchers the chance to draw conclusions regarding the content of the syllabus, the teaching method and its relationships to everyday use.

Doubts began to be expressed as to the likelihood of Mathematics to be used in situations not purely mathematical and questions arose as to whether Mathematics was taught for itself or in order to facilitate people in their work and/or to meet their special needs. It appeared that pupils consumed all their energy in learning difficult concepts of Mathematics, the applicability of which they failed to see.

There were those who disapproved of the new approach to Mathematics and exerted severe criticism to the "New Mathematics" scheme, Morris Kline being one of them.⁶⁵ Discussing the situation in the U.S.A., Kline accused professors of Mathematics, who were responsible for the curriculum reform that they were only interested in developing future Mathematics, so they ignored teaching. Having forgotten the time and effort they themselves devoted to reaching their level of knowledge, they imagined they could immediately impart this knowledge to young learners. Kline went so far as to characterize professional mathematicians as the most serious threat to Mathematics teaching. He further accused the "New Mathematics" approach that, while it proclaimed the eradication of the traditional curriculum defects - mainly rote learning and difficult, inaccurate language - by teaching subjects logically and by introducing precise language, in reality, it complicated things. The logical approach was difficult in practice, because pupils had to justify each step they took in a procedure, in order to prove its mathematical relation. Therefore, something that could be done easily on the basis of experience, now demanded a lot of difficult reasoning. Concerning the language, much terminology and symbolism was used in the name of clarification and preci-

sion, while the covert purpose was to show the complexity and sophistication of simple and perfectly intelligible concepts. As for the set theory, the new approach introduced, although it attracted a lot of noise and attention, it found little use in the end.

Thus, at the outset of the 1970s new trends emerged in relation to Mathematics education. Notions such as "education for all," "individual needs," "child-centred education," "learning through activities" affected the Mathematics syllabus and teaching, causing a shift in Mathematics education. From being the body of language aiming to fulfil the long-term needs of the learner - his participation as an adult in the society and his future individual needs - Mathematics became the instrument which catered for the short-term needs of the child: the child, that is, could derive pleasure from being engaged in a mathematical situation and, moreover, he could see the usefulness of Mathematics in his everyday life at school and in his play. As Brown (1981)⁶⁶ claims "the curriculum is not intellectual food to be fed by the teacher to the child in chunks, according to the edict from on high. At the point of transfer, a complex interaction is in process between a mathematical idea, an individual child with his present personal perceptions, interests and capabilities."

In the U.S.A. the curriculum reform presented two different orientations. The one focused on content - logical thinking, precise language and new concepts of set theory and function and the other on child-centredness, learning by discovery, exploiting the child's own environment and experiences and considering the differences between children of the same age. The common characteristic that both these approaches or aspects had was that in either case the people who planned the reform were mostly university scholars.

In England, it was not until the publication of the Hadow Report (1937) that the idea for a change in primary education began to be formulated. The references to Mathematics made by the Report (pp.175-182) were not so clear. It stated that too much time was given to Arithmetic and too little to Geometry. According to the Report, the time devoted to Arithmetic, which was regarded as being mainly concerned with the fundamental processes of "rules," should be reduced. Nevertheless, the Report maintained that "unless he (the child) can add, subtract, multiply and divide accurately, quickly and without hesitation, his future progress will be severely handicapped." (p.176) In general, the Report's references to Mathematics were rather confusing. Thus, while at a point it suggests that "increasing attention should be paid to the application of Arithmetic to matters within the children's environment," (p. 178), at another point, it disagrees with the idea of using concrete experience for Mathematics learning. As it characteristically reads, "it has often been urged that the beginnings of Arithmetic should be 'concrete.' If by this is meant that the child's early work should be founded on his personal experience and deal as far as possible with things familiar to him, it is a truism, and it applies to all teaching at this stage. But if it means that the child must only deal with numbers of articles and never with number in the abstract, must add horses to horses and take nuts from nuts, and never add three to four or take seven from twelve, it is pure pedantry." (p. 175-176)

Despite its complexity and the fact it had no significant, immediate effect, the Hadow Report set the basis for a child-oriented primary education, by recognizing that children of the same age differ in intellectual abilities and it is a mistake to classify them in a single category. Moreover, it brought forward the notion of individualization, by suggesting that very bright children "should be allowed to go forward to the new work of which they are capable." Concerning Mathematics, the Hadow Report accepts that the project method may be useful as a start-

ing point in Mathematics teaching, but the mystery of the task should be "obtained through a regular and systematic practice..."

Although in the U.S.A. the changes in the curriculum were initiated by theory, in England the reformers tended to be rather impatient of theory, they promoted a pragmatic approach for the planning of Mathematics to which many teachers contributed but the contribution of University Mathematicians was minimal.⁶⁷ In 1956, the Mathematical Association in England published a report on primary education. In this report, a transposition took place which gave less weight to the content of Mathematics syllabus to the child himself - who was regarded as a unique individual with his needs and developmental range. Groups of teachers collaborated and designed projects like *Muffield Mathematics*, *Fletcher Mathematics*, and *SIF*. These new schemes tried to be less abstract, based on "applied" Mathematics and made use of everyday experiences and material wherever possible.

Nevertheless, even if tendencies for an innovation in Mathematics curriculum had begun to be formulated immediately after the War, it was not until the *Plowden Report* (1967) was published that a real change took place in primary education. The knowledge centred philosophy gave way to child-centredness and the traditional teaching techniques were modified. The changes in the primary curriculum resulted in changes in both mathematical content and teaching.

The Plowden Report suggests that the new approach raises great demands for Mathematics knowledge and understanding, on the teacher's part and it admits that teachers who in their majority have not been adequately trained in Mathematics will face many difficulties in applying the new approach. It praises some schools' initiative to have already "rethought and reorganized their mathematical syllabus and teaching methods." (p. 238, par. 657.) The report also attempts to disperse the fears, already

expressed, with regard to a decline in computation and accuracy, claiming that a new approach may be proved unsuccessful in some cases - besides, a traditional method runs the same risk - but most probably, as children will be more personally involved, precision "is likely to improve since in this kind of work there is a built-in incentive to accuracy." (par. 658) The part concerning the Mathematics curriculum concludes with a wish that the new approach does not end up as a "novelty" inside an old tried syllabus, implementing textbooks as teaching material and "consecrated by familiarity."

The introduction of Comprehensive Education, at the end of 1968, in many⁶⁸ Local Educational Authorities abolished the examination at 11⁺. This move had direct effects on the curriculum of Mathematics which, at last, was liberated from the demands and pressures which these examinations exercised upon it. The very first result was that Mathematics, which had in the main been abstract and incomprehensible to many children, became definite and was based on practical experiences. By participating in everyday activities and handling concrete materials, children were now able to explore the various areas of Mathematics. Piaget's developmental theory and his distinction between the stage of concrete and formal operation had affected curriculum planning. Land⁶⁹ refers to the ways in which these Piagetian suggestions had been employed in England to formulate the stages of development of mathematical topics.

The role of environment in Mathematics understanding and learning is also stressed by Matthews (1973)⁷⁰ who claims that children by studying their environment realize the usefulness of Mathematics and gain pleasure from it; he points out that the children need concrete operations before they reach the stage of formal operations, when they can solve problems in an abstract form but still directly related to their personal experiences. He also recommends that Mathematics should be prompted from the pupils' environment, if we wish the children's interest, enjoy-

ment and knowledge of Mathematics to grow too. He also draws our attention to the new trends developed in the study of Mathematics involving all curriculum areas. Although he does not deny the positive results that such an approach might bring, he, nevertheless, argues that there will always exist subjects which should be studied mathematically only (p. 78, G. Matthews, 1972). Opinions are expressed which suggest that the child's eagerness to please his teacher should be replaced by the interest "of making and evaluating" mathematical judgement. Mathematics should be meaningful for the pupil instead of being abstract and mysterious, it should be pursued for the learner's own needs and interests a position also shared by Brissenden.⁷¹

In 1973 the Proceedings of the Second International Congress on Mathematical Education were edited by Howson shedding new light on the psychology of Mathematics learning and the concept of structure in Mathematics. Prof. Fischbein,⁷² for instance, argues that the child should be initiated into mathematical structures empirically very early in his life. This could be realized, he maintains, by anticipating the fundamental system of knowledge for this stage of development. The schemes created could be used by the child as matrices that could develop his mathematical thought.

A similar position is expressed by Prof. Freudenthal⁷³ who proposes that if we are to introduce the child to certain mathematical patterns then we should start with simple and primitive structures. Then, he refers to Jerome Bruner's statement that practically every subject could be taught to any child at any stage provided that we are "careful and honest if we want to adapt some piece of high Mathematics to lower level. Simplifying is a good thing, but wrong elementarizations are a danger..." (p.113)

Furthermore, the necessity for pupils to develop the ability to generalize Mathematical relations and operations is stressed.

Krutetskii (1976)⁷⁴ states that "we shall consider the ability to generalize Mathematical material from another standpoint, also on two levels: 1. as a person's ability to see something general and known to him in what is particular and concrete (subsuming a particular case under a known general concept) and 2. the ability to see something general from something still unknown to him in what is isolated and particular (to deduce the general from particular cases, to form a concept.)" He then continues by claiming that there is a difference between the case of a pupil who recognizes a situation in which an already familiar to him formula could be applied, and the case where the pupil can deduce an unknown to him formula from particular cases.

In the early 1980s, new methodological principles appeared in a Mathematics curriculum based on the study of the environment. The principles described by Oteiza (1984),⁷⁵ are those of construction, organization and functionality of knowledge, the principle of unity of various functions, and of activity which could affect the pupil's learning process.

With a view at the teacher-pupil interaction and the way different content and teaching styles affect the pupil's progress several pieces of research were carried out. Thus Bennet (1976) found that the pupils' mathematical understanding increased with formal teaching styles.

In 1978 a survey by HMI⁷⁶ revealed that the free decisions of teachers on what should be taught might result in striking differences between the content of Mathematics syllabus that different pupils, even in the same schools, were introduced to. The report also stressed the fact that too much time was spent on repetitive practice of skills already acquired, a practice purely mechanical and unrelated to everyday life.

Despite the controversy caused by the application of individualization in practice, the ORACLE findings (1980) showed that in Mathematics the class teaching method was the most usually employed; also according to the pre-test and post-test data on pupils' progress the "class-enquirers" made the highest improvement.

The sex differences in performance and in attitudes towards Mathematics were pointed out by studies such as the APU survey (1980,1981).⁷⁷ The Survey indicated that attainment differed between the sexes in the different areas of the syllabus. It also discovered that certain topics caused difficulties to the majority of pupils, while others proved to be very simple, consequently the children's success rate in them was quite high.

Mathematics has always been considered a difficult subject, moreover, the content, method and objectives of the "New Mathematics" have often been questioned. Nevertheless, scholars, such as Choat (1980)⁷⁸ who claims that there is not such a thing as "modern or new" Mathematics, but it is the same Mathematics that has been practised for more or less a century. What is new is the approach to Mathematics teaching. According to this new approach pains are taken to present the subject in an interesting, exciting way for children, so that they become actively involved instead of remaining passive listeners at best or even reject it as almost all pupils did in the past.

Choat believes that the supporters of the "back to basics" move, those who oppose the "new Mathematics" or any new approach to Mathematics teaching, for that matter, regard Mathematics as the discipline which can make children mechanically competent, able in computation and aware of some basic processes of Mathematics. They believe that learning by understanding is a waste of time. "They would prefer children to learn facts, and once facts have been acquired, hope that understanding materializes." (Choat, 1980)

Mathematics is also regarded as "a difficult subject both to teach and to learn" (par. 228) by the Cockcroft Report (1982)⁷⁹, which admits that it "is also a subject which requires hard work and much practice, whatever one's level of attainment may be" (par. 229) and it warns that "whatever their level of attainment, pupils should not be allowed to experience repeated failure." (par. 230) The report also gives support to the new broader curriculum and suggests that there should be links between Mathematics and other areas of the curriculum and it advocates the need for practical work. It also pays special attention not only to pupils' attainment scores but also to the attitudes they form towards Mathematics during their primary schooling. The need for assessment and continuity is also stressed.

Referring to the crisis in Mathematical education in the U.S.A., Davis (1984)⁸⁰ recognizes two major problems in the application of Mathematics in schools: The first is the dangerously uneven pace. Pupils are detained by very simple problems, concepts or activities, although their cognitive level may cry out for more complicated and demanding ones. This is a serious hindrance to children when they proceed to colleges which, of course, require a more advanced knowledge of certain mathematical areas. The second problem, as Davis perceives it, is the wrong way that Mathematics may be presented to pupils. The way Mathematics is taught is at times lacking in vividness and imagination, as it persists on the "learning of dead 'facts' and 'techniques'" disregarding "its true nature which involves processes that demand thought and creativity." (p. 347) Davis continues by enumerating certain "reasons" and "non-reasons" for these deficiencies: among the reasons he includes are the teachers' inadequate education, the parents' and /or teachers' low expectations, the disagreement among innovators for planning a better curriculum, the conflict between teachers' and parents' views on education, the goals that progressive education has set for itself and finally the philosophy behind the new teaching methods which are

based on the pupils' cognitive level (a much too radical innovation to be accepted by a generation which grew up through traditional education.) As for the "non-reasons," he argues that the students' cognitive limitations and the inadequate time allowed for each lesson should not be listed among the problems encountered in Mathematical learning. Nevertheless, despite his reservations, he allows for some optimism in the area of a Mathematics curriculum evolution.

Bennett (et al. 1984)⁸¹ drawing evidence from the data he gathered from his second study⁸² on "the quality of learning environment" conducted with six and seven year old pupils in sixteen classes by teachers who were strongly in favour of individualization, confirms that "there was a wide variety in curriculum coverage both within and between classes and in terms of both content and structure." (p. 77) Furthermore, he suggests that this diversity may be due to different schemes of work adopted by the schools or the class teacher's decisions on the type of individualized instruction. Bennett also finds that work on the four number rules was over-emphasized in all sixteen classes of the research and he concludes that in reference to the pupils' progress, even though low attainers had covered a narrower curriculum than their advanced classmates and they were tested in smaller content areas, their scores in the given tests indicated that their gains were poorer than those of high attainers.

It can be observed then that all these years following the Plowden Report have been characterized by a continuous effort to discover and establish new mathematical schemes intending to develop a rich mathematical content. The curriculum containing such a content would have clearly defined open aims and objectives influenced by the philosophy of child-centred progressive education. However, the attempt at innovation in the way of mathematical teaching and learning was followed by an equally serious attempt for a "back to basics" movement. Nevertheless,

the new trends in mathematical teaching and learning evoked, naturally enough, varied reactions. Views of the type: "learning through concrete materials and experiences," "mathematical concepts are met in the exploration of the child's environment," "learning Mathematics according to individual needs, abilities and stage of development" constitute radical and profound changes to pass unnoticed or unopposed by the conservative or less progressive forces.

Warnings accumulating from researchers about falling standards in Mathematics, complaints from employers about their employees' lack of understanding of basic mathematical concepts and skills, as well as their inability to put acquired knowledge into practice, also pressures exerted for assessment and evaluation of Mathematics education indicate that a new tendency about the content and teaching of Mathematics in primary education is being formulated.

The Cockcroft Report made an attempt to convince all those concerned that nothing could justify a "back to basics" move, but it simultaneously drew attention to the way that the Mathematics content and material was treated in schools. Moreover, it suggested that good Mathematics teaching should include not only instructions by the teacher, but also discussion between him and the pupils and between pupils themselves. It should also promote practical work in order to consolidate fundamental skills and encourage investigation and exploration in everyday situations.

The ideas introduced by the Cockcroft Report were later (in 1985) re-emphasized by another publication issued by HMSO⁸³, which supported investigational and practical work and made a point of reappraising Mathematics teaching in an effort to increase the pupils' success in this subject-matter.

This brief report of the literature concerning the development of Mathematics teaching and learning in the last twenty years highlights the fact that a remarkable change has taken place in the field, the application of which evoked numerous difficulties as well as opposition. Despite the efforts for a "back to basics" move, it appears that such a complete turn is out of the question since the innovation has been well established. What seems probable, though, is that the criticism exerted on the content and teaching method of Mathematics and the consequent competence of children, as well as the emphasis put to assessment and testing, all point to the adoption of a new Mathematics curriculum framework, breaking fresh ground for a new era of Mathematics teaching.

As Cornelius (1985)⁸⁴ indicates, "perhaps the reduced need for basic arithmetic and the use of new opportunities created by computers will mean that there is more scope for doing "real" Mathematics with able and willing pupils. Maybe, there will be a rekindling of interest in things like school geometry and the study of more abstract pieces of Mathematics." (p. 30).

Hayden and William (1984)⁸⁵ also discern the prospect of the creation of a new "New Mathematics." In support of their view they attempt a historical review in the 1960 decade, when "New Mathematics" emerged, by juxtaposing at the same time the situation prevailing in the wider educational field then, with the situation existing today. Thus, they noticed that the technological progress, the boom of industry, the demands articulated by employers, the parents' protestations about the inadequacy and inappropriateness of the provided knowledge seem to exert pressures for a new approach in Mathematics education only the pressures exerted seem to relate to *more* rather than alternative Mathematics content or teaching. A new change then seems to be formulating in Mathematics education aiming at providing children with the adequate mastery of the concept of number and the skills of computation, so that employers, professors and every-

one involved in educational matters, in general, were able to exploit this knowledge to its full extent.

The Education Reform Bill currently being investigated in Parliament seems to suggest that within the core curriculum Mathematics will be allocated a major place. It is also suggested that teachers will be expected to provide concise and accurate record of pupils' performance in Mathematics and it will be expected that testing will be carried out at different ages within the primary school. The latest information available suggests that basic work will be retained, the learning of tasks expected, but that diversity may be achieved within the demands of the core curriculum.

PRIMARY MATHEMATICS DEVELOPMENT IN GREECE.

The Mathematics syllabus in primary education had remained almost unaltered since the end of the previous century and up to 1982, when the new Mathematics book for primary schools was written based on a new philosophy of the Mathematics curriculum. The knowledge which the old curriculum intended to impart to pupils was completely cut off from their everyday experiences and interests and it did not serve any of the needs a contemporary adult might have had, not mentioning the needs of the children to whom it was addressed. The teaching method was uninspiring, austere, pedantic, obliging children to mechanical rote learning rather than actual understanding of the introduced concepts. As it is stated in *O Politis* (1978, no. 22) " this programme of Mathematics teaching constitutes an organized set aiming at shaping people according to models, such as the accountant, the tradesman and the money-broker as they were crystalized at the end of the 19th century. Besides, the problems themselves for which pupils are called to seek solution are indicative of the intentions: at least 90% of the problems contain purchasing, selling and loans."

The fact that the Mathematics syllabus remained "stuck in the mud" up to the beginning of the 1980s was mainly due to the fact that the technical- economical development of the country was such that did not demand the radical changes in content and teaching methods that were realized in other countries.

Moreover, in Teachers' Colleges, students were not introduced to the new trends in Mathematics teaching and curriculum content, so that the situation remained the same: the children in a class were divided into a group of a few good at Mathematics pupils and the majority who did not understand, disliked or were appalled by Mathematics. The way that Mathematics was presented at primary school - completely cut off from reality, was a non-sense puzzle, introduced through simulated, artificial situations - while the Authorities maintained the view that Mathemat-

ics was within few children's capacities and the indifference and dislike of most children was sustained.

In the 1970s various initiatives concerning an integrated approach to the teaching of Mathematics appeared. As *O Politis* (1977, no. 24) concedes "Mathematics is a tool necessary for the study of absolutely any subject. It is impossible to understand and explore relations and structures without advocating Mathematics."

The Mathematics manual up to 1974 had been completely old-fashioned. With the innovation of 1976 (see chapter II, p. 24) new manuals were published. The Teachers' Confederation in an article⁸⁶ blames the books for being inappropriate, not "modern," incomprehensible, with an advanced terminology suitable for secondary school children rather than primary pupils. It is an austere criticism, it grants the books no positive elements and it is directed mainly towards the fourth, fifth and sixth class books. Particularly for the fifth and sixth class books, the Confederation denounces that even if they had been rejected by a competent Committee of Selection, nevertheless, they were forwarded for publication and use at schools. The negative points the above books are charged with are that they contain a large number of secondary concepts, the units they include do not correspond to contemporary reality, in fact several of them are absolutely outmoded, that, finally, their syllabus is designed with the children's preparation for secondary school in mind, completely ignoring their present needs and interests. This overt accusation expressed by the Confederation and especially the personal attack against one of the writers resulted in a series of actions: the latter sent an extrajudicial invitation to the Confederation, who in their turn answered in detail to each one of the accusations they had spread around refuting the writer's "feeble" claims.⁸⁷

Meanwhile, in the free market, Mathematics books, mostly addressed to nursery and primary school children gradually appeared. They were nicely designed, with pictures, graphics,

games and their appearance and content made them accessible even to pupils who disliked Mathematics. Unfortunately, however, the fact that these books were not prescribed by the Ministry of Education and, furthermore, teachers were not prepared to adopt the new methods introduced called into question their value. All these efforts, initiated by either governmental or private factors, point to the fact that the need for a new Mathematics book was imperative.

Furthermore, several isolated calls were heard for the necessity of a change in the quantity and quality of the syllabus, but mostly in the quality of teaching. As an article in a newspaper indicates "the school should not serve the needs of the economy, but the needs of people, their mental and spiritual cultivation. Mathematics should not be limited to computation, so as to cover the needs of the technological and economic society, but they should be based on children's and teachers' active participation in all important procedures, methods and thought. (Newspaper *Macedonia*, 14 Aug., 1983)

Naturally, the circulation of the first books⁸⁸ in September 1982, was received with either enthusiastic comments or careful "well-disposed" criticism or with covert opposition a bit later. Thus an article of the newspaper *Vesna* (26 Sept., 1982) read: "My *Mathematics* has nothing to do with one plus one and the numerical operations children have been taught till now. Numbers have meaning. Teachers and children have objects to deal with. . . . Many a time the problem resembles a game, a puzzle similar to the ones the young pupil may encounter in a children's magazine." A certain mathematician welcomed the new book in an article in a daily newspaper, nevertheless, he did not fail to point out certain "abuses" of basic mathematical concepts occurring in the Teacher's book. He referred to the particular lines of those pages, where certain concepts, such as seriation, correspondence, sets or relations, and the number which are misinterpreted or misused. (Newspaper *Thessaloniki*, 19 Nov., 1982)

Thus, the first serious attempt at innovation in primary education was made as late as the beginning of the present decade. In this process, the Mathematics curriculum was re-evaluated and reorganized in as far as the content of the syllabus, as well as its teaching method was concerned.⁸⁹ It is, therefore, too early to present an evaluation of the innovation recently introduced as it is still in the very first stages of its application. It should be noted that in the short time of its application: 1. even if it has not cultivated a positive attitude in children towards Mathematics, nevertheless, it has definitely helped them overcome their fear and dislike of the subject but also to derive some pleasure from working with it. 2. it has created diverse feelings among parents, who, on the one hand, see their children work on Mathematics with pleasure and on the other, examining the mathematical syllabus and realizing how different it is from what they were taught, find it either very "unmathematical," or too game-oriented or finally, too difficult or easy according to their personal mathematical abilities. 3. it has caused very different reactions on the teachers' part, depending upon their age, training, socio-cultural background, their general attitudes to education and their political views. 4. despite certain opposition it has evoked,⁹⁰ overt or covert, despite the mistakes in its application or the difficulties and problems it has encountered, we might say that the innovation has outlived its most difficult phase. It has penetrated the primary school and has accomplished, even with considerable delay, a change in the Mathematics curriculum.

Unfortunately, the history of the evolution of Greek primary education⁹¹ does not allow for overt optimism for the future of the innovation. The present, however, offers more prospects than the past as well as a definite hope that a relapse to traditional, conservative educational systems should not be feared.

Curriculum development in Mathematics.

Except for the already mentioned move known as "New-Mathematics," which was mainly content-oriented and took different forms in various schools and countries other trends developed as well.

The Behaviourist approach to Mathematics was mostly successful in the U.S.A. and it did not originate from Mathematics but from educational psychology. Alternatively to the "New Mathematics" approach, which was content-oriented, the behaviourist proposal reformed the learning and teaching methods. The theory this approach is based upon is that of stimulus and response: a stimulus-response programme is created in order to set the learning process going and the results of this process are observed as changes of behaviour. The success of the learning process, then, is verified by the relative change of behaviour it brings about. The main characteristic of this approach is that its content is very well organized in tasks, it entails a low level of abstraction and it provides the necessary means of controlling the pupils' progress as well as the teacher's work. The "New Mathematics" lent its content to the behaviourist approach quite often. Even very complicated concepts were formulated as parts of a behaviourist learning programme. The application field of the behaviourist approach is mostly programmed into learning and individual instruction schemes and it could be claimed that an example of these schemes in the primary sector in England is SMP.⁹²

The Structuralist approach: Bruner's influence in the Mathematics curriculum derives from genetic epistemology but it relies not only on psychology, but on Mathematics, too. The main representative of this theory which refers to the process of concept formation is Jerome Bruner who studied "the structures of disciplines." (p. 107, G. Howson et al., 1981).

Bruner (1960)⁹³ claims that the understanding of the subject's structure could drive the child to the understanding of the basic concepts of a discipline. If a child conceives the funda-

mental relationship between the external stimulus and the driving force then he may tackle numerous concepts, which may appear new, but in fact they are directly related to the known ones. The child, that is, will comprehend the structure of a topic if he may relate it to other topics. Conceiving the structure actually means being able to perceive the interrelation of things. Bruner claims that there are several strong arguments in favour of the study of the fundamental structure of the concept as a teaching method. Thus, according to Bruner, 1. a topic becomes more comprehensible if its basic structures are understood. 2. the simpler the way a subject is presented, the easier the child retains the details it includes. 3. the "transfer of knowledge" can be achieved through the understanding of basic principles and ideas. 4. the gap between "advanced" and "elementary" knowledge can be bridged through constant re-examination of the curriculum in the different stages of education. (DP, p. 39.)

Thus, Bruner maintains that if we are to plan the curriculum, then we should have in mind that the content should be defined in terms of the comprehension of the basic principles constituting the crux of the subject. The learning process will thus proceed in a spiral way. The child, that is, having grasped the basic principles of a subject, will continue enriching and furthering it, since he will continuously encounter new concepts directly related to the original one. Basic structures, formed by little concepts become more elaborate with the continuous addition of new concepts. (Howson, 1981, pp. 107-108) The weak point of this theory of spiral curriculum seems to be that it devises modes to make those structures clear to children whose cognitive structure is of a low level.

The Piagetian contribution to the shaping of Mathematics curriculum. (The Formative approach)

Studying children's mathematical development, Piaget found that by manipulating concrete material, the child abstracts concepts, which, in turn, he internalizes and builds in schemata of activ-

ity. The study of the development of physical causality persuaded Piaget that there do not exist special attitudes in children, so he concluded there are no "good" or "bad" pupils in Mathematics, but rather "good" and "bad" instruction given to them, very often, that is, the instruction supplied is not adaptable to the children's cognitive level. Therefore, it is not the concept itself that cannot be understood, but the lesson through which it is being transmitted to the child. (Sohan, Madgil, 1974)⁹⁴

Piaget claims that children's inability to cope successfully with some specific subjects may be due to the fact that the child was forced to pass too rapidly from the concrete to the abstract, from the qualitative structure of the subject to the quantitative. He also stresses the need for concrete operations and for active learning; he suggests that if a child was left to investigate a problem himself, it would be found that there exists a great similarity "between the principal operations employed by the child and the notions they (the teachers) attempt to instil into him abstractly." Thus, similarly to the structuralist approach, it is very important to create appropriate teaching situations if it is to present a problem to the child. Piaget, very much like Bruner, maintains that children of the same age have different abilities and they learn through different learning processes which, however, conversely to what structuralists believe, the curriculum subject will initiate rather than determine. In Piagetian theory the principles that determine the content of the syllabus and the teaching methods are based more on the structure of personal development than on the structures of Mathematics.

The target of any curriculum planner should be to find such content and methods which will adequately provide for children's cognitive abilities rather than promoting the embodiment of mathematical structures. Piaget also stresses the need of approaching subjects from an interdisciplinary point of view. Howson (1983)⁹⁵ finds that an application of this approach in English primary education is the Nuffield Junior Mathematics

Project which, however, is also influenced by the integrated approach of Mathematics teaching.

Many years ago in America an important contribution to the education debate was Dewey. His contribution to the Mathematics curriculum is the integrated approach. Dewey (1938)⁹⁶ supports the inter-marriage of science and philosophy in education, in an attempt "to overcome the split between knowledge and action, between theory and practice, which now affects both education and society so seriously and harmfully."⁹⁷ Dewey, therefore, favoured a "project" method according to which the barrier between different disciplines would be looser and each individual child, through his own experience, would build up, enrich and refresh his own body of knowledge.⁹⁸

Thus, the division of learning into "subjects" is regarded as appropriate if it is to help the child in the above process, while, at the same time, it corresponds to his experiences and intellectual development. According to this approach, Mathematics learning comes within a wider curriculum content and the progression in Mathematics promotes progression in other curriculum subjects as most of them depend upon Mathematics in order to become understandable to pupils. This approach is quite favourably accepted in an integrated day organization of the classroom which is still quite popular in many educational areas in England and elsewhere.

The choice of a specific approach for Mathematics teaching is neither simple nor always free from constraints. Within a centralized system, in Greece, for example, the teacher has very few, if any at all, chances to determine the programme she considers appropriate for the particular class of the particular area of the country in which she works. In this case, the decision for the suitable approach is entirely up to the Ministry of Education, which almost always prescribes a uniform scheme for every school of the country. All the class teacher is expected to do is to choose the way of applying the predetermined approach in her classroom.⁹⁹

In a decentralized system, the system adopted by English schools, the L.E.A. plays a major part in policy matters but the headteacher of the school and the teachers determine the most appropriate approach to be used, thus providing for the needs and capabilities of the children. Moreover, the teacher may decide the content of each year's syllabus as well as the parts of the syllabus which will be suitable for every individual child. Despite the advantages this system offers, a number of problems is still created due to the variety of choice permitted. Thus, if free choice is not allowed in the consecutive stages of education, many difficulties may arise when the child passes from one school to another and from the primary to the secondary stage of education. The actual realization of these problems has formulated a demand for a "core curriculum" common to all students of the same educational level, which will again allow an amount of freedom - the question is how much - for teachers and subsequently, for children.

A discussion of two individualized approaches to Mathematics - Fife Mathematics Project and SMP.

As it has already been mentioned in the present chapter, the trend developed in the 1960s was for the discontinuance of streaming in primary education, which was officially established by the Plowden Report. That move resulted in the adoption of mixed ability classes, in a reorganization of classroom settings and reconsideration of teaching and learning methods and processes. Thus, a change has been realized from 1970 onwards, from the formal traditional class-teaching to the progressive approaches of group and individualized instruction. The philosophy of child centred education set the new aims and objectives of primary education and prompted the planning of new schemes of work.

In Mathematics the adoption of mixed-ability classes created a number of problems mainly due to its sequential structure. The linear nature of mathematical thinking advocated group teaching as the only workable solution in Mathematics teaching, provided the groups in a class were of at least of a roughly homogeneous ability. In fact, experience has shown that individual instruction was a rather inapplicable theory in the case of Mathematics. In an effort to allow children the opportunity that child-centred philosophy acknowledged them - namely, to be recognized and treated as individuals - several individual projects were designed, printed and distributed to schools favourably disposed to individualization. Such schemes went through a period of experimentation, and then their demand diminished either because they were found to be inadequate in some way for the purposes intended, or because they were used in parallel with another scheme, mainly as supplementary material. Finally, the decline in sales might have been due to the publication of several new projects which advertised optimum efficiency in Mathematics teaching and persuaded teachers that they were worth given the chance to make observations and draw conclusions as to the strong or weak points of the projects. Unfortunately, it so happened that an evaluation of their curriculum was not always

available. When sometimes it was, the decision was not based upon common intentions and purposes. With little evaluative material available, it is difficult to assess the precise value of "individual approaches," however, a brief description of two only may serve the purpose of highlighting some of the advantages and disadvantages of card-based systems.

A brief description of two individual card based projects will be attempted here, the Fife Mathematics Project - which was addressed to older than primary school children, twelve to fourteen year old, and was applied in Scotland - and SMP - which was applied in primary schools in England. This reference to the two approaches will not involve their evaluation but simply a description of their aims and objectives, the difficulties they encountered during their application, as well as their possible effect on pupils.

This report was judged useful as an exploration of the material and the field of application of individualization in Mathematics and in order to compare, where possible, the difficulties or findings of the present research with the corresponding English systems. As far as evaluation is concerned, only one has been conducted for the Fife Mathematics Project by Douglas Crawford (1975), while no official appraisal has been reported of SMP up to the completion of this study.

The *Fife Mathematics Project* focused attention on the teaching method rather than the content of the syllabus. It could be thus claimed that it is based on the formative approach to the curriculum. Its teaching method involves class instruction and project work. In the latter, the pupils work either as individuals or in pairs. The teaching material for the first year consists of nineteen Mathematics Workcard Booklets with associated worksheets and equipment.¹⁰⁰ The booklets follow a pattern of increasing difficulty and each of them develops a certain topic through eight workcards, which are not necessarily based on the syllabus prescribed for that age range. The purpose of the Fife's experiment, as outlined by Guiles is:

1. to see how mixed-ability classes at the first-year level react to a relatively free classroom situation in which each individual has considerable freedom to choose what he will work at and whom he will work with.
2. to see how the experimental method of working affects the understanding, knowledge and behaviour of the children involved.
3. to find out the difficulties of working in this manner and to try out ways of getting round them.
4. to give teachers and everyone interested an opportunity to see this kind of work in progress so that they can make their decisions about it. (Crawford, 1975, p. 9)

The project was applied in a pilot form in one school starting in February 1970. At the end of the school year, it was judged worthwhile to expand the application of the project into a greater number of schools. Thus, in 1971 the programme was introduced into nineteen schools and in 1974, thirteen of the original nineteen schools were still using it.

In his effort to evaluate the project, Crawford collected information about its design and aims from its organizer, about the pupils' reactions from their teachers and about the teachers' opinions from questionnaires he distributed among them. The pupils' achievement was not easily assessed because of the varied progress that children exhibited through the project's material, a fact that rendered difficult the interpretation of the pupils' tests. It could be argued, therefore, that the project's evaluation was limited to the way in which children learned and ignored the mathematical content that had been learned.

According to the teachers' opinions, as they are reported in Crawford's book, several general conclusions about the project's applicability, as well as its advantages and disadvantages could be drawn. Thus, the points that teachers stress in the questionnaires are:

1. It is difficult "to keep track of the pupils' work." (p. 101) If the class is large, then the lesson must be very well organized, so that it yields advantages for the pupils.
2. At the beginning the pupils were enthusiastic and interested in the project work, attracted by its newness, nevertheless, when the novelty faded, their fervour dropped considerably.
3. The provision of materials is not adequate.
4. It is "time-consuming" (p. 110) because it involves a lot of movement on the children's part; besides, children are usually obliged to wait a long time for the teacher to answer their questions and at times they resort to practical methods to resolve their problems. This makes the application of the programme problematic in schools which follow a strict timetable, since it requires at least two consecutive teaching sessions. (p. 111)
5. The project is very flexible, its material can be used in a number of ways and the topics are so arranged as to be tackled in any order the pupils finds suitable or the teacher suggests.
6. The pupils enjoyed working with the cards, the bright ones were able to proceed as fast as they liked, but even the poor ones gained satisfaction from the cardwork.
7. Certainly a lot of noise was created in the classroom, but most of it was purposeful.
8. The necessary completion of the whole syllabus is not within the project's targets and this, of course, adds to its flexibility. In case, however, that a definite curriculum content had to be covered, then its flexibility would be considerably limited. Perhaps, this is why most teachers consider the programme a "complement to syllabus work, as a form of mathematical enrichment, in fact," (p. 100) and suggest the parallel use of class-teaching from time to time.

Finally, Crawford, expressing his own viewpoint, states that pupils seemed rather satisfied with the content of the project, (p. 139) although some very bright pupils in a school complained that the suggested work was far too easy and the use of concrete apparatus was over-emphasized. He also noted that there were several difficulties concerning the pupils' assessment, their

progress and the time devoted to each individual. In conclusion, he concedes that the project is too demanding on teachers who are not used to such novel approaches.

When we turn to a discussion of *SMP*, it should be mentioned that the first two units of *SMP* is the result of a group of teachers' work, who, challenged by the changes which had been realized in primary education and the difficulties they had been encountering in order to cope with the new systems decided to hold a conference, at Easter 1972, to discuss their problems and communicate their ideas and recommendations. At that conference, they admitted that the "major problems facing schools teaching 7-13 year old children were identified as a lack of Mathematics specialists, a poor structure and progression in many Mathematics schemes, a lack of practical work, poorly organized materials difficult to use in the classroom and an excessively high reading level in Mathematics material. There was, therefore, need for a new, structured, up-to-date Mathematics course for the middle years. It should be more relevant, interesting, mathematically sound, readable and attractive."¹⁰¹

The objectives set at that conference defined that "the 7-13 course should weave together the following four essential ideas: enjoyment and interest, mathematical ideas and skills, relevance to the life of the pupils, integration with other subjects."¹⁰² *SMP* is a card based system with the intent to make Mathematics understandable and enjoyable to pupils of different abilities and different social backgrounds, to promote group and individual work and occasionally encourage class-teaching, to develop pupils' intention in discovery work, to facilitate learning through the use of concrete apparatus.

The main characteristics of the *SMP* is that "the curriculum follows a course representing the best of what most schools are now teaching." (teacher's handbook, preface) and could be completed in any order. It is very flexible allowing for many different forms of organization (class and group teaching and individual work) and it includes continuous pupils' assessment.

SMP first circulated in 1977, it was enthusiastically accepted and used by teachers, but in the 1980s a period of decline followed. Recently, however, it has been revised and it is now often seen as valuable supplementary material to a main core Mathematics scheme.

Unfortunately, no systematic evaluation of the project has ever been attempted. It would have been most helpful if some information was available about the teachers' opinions, pupils' reactions and the experience of the original teachers' group responsible for the introduction of SMP to have been reported.¹⁰³ This would have facilitated a discussion on the problems, the objective difficulties or profits deriving from the project's application. Furthermore, SMP could be compared with any other similar card-based, individualized project so that tentative conclusions could be drawn. Thus, a new individualized programme could be planned, which might enjoy the teachers' full support as the most profitable and least problematic scheme of work. All we could put forward then, as a sort of evaluation is the personal opinion formed by the careful observation of the programme's application in very few English schools (three or four) and the discussion with the teachers who applied it. But these views may not be representative of all teachers who have implemented the project and they could never be generalized. A further discussion of its application, the present concern of the study, makes comments and suggestions for its use in primary schools in Greece; some of the findings may also be applicable to other primary schools.

NOTES TO CHAPTER II

1. See Olive Banks, *The Sociology of Education* (London, Batsford Ltd., 1968).
2. See Geva M. Blenkin and V.A. Kelly, *The Primary Curriculum* (London, Harper and Row, 1981).
3. Board of Education, *Report of the Consultative Committee on the Primary School*, (Hadow Report) (London, HMSO, 1931), p. xvi.
4. Ibid., pp. xviii-xix.
5. Ibid., p. xxi.
6. Board of Education, *Handbook of Suggestions for Teachers*, (London, HMSO, 1937).
7. See Colin Richards, *The Study of Primary Education: A Source Book, Vol. 1* (London, The Falmer Press, 1984), pp. 34-36.
8. Central Advisory Council for Education (England), *Children and their Primary Schools, Vol. 1* (Plowden Report) (London, HMSO, 1967).
9. Ibid., p. 272.
10. Ibid., p. 187.
11. See *Black Papers*, (eds. Cox and Dyson, 1969-1970).
12. Department of Education and Science, *A Language for Life* (Bullock Report) (London, HMSO, 1975).
13. See Michael Hyndman, *Schools and Schooling in England and Wales* (London, Harper and Row, 1978), p. 56.
14. Neville Bennett, *Teaching Styles and Pupil Progress* (London, Open Books, 1976).
15. Department of Education and Science, *Education in Schools: A Consultative Document* (London, HMSO, 1977).
16. Department of Education and Science, *Primary Education in England: A Survey by HM Inspectors of Schools* (London, HMSO, 1978).
17. Maurice Galton, Brian Simon, and Paul Croll, *Inside the Primary Classroom* (London, Routledge and Kegan Paul, 1980).

18. Maurice Galton and Brian Simon, *Progress and Performance in the Primary Classroom* (London, Routledge and Kegan Paul, 1980), p.13.
19. HMI, *9-13 Middle Schools: An Illustrative Survey* (London, HMSO, 1983).
20. See, *News-Letter* 5/85, p. 30.
21. Barry MacDonald's, "Who's Afraid of Evaluation?" in Colin Richards (ed.), *New Directions in Primary Education* (Sussex, The Falmer Press, 1982), p.163.
22. *News-Letter* 2/87, p. 39-42.
23. See, Anna Fragoudaki, *Educational Reform and Liberal Intellectuals* (Athens, Kedros, 1977).
24. Volos is a medium-size town in central Greece.
25. Delmouzos was found not guilty of the charges in 1914 and in 1917 he was assigned as a High Inspector of primary education when the Liberal party was in power. In 1920, when the Liberals lost the elections he resigned his post. In 1923, Delmouzos became the Principal of Maraslios Teachers' College, when the Liberals were in power again, only to be dismissed in 1926, when Pagalos enforced the martial law. In 1929, when the Liberals regained the power, Delmouzos became professor at the Aristotle University of Thessaloniki and in 1936, when Metaxas became a dictator, he resigned once more.
26. Demotic is the language employed by people in their everyday interactions.
27. See, Alexis Dimaras, *Modern Greek Education: The Reform that Never Happened* (Athens, Hermes, 1974).
28. Andreas Kazamias, "The Educational Crisis in Greece and its Paradox: A Historical, Comparative Outlook." *Proceedings of the Academy of Athens*, 1983, p. 451.
29. See *Didaskaliko Vema*, "The Confederation of Greek Teachers on the Primary School Manuals." 1980, 862, p. 2.
30. Extracts of Ch. Fragos and Th. Geros' speeches at the first Hellenic Scientific Conference on the issue of Teachers' Colleges, in "The University of Teachers: A National Matter." *Didaskaliko Vema*, 1980, 867, p. 2-3.

31. An article from the newspaper *Exormissi* (20 Sept., 1980) reads: "Public education has been degraded through the new governmental measures."
Also in *Kathimerini* (21 Sept., 1980) "Education 1980: Innovation without Enthusiasm."
32. Anna Fragoudaki and Marianna Kondili, "'The Educational Reform' as a Political Ideology: The Political Parties' Standpoint on Education." *Politiki*, 1982, 3, pp. 104-117.
The lack of objections, according to the authors, was mainly due to the fact that the progressive parties were caught by surprise when they realized that the governmental measures constituted the demands the Opposition had expressed for years. Thus, the progressive forces could not, this time, identify themselves with the innovative move of the country.
33. Ibid.
34. See: Panos Polychronopoulos, *A Critical Analysis and Evaluation of the Ideological and the Knowledge Functions of the Greek School System, 1950-1975, Vol. A* (Athens, Kastaniotis, 1980), pp. 219-220.
35. K. Andriopoulos, "The New Curricula and Manuals of the Primary School." *Epistimoniko Vema tou Daskalou*, 1985, 6, pp. 30-40.
36. C.H. Dobinson, *Jean-Jacques Rousseau* (London, Methuen, 1969), p. 82.
37. J. Bowen and P. Hobson, *Theories of Education* (Sydney, John Wiley and Sons, 1974), p. 4.
38. Ibid., p. 181.
39. B.A. Cooper, "Peter's Concept of Education." *Educational Philosophy and Theory*, Oct., 1973, 2.
40. F. Murphy, "The Paradox of Freedom in P.S. Peter's Analysis of Education as Initiation." *British Journal of Educational Studies*, Feb. 1973, XXI, 1.
41. See Norman Kirby, *Personal Values in Primary Education* (London, Harper and Row, 1981), pp. 60-80.
42. Ibid., p. 66.
43. B. Bernstein, *New Society*, 14 Sept., 1967, pp. 351-53; in Alan Harris, Lown Martin, William Prescott, *Curriculum*

- Innovation* (London, The Open Univesity, 1975), pp. 155-161.
44. Ibid.
45. R. Sharp and A. Green, *Education and Social Control: A Study in Progressive Primary Education* (London, Routledge and Kegan Paul, 1975), p. 212.
46. G.W. Bassett, *Innovation in Primary Education: A Study of Recent Developments in Primary Education in England and the U.S.A.* (London, Wiley and Sons, 1970).
47. Harry Kay, "Programmed Instruction," in H.J. Butcher and H.B. Pont (eds), *Educational Research in Britain* (London, Univ. of London Press, 1968), p. 156.
48. J. Mitchell, "Freedom in the Junior School," in D. Rubinstein and C. Stoneman (eds.), *Education for Democracy* (London, Penguin Books, 1973), pp.98-103.
49. G.R. Woods and R.St.C. Barrow, *An Introduction to Philosophy of Education* (London, Methuen, 1975).
50. Ibid., p. 131.
51. R.J. Riding, *School Learning: Mechanisms and Processes* (London, Open Books, 1977).
52. Maurice Gibbons, *Individualized Instructions: A Descriptive Analysis* (New York, Teachers' College, Columbia Univ., 1971).
53. Deanne Boydell, "Teacher-Pupils Contact in Junior Classroom," *British Journal of Educational Psychology*, 1974, 44, pp. 313-318.
54. Neville Bennett, *Teaching Style and Pupil Progress* (London, Open Books, 1976).
55. P.N. Richards and Ann Bolton "Divergent Thinking, Mathematical Ability and Type of Mathematics Teaching in Junior School Children," *British Journal of Educational Psychology*, 1971, in N. Bennett, *Teaching Styles and Pupils' Progress*, p. 26.
56. Maurice Galton and Brian Simon, *Progress and Performance in the Primary Classroom* (London, Routledge and Kegan Paul, 1980).

57. Neville Bennett, Charles Desforbes, Anne Cockburn, and Betty Wilkinson, *The Quality of Pupil Learning Experiences* (London, Lawrence Erlbaum Associates, 1984).
58. Department of Education and Science, *Education in Schools: A Consultative Document* (The Green Paper) (London, HMSO, 1977).
59. Maurice Galton, et al., *Inside the Primary Classroom*.
60. Norman Kirby, *Personal Values in Primary Education*.
61. Bennett et al., *The Quality of Pupil Learning Experiences*.
62. Richard Colin, *New Directions in Primary Education*, p. 48.
63. Jean Piaget, *Psychologie et Pedagogie*, translated into Greek by A. Ververidis (Athens, Livanis, 1979), p. 55.
64. Robert Morris (ed.), *Studies in Mathematics Education* (Paris, UNESCO, 1981), p. 106.
65. See, Morris Kline, *Why Johnny Can't Add* (London, St. James Press, 1973).
66. Margaret Brown, "Goals as a Reflection of the Needs of the Learner," in Robert Morris (ed.), *Studies in Mathematics Education*, p. 24.
67. G.A. Howson, "A Review of Research in Mathematical Education, Part C," *Curriculum Development and Curriculum Research* (Windsor, NFER, 1983).
68. Even in 1988, however, a number of L.E.A.'s retained the 11+ examinations.
69. Frank Land, "The Teaching of Mathematics," in J.H. Butcher and B.H. Pont (eds.), *Educational Research in Britain. 2.* (London, Univ. of London Press, 1970), pp. 64-81.
70. Geoffrey Matthews (ed.), *Mathematics through School* (London, John Murray, 1973), p. 11.
71. Thomas H.F. Brissenden, "Deciding the Objectives of Primary Mathematics," Maurice Chazan (ed.), *Aspects of Primary Education* (Cardiff, Univ. of Wales Press, 1972), pp. 117-138.
72. E. Fischbein, "Intuition, Structure and Heuristic Methods in the Teaching of Mathematics," *Developments in Mathematical Education: Proceedings of the Second International Congress on Mathematical Education*, A.G.

- Howson (ed.) (London, Cambridge Univ. Press, 1973), pp. 222-232.
73. Hans Freudenthal, "What Groups Mean in Mathematics and What Should Mean in Mathematical Education," *Developments in Mathematical Education: Proceedings of the Second International Congress on Mathematical Education*, pp. 101-114.
 74. A.V. Kruteskii, *The Psychology of Mathematical Abilities in School Children* (U.S.A., Univ. of Chicago Press, 1976), p. 237.
 75. Fidel Oteiza, "The Environment as a Source for the Elementary Mathematics Curriculum," in Robert Morris (ed.), *Studies in Mathematics Education*, pp. 51-67.
 76. Department of Education and Science, *Primary Education in England: A Survey by HM Inspectors of Schools* (London, HMSO, 1978), p. 89.
 77. Department of Education and Science, Assessment of Performance Unit, *Mathematical Development: Primary Survey Report, 1* (London, HMSO, 1980).
Also, D.E.S., *Mathematical Development: Primary Survey Report, 2* (London, HMSO, 1981).
 78. Ernest Choat, *Mathematics and the Primary School Curriculum* (Windsor, NFER, 1980).
 79. *Mathematics counts* (The Cockcroft Report) (London, HMSO, 1982).
 80. Robert B. Davis, *Learning Mathematics: The Cognitive Science Approach to Mathematics Education* (London, Croom & Helm Ltd., 1984).
 81. Neville Bennett, et al., *The Quality of Pupil Learning Experiences*.
 82. In this second research, Bennett appears milder in his critique of informal teaching methods.
 83. Department of Education and Science, *Mathematics from 5 to 16* (London, HMSO, 1985), pp. 2-7.
 84. Michael Cornelius, "From Jeffery Syllabus to Cockcroft Report, Part 2," *Mathematics in School*, 1985, 14, 5, pp. 28-30.

85. Robert Hayden and Rudolf William, "Will There Be a New Math?" *Journal of Curriculum Studies*, 16, 3, 1984.
86. "The Confederation of Greek Teachers on Primary School Manuals," *Didaskaliko Vema*, 862, Jan. 1980, p. 2.
87. "The Extrajudicial Invitation Pressed by Prof. Megas and the Response of the Confederation of Greek Teachers," *Didaskaliko Vema*, 868, Apr. 1980, pp. 2-3.
88. In 1982, only the first class book was published and the publication of the six books of all classes was completed in three years.
89. For a brief report of the philosophy of the new Mathematics curriculum, as well as the content of the new pupils' books see appendix B, pp. xix-xxii.
90. For the reactions - oppositions perceived, but seldom made public, see B, p. iii-x.
91. For a brief report of the evolution of primary education in Greece, see ch. II, pp. 20-27.
92. See, A.G. Howson, *Curriculum Development and Curriculum Research, Part C* (Windsor, NEFR-NELSON, 1983).
93. Jerome Bruner, *The Process of Education*, translated into Greek from the 1960 English edition (Athens, Karavia).
94. Sohan Madgil, *Piagetian Research: A Handbook of Recent Studies* (Windsor, NEFR-NELSON, 1974) p. 273.
95. G. Howson, Ch. Keitel and J. Kilpatrick, *Curriculum Development in Mathematics* (Cambridge, Cambridge Univ. Press, 1981), p. 177.
96. John Dewey, *Philosophy of Education: Problems of Men* (U.S.A., Littlefield, Adams and Co., 1975).
97. *Ibid.*, p. 164-168.
98. See, an extract from John Dewey's, *Democracy and Education*, rpt. in J. Bowen and P. Hobson, *Theories of Education*, pp. 188-203.
99. The application of such a scheme is currently in use in France.
100. Douglas H. Crawford, *The Five Mathematics Project An Experiment in Individualized Learning* (London, Oxford Univ. Press, 1975).

101. Alan Rogerson, "SMP," *Mathematics in School*, 7, 5, Nov. 1978, pp. 4-6.
102. Alan Rogerson, "SMP," *Mathematics in School*, 14, 1, Jan. 1975.
103. Information provided by the Director of the SMP project.

CHAPTER III

Design and Organization of the Study.

At the beginning of this research the most prevailing projects for the teaching of Mathematics in English primary schools were investigated. This investigation aimed at selecting the most appropriate method for conducting a study in the Greek elementary school. During my teaching practice as a student in the P.G.C.E. course, at Northampton, I became acquainted with several of the current projects on Mathematics teaching. That was a valuable experience when the question of the project selection arose.

The selection of the project.

a. The reasons that dictated the choice of the particular project.

i. At the time the research was decided upon new books on Mathematics, illustrated and attractive in format, were being used in Greek primary schools.

ii. Although one of the aims of these new books was to persuade the teachers to try a different approach from the traditional one, the majority of the teachers followed the formal approach. No apparatus was used in most cases and direct teaching with very little participation from the pupils as well as class instead of group or individualized approaches were the routine teaching styles.

iii. The classrooms and the organization of teaching, in general, did not allow children to move freely during the lesson, nor were they given the opportunity to be engaged in group or paired activities.

iv. According to the ministerial permission granted for the research, the children's involvement in the suggested English project was not to disturb the course of their lessons on

Mathematics. Therefore the English approach had to be applied alongside that of the Greek system.

v. The research would be applied in more than one school situated in different areas of the town. Thus, both appropriate and necessary apparatus and children's working materials would be provided for all the schools.

Taking all these factors into account it was imperative that the project to be chosen should be radically different from the Greek one, give another dimension to the teaching of Mathematics and perhaps be preferable to the pupils' manual. Thus, we excluded those English projects which made use of books, quite often less impressive than the Greek ones, as well as those which proved to be very good but implemented a great deal of very expensive apparatus. Furthermore, at the time when the research was being decided, a general enthusiasm for more individualized approaches and a tendency towards a card-based project on the teaching of Mathematics, namely SMP¹, prevailed in England.

During my teaching practice experience, I was given the chance to get acquainted with the SMP project and was alerted to its integral advantages.

b. Some specific characteristics in relation to SMP.

The School Mathematics Project:

i. does not use books, but employs cards which are very attractive and illustrated with characters² familiar to the pupils.

ii. is specifically suitable for mixed ability classes. It allows for both the very bright pupils who have the chance to work at their own pace and for the weaker ones who could make use of the easier cards and proceed according to their own achievement level.

iii. enables pupils to benefit from the experience of their schoolmates who have already completed satisfactorily the same cards and thus are able to pass this knowledge on to the other children through discussion.

iv. offers satisfaction to all pupils as the brightest ones do not get bored by having to wait for the others to catch up and the less able ones are far less frustrated as they do not have to measure their progress against the rest of the class.

v. is concerned as much with the way in which pupils learn, as with what exactly they learn. Mathematics is much more than a body of knowledge. It is a way of thinking. This attitude of mind lasts long after the actual facts have been forgotten. So it is often the process and not the content itself that must be emphasized.

vi. equips pupils with a sense of responsibility; it is up to them to decide the topic and the number of cards that they will complete in a school hour.

vii. reinforces pupils' self-confidence by giving them the opportunity to move freely in the classroom, while it introduces them to the idea of co-operative work.

viii. helps children to understand the various mathematical concepts by using concrete examples through the use of mathematical apparatus. Alternatively, when pupils use the Greek manual, they deal with nothing but abstract material. Therefore, if the children are to cope with the latter approach, they need to possess a high ability level in order to interpret the presented information and respond to the questions given accordingly.

ix. teaches pupils how to explore, thus furnishing them with an important skill if they are to appreciate the significance

of more formal Mathematics they will be confronted with during later stages of their schooling.

x. helps pupils grasp mathematical concepts by using their intuitive thinking and then, once the concepts are understood, they are given practical work to consolidate them.

For all the afore-mentioned reasons SMP was envisaged as the most suitable approach amongst others considered and as the most appropriate project for the conditions under which the research would take place.

The Greek version of the cards.

One of the first problems we had to deal with was that of the adaptation of the cards into Greek and their subsequent production. The difficulties encountered were of both a technical and functional nature.

a. Difficulties associated with technical reasons.

The main concern was to produce the Greek version of the SMP cards as similar to the English version as possible. Two possibilities were feasible:

- i. To produce absolutely new cards, made of exactly the same material and keeping the format of the original English ones.
- ii. To make use of the original SMP cards, after adapting them so as to serve the Greek school needs.

Important factors pertaining to the production of the cards were the cost involved as well as the technical perfection required so that the quality of the original cards could be retained.

Although at the beginning the first alternative seemed preferable, on second thoughts it proved impracticable because of the reasons mentioned below:

i. For the production of the cards we needed the same quality card-board of the model card. A small market research, however, proved that the same quality card-board, if attainable at all, would raise the cost of the production extremely high.

ii. The type-setting in Greek and the card illustration in two colours, black and red, were certainly attainable but it would take a lot of time, on the one hand, and the cost would be high, on the other, due to the limited number of the copies needed.

iii. Had the cards been entrusted to a printer to produce, there would have been no means of controlling the production. Therefore, the card quality might be appropriate but the production would take too long, so that the research might not begin on time.

Bearing all the above in mind, it became quite obvious that in order to achieve for the Greek version of the cards the quality and appearance level of the model cards would be a hard task. In any case, the total cost of the production would apparently be very high and the time needed for its completion could not be directly controlled.

Having rejected the first possibility the second one was examined very carefully. The idea to use the original SMP cards after replacing the English text by the equivalent Greek one seemed like a good solution.

To accomplish this, different approaches were tried out:

1. The English text was covered with white paper on which the Greek text was written in handwriting. Although the intention had been to give the children the impression of something natu-

ral and familiar, the result was unacceptable. The handwriting was certainly not so formal and it was nearer to the children's own writing. At the same time, however, it was very much off-hand and times not readable.

ii. The English text was covered with strips of white paper on which the appropriate Greek text had been typed. The result was again not quite satisfactory. The typewriting was very different from that of the SMP card letter-characters and the strips on the cards were a poor substitute of the original text.

iii. The Greek text was written with LETRASET. An effort had been made to find the same characters as those used on SMP cards. Then photostated copies of the text were made on a particular smooth, greyish, quite thick paper. Of course, the quality and colour of the paper were selected with the original card always in mind. The SMP card was of a smooth surface also and the grey colour, being so clearly distinct, was preferred over the white because numerous trials proved that the same white of the model could not be achieved. Finally, the strips used had to coincide with the exact length and width of the text of each one of the cards.

The latter approach was considered as the one yielding the best aesthetic results. The appearance of the card was sufficiently good, it might actually be taken for the actual model by somebody who did not know the original English version.

Nevertheless, the pleasant aesthetic effect was not the only factor weighing for the adoption of the chosen procedure. The fact that the time duration of the production could be entirely controlled and also that the cost, although still very high, was considerably lower than it would have been in the case of commercial production were decisive reasons too.

Functional difficulties.

Having decided upon the form of the Greek version of the cards, the question of the number of the cards to be produced arose. According to the study design, during the pre-pilot study the children would use appropriate worksheets rather than cards. For the pilot study, the children of one class would form four groups and make use of the SMP cards. For the purposes of the main study, the children of three second classes, in three different schools would employ the cards in exactly the same way as the children in the pilot study, unless, of course, the results of the pilot study dictated a different approach for the main study.

With the above facts in mind, it became obvious that no matter whether the children were divided in groups or not, the cards of one box only would be insufficient for the whole class, considering that they would work on them simultaneously. The problem would become even more acute if the children were actually divided into groups. It would then become imperative for each group to have their own box of cards, so that a lot of unnecessary and time-consuming moving to and fro could be avoided. Even if the children of each group started off from a different topic and did not work at the same pace, it would certainly happen that two or even three children would demand the same cards at the same time.

Finally, the children, either out of enthusiasm for the project or competition among them might ask to take some of the cards home. In this case, if there were only one box of cards available, this opportunity would be lost to the children. In any case, we would risk to either lose some of the cards or have them forgotten and left at home, and in either case our work at school would be extremely difficult.

It was, therefore, decided to have four series of cards prepared for each of the three classes. The question arose whether four series of the original SMP cards should be ac-

quired and used or photostated copies should be used instead. Even if the children were divided in groups and each one of them used a box of its own we still ran the risk of facing misunderstandings and quarrels, in case some of the groups happened to work from the photocopies and others from the original cards which were undoubtedly more popular.

In the end it was decided to use four series of the original SMP cards for the pilot study. They would be completed with the cards of sections 2 and 3 later on, so that they could serve the main study purposes along with eight additional complete series of cards. The prospect, however, of using photocopies to cover the main study needs was also considered.

Reasons for the choice of seven-eight year³ old children for the purposes of the study.

For the purposes of the research it was decided that the second box of the SMP cards (the orange box) should be used with a second class of the Greek primary school.

The choice of the second class in preference to the first or alternatively one of the older classes was dictated by a number of reasons.

i. The first box of SMP is addressed to 7⁺ year old children. The children in Greece first go to primary school at the age of 6, so the content of the first box should be suitable for second class children.

ii. The SMP cards sometimes employ a long and difficult text that the pupil has to read in order to answer the questions or to solve the problems. It is, therefore, assumed that if a child is to use the cards, he should be able to read fluently, otherwise he would have difficulties in understanding the text. In England the statutory age of admission is five and therefore children have two years of schooling before starting to use the SMP cards. In Greece nursery provision is not compul-

sory and children are taught neither to read nor write at nursery schools. Now as far as Mathematics is concerned, only during the last two or three years some basic mathematical concepts have been introduced through the use of appropriate activities. Consequently, children do not know how to read and write when they first go to primary school, thus the first class pupils were excluded from this research. Furthermore, even in an English school, SMP is unlikely to be applied in a class, unless the children have already been introduced to the basic mathematical concepts through the use of another method usually designed by the school itself.

iii. In the first class of a Greek school the whole of the first term is consumed with children's efforts to adjust themselves to their new environment and to come to terms with the rules and obligations of school life. So even if the previous reason (ii) had not existed, a whole term would have been wasted for the children to adjust to school life.

iv. If one of the older classes was chosen instead of the second class, the children would then have had to use the box of cards corresponding to their age which, of course, could not have been the first one (orange box). In each box, however, the knowledge of certain concepts, symbols and expressions used in previous boxes is taken for granted. Each box, therefore, comes in succession to the previous one, while preparing the ground for the content of the next one. It was also the structure of the project, therefore, that dictated the use of the first box of SMP and thus determined that the second class should be the field of application.⁴

v. It may be argued that the children at an early age (seven-eight) are more receptive, more open to accepting changes and to cooperating in new teaching approaches.

Although they have been conditioned to the school environment and they have adapted their behaviour to its regulations and demands, nevertheless, they have not fully identified them-

selves with it and are open to new ideas. Liveliness, enthusiasm and independence are characteristics of their age, but they get easily tired of an activity that lasts long or is repeated too often. It is natural then that the traditional way of Mathematics teaching is sometimes boring and lacking in interest for these children and, therefore, the idea of a change excites them.

vi. The older children having experienced the particular educational system for over two years have presumably almost identified the various subjects with the corresponding teaching methods currently in use. The existing teaching scheme eventually becomes the only possibility and the lesson is identified with the particular approach which is applied with little or no change throughout their years at primary school. Thus, the older children gradually adapt to the system and become more practical and possibly less imaginative. Any change that threatens the established patterns shakes their sense of stability and self-confidence.⁵

The aims of the study.

The main purpose of the research was to examine the possibility of using an individualized approach in the teaching of Mathematics in Greek primary schools.

The children's ability to adjust themselves to the new method and their subsequent progress in Mathematics alone would not influence the decision of its introduction to the Greek school. Their behaviour and reaction to the programme would be of equal importance. Therefore, their participation in the lesson, their enthusiasm or work satisfaction, their initiative and spirit of cooperation would count as much as their progress in Mathematics.

Another purpose of the research was certainly to assess the two different methods of Mathematics teaching. On the one hand,

the method in practice for years was based solely on text books. Little or no use of apparatus was made and no consideration was taken what so ever of the individualized needs of the pupils. It was the product of a strictly fixed curriculum and centralized educational system. The SMP, on the other hand, was a highly individualized method. It relied on the use of cards and apparatus and attempted to supply children with basic mathematical concepts and skills allowing them to work at their own pace and ability level.

A further aim of the research was to examine the differences in mathematical performance between boys and girls as well as the various competence levels achieved by the three experimental groups of the main study.

The population from which the sample was drawn.

The research was designed in three stages: the pre-pilot, the pilot and the main-study. The target population involved second class pupils of Greek primary schools. The sample was selected among primary schools of greater Thessaloniki.

The total number of the primary school children in Greece in 1983, the year when the research started was 880,753. The total number of the second class children was 148,044. The corresponding numbers in the city of Thessaloniki at the time were:

Primary school children: 71,661

Children attending the second class: 12,210

The sex distribution of the above numbers was:

a. In the Elementary schools of Thessaloniki:

Boys: 36,783.

Girls: 34,878.

b. The total number of the second class pupils:

Boys: 76,365.

Girls: 71,679.

c. The number of the second class pupils in Thessaloniki:

Boys: 6,304
Girls: 5,906

The sample

The sample was small in all three stages of the study and was selected by the researcher for the first two stages, pre-pilot and pilot, whereas the L.E.A. suggested the schools of the main study. The nature and aims of this type of study certainly demanded a larger sample, nevertheless the circumstances under which the investigation was conducted gave no alternatives.

The main reasons which dictated the particular size of the sample are outlined below:

- a. This particular project was suggested by an individual researcher and not, as it is usually the case, by a formal research group normally formed and appointed by the Ministry of Education.
- b. Being the task of one person only and not of a team of teachers-researchers, the research lacked the versatility of group work.

Thus the sample used was eventually made up of:

- a. six children of the experimental school, readily available and willing to cooperate at the pre-pilot stage of the study.⁶
- b. twenty four children, a whole second class in a state school selected from several proposed schools in the same area and served the needs of the pilot study.
- c. fifty seven children of three schools, in three different areas of the town were selected by the L.E.A. to serve the purposes of the main study.⁷

Organization of the study.

It was decided that the research should be conducted in three stages: the pre-pilot, the pilot and the main study.

a. The pre-pilot study was carried out with the help of six children only in one of the two experimental schools of the town and was extended over a period of three weeks. The SMP cards were not used in the pre-pilot study. The children were taught some selected topics extracted from their own syllabus through the use of worksheets.

The purpose of the pre-pilot study was to test the new teaching approach and also get some indications of the pupils' reaction to it. Having assessed the findings of the pre-pilot study we proceeded to the pilot study.

b. The pilot study was conducted with a class of twenty four children in the 11th state school of Thessaloniki for a whole school term (twelve weeks). The first section of the SMP cards served the project's needs. The pupils were divided into four groups according to their ability in Mathematics. They were given a test based on the syllabus they had been taught before the application of the project and at the end of the term they were given another test on the material covered by their own books.

The pilot study was a small-scale model of the proposed main research project and it included a few mathematical topics only. Nevertheless, the results of its application indicated certain changes later adopted in the main study.

c. The main study was applied in three schools suggested by the L.E.A. and were so chosen as to represent the middle class, in the town centre, the working class and travellers' children.

in a suburban area and a mixed population in a rural area (a small village not very far from the town).

The study was extended over the whole year 1985-1986. The same procedure was followed in all three schools with the exception of the school in the suburban area which presented some peculiarities.⁸

Assessment tests based on the SMP original ones were given to the children on completion of the relative sections. Additionally, during the year, the children were given tests on the syllabus they had been taught both through the Greek teaching system and the use of the SMP cards.⁹

At the end of the year, questionnaires were distributed to the pupils, parents and teachers involved in the study in order to sample their opinions and to ascertain their feelings about the newly introduced Mathematics project.

PRE-PILOT STUDY

The pre-pilot study was considered essential for the purposes of the research, since it would serve as a small scale model of the project, only with the participation of a few pupils. It would allow us to consider the necessary changes and improvements to be made before deciding upon the time, money, resources and personal involvement required in order to carry out the main study. It was regarded as a useful indicator of both pupils and teachers' reactions to the suggested project, as well as the possible alterations of the approach needed. Introducing the new approach would provide opportunities to observe the behaviour of the pupils, their difficulties with the apparatus and their understanding of mathematical concepts. The children's enthusiasm or caution, the comments they made, their success or failure to understand and to follow up the notions included in the teaching material would be exhibited during this period. It could, finally, alert us to some of the problems likely to occur during the main study, thus offering a qualitative evaluation of the new mathematical approach.

The selection of the pre-pilot sample.

According to the study design, it was intended that the sample, as well as the period of time each of the next stages would last, would increase. It was, therefore, decided at this stage to work with a very small sample for a short time. Thus a small group of six second-grade pupils of the experimental school served the purposes of the pre-pilot study.

At the beginning, it seemed like a reasonable idea to find six second-grade children of the researcher's acquaintance and conduct the pre-pilot study in an at-home situation. The children could gather at the researcher's house twice a week and be taught Mathematics from the worksheets specially prepared for this stage of the study. However, at the prospect that this initial suggestion might induce a number of difficulties, other volunteers were sought. An attempt was made to find a small

group of pupils either in the class of a teacher who would not object to having her programme disrupted for three weeks or more, or in a school where the principal would be willing to support the research. Thus, eventually, the one-class experimental school was chosen to serve the pre-pilot study needs.

The selection of the sample was dictated by the needs of the study but also the limitations and the obligations of the formal procedures to be observed in the course of the research.

In order to apply the study to a school a ministerial permission and the L.E.A.'s agreement had to be granted. An application for the pilot study school had already been submitted to the Ministry of Education. While expecting the Ministerial permission, though and quite pressed by time (the school year 1983-84 had already started) it was decided to proceed with the pre-pilot study taking advantage of the available sample.

The population from which the sample was drawn.

The pupils of the experimental school were all randomly selected. The procedure followed every year in order to select the pupils of the first grade is somewhat unusual. Interested parents write formal applications to the school. A drawing of lots, where parents may be present, follows and the children that are drawn are allocated to the first classes of the different schools. The pupils who are thus selected for the first class come from different areas of the city and not only from the one where the school is situated.

It is generally believed that the experimental school offers schooling of higher standards. This implies that the parents who take the trouble to bring their children to this school, no matter how far away they may live, are very sensitive about their children's education, and try to help them in any possible way. Thus, one could presume that the social background of the average pupil of the experimental school is rather better

than that of other pupils. If we accept that the social background affects to some degree pupils' cognitive development and educational progress it is then probable that the pupils of the experimental school come to school better prepared to start this new important phase of their lives than many other children in the town schools.

The reasons why the particular school was selected.

The one class experimental school of Thessaloniki was chosen as appropriate for the pre-pilot study. The reasons for the particular choice were.

a. The school was attached to the Teachers' College and it was to this school that the students of the college were assigned for their teaching practice.

By the time this first stage of the research was to be carried out, I had been appointed as the Mathematics specialist at the Teachers' College. The experimental school and the Teachers' College shared the same playground. The fact that school and college were in such close proximity certainly added flexibility to my own programme. That is, it made it easy for me to visit the primary school, even during a break between two sessions at the Teachers' College.

b. The experimental character of the school implied that it would be more open to changes in its curriculum and teaching methods, more progressive, that is, than most schools in town.

c. The teachers were expected to be better qualified and more innovative than other teachers in the non-experimental state schools. The fact that very often the students of the Teachers' College attended their classes or practised in their classrooms normally affected them in adopting a more progressive form of organization.

d. The pupils were familiar with more flexible teaching methods so they would supposedly accept an individualized approach in Mathematics more readily.

e. There were only six pupils in the second grade, an ideal number for the pre-pilot study. In an "ordinary"¹⁰ school the individualized project could be applied to a group of six children while the rest of the class would continue with their Mathematics manual. Of course, such an arrangement could be disappointing for the pupils who would be excluded from the new project, apart from posing problems to the experimental group who might become retarded in their normal curriculum demands.

f. It was expected that the teacher of the experimental school would be more co-operative than teachers in other schools. The presence in the classroom of another teacher who would occupy all the pupils of one class for a teaching session, leaving only the pupils of the other three classes to him, would help rather than inconvenience him. Furthermore, it would be beneficial for the pupils as they would have more of their teacher's help and attention.

The preliminary visits to the chosen class.

After the school and the class were chosen, some preliminary visits were considered necessary in order to explain the aims and content of the study to the teacher of the class and arrange the circumstances under which the study was expected to take place. Moreover, the visits gave the researcher the chance to contact the children who would participate in the research and familiarize them with the teaching method to be followed. The teaching hours and days, as well as the concepts to be taught were also decided.

During the preliminary visits it was discovered that the pupils had just been taught fractions from their manuals. Their teacher, however, judged that the topic had not been completely

comprehended by the children, who, moreover, found some concepts particularly difficult. Nevertheless, under the pressure of the syllabus he was obliged to proceed, he had no extra time, that is, to scrutinize the particular unit. Fractions then was a suitable subject to be taught using the new approach. Thus, not only the children would benefit from the revision, but the effectiveness of the method could be tested as well. Since the children would have the experience of being taught the same subject through two different teaching methods, their reactions would offer grounds for comments and conclusions.

It was eventually decided that fractions would be taught for three and not for two hours a week as it had originally been planned. The unit on Time was to be prepared to follow the teaching of fractions in case the continuation of the research for three weeks was feasible.

The procedure followed during the study.

Having decided that the topic to be developed was fractions, one week only was left to prepare the necessary teaching material. It had already been decided that the pre-pilot study would be taught through worksheets and not through the original SMP cards. Since the time available for the preparation of the teaching material was extremely limited it was decided to employ the use of worksheets on the particular subject from various Greek and foreign books. The content would, of course, be translated and revised if necessary.

The application of the study (syllabus, material and teaching method).

The pre-pilot study was eventually applied for a total of three weeks and for three hours weekly, on Monday, Tuesday and Thursday. The first two weeks were devoted to the teaching of frac-

tions and the last week, during which continuation and consolidation of fractions had been intended, to the topic of time. The teaching was carried out in the same classroom the children used daily, the children of the three other classes being taught by their teacher at the same time.¹¹ The arrangement of the desks was such as to form three different groups. No rearrangement was necessary, since the researcher was able to sit among and work along with the sample group.

The teaching procedure was designed as if the children were to be taught the relative concepts for the first time. That is, it was not taken for granted that the children had already been introduced to the subject so that the research would attempt to continue with a deeper examination of the already taught concepts. A fresh start was made which covered the book syllabus plus some additional material.

The teaching strategy involved the use of every day objects and exploited real life activities in an effort to facilitate the pupils to figure out mathematical notions and acquire mathematical skills. All the pupils were engaged in all the proposed activities and were free to take as many worksheets as they felt competent to fill in. Thus each child's varying skills and competence level was taken into consideration.¹²

Decisions derived from the pre-pilot study.

The object of the pre-pilot study was not to test the SMP itself as teaching material but as a teaching procedure. The decision to continue the research would be based on the pre-pilot study findings.

At the end of the pre-pilot study, we were in a position to claim that the children's reactions were positive. They obviously enjoyed being taught Mathematics in this way, they took the lesson for a game. They all wished the research to con-

tinue and pleaded with their teacher to apply the same approach in their routine Mathematics lessons.

The children's reactions to the research encouraged us to proceed with the pilot study bearing, however, in mind that the conditions under which the pre-pilot study was carried out were almost ideal¹³ and we should not expect to encounter the same working conditions for the pilot study, too.

PILOT STUDY

On the 18th of August, 1983, an application was submitted to the Ministry of Education (Research Centre of Secondary Education), asking for permission to teach Mathematics through the SMP method in the second class of a primary school of Thessaloniki, preferably the 11th school.

My wish to carry out the research over a two term period was included in the application. On 3rd November, 1983, the Ministry approved my request to carry out the research and appointed the 11th primary school for the purpose. The research was to be conducted under the following conditions:

1. It would last for the whole second term and occupy the children for two of the four hours allotted to Mathematics.
2. Under no circumstances should the research disrupt the school routine.

On 9th January, 1984, the document in question was signed by the Ministry of Education, so the research started in the middle of January 1984.

The design of the pilot study.

Having acquired the necessary permission and because the second term had already started the immediate application of the study was considered imperative.

It was decided to divide the pupils into four groups so that each group could start on a different topic.

Four series of the first section of the SMP original cards were prepared to serve the needs of the project.

The necessary apparatus was secured and four preliminary visits to the school were programmed. These visits aimed at acquainting the researcher with the working conditions, the teaching staff and the second class children and teacher who was to take part in the research. A common test on Mathematical material taught up to that time would be given to both second classes of the school at the very beginning. After the completion of the pilot study both classes were to take another common test on the material they had covered regardless of the SMP method and terminology. In addition, the class that had participated in the research would take the SMP test on the first section. Also, on completion of the research, the children involved in the research and their parents would be asked to answer prepared questionnaires.

A meeting was planned with both second class teachers in order to familiarize them with the SMP objectives, to hear their personal views on the function and efficiency of the system and to discuss the possibility of adapting the SMP approach to the Greek primary school.

Preparing the cards.

It was decided for the pilot study to employ only the cards of the first section. The procedure of preparing and producing the Greek version of the SMP cards has already been described.¹⁴ Although all 171 cards of section 1 had been prepared, not all of them were used for the reasons mentioned below:

a. The cards from 1-7 to 1-40 that deal with addition were excluded. These cards use multibased approaches (Base 3, 4), so it was judged that they would rather confuse the children who had already got used to the denary system; besides the multibased approach was not included in the second class syllabus.¹⁵ Therefore, it was decided that concerning the addition only the exercises based on the denary system would be used.¹⁶

b. The cards 1-40 to 1-50 were also exempted, because the exercises included in these cards made use of four-digit numbers. Again according to the Greek syllabus for the second class the children are taught to operate with numbers up to the first hundred. Since they were containing facts with hundreds and thousands, these cards were excluded from the study.

c. The cards 1-37* up to 1-40* were excluded as containing four-digit integral numbers.

Thus the box was presented to the children with 123 [171-(34+10+4)] instead of the 171 cards of its English version.¹⁷

The cards were protected by transparent, plastic cases and placed in four open-topped, plastic boxes, one for each one of the series.

Preliminary visits to the school.

Four preliminary visits to the school were sought so that the researcher might become familiar with the school, the Principal, the teaching staff and of course the children and teacher of the second class and explain to them all what the purpose of the study was and what it was to implement.

During these visits the Principal appeared very understanding and obliging. He promised to arrange for the research to be applied in the class of the teacher who held modern educational attitudes and was thus likely to foster an innovative approach. Also, he did not fail to mention the unsuitability of the building and other facilities of the school, a fact that certainly did not favour conducting that type of research.

By contrast the teaching staff appeared rather reserved and reluctant to get involved in the new project. They did not seem

to understand the implications of the new project, what was being requested and also the possible benefits that might result.

The class teacher was open in attitude and she became very co-operative as soon as she was assured that she would not share any of the responsibility for the research work. She warned the researcher that the children were very naughty, their ability level¹⁸ was around the average and she expressed her doubts about the children's suitability as a sample.

In the course of these visits, in one of their routine Mathematics lessons, it became apparent that the children were rather fidgety and noisy, some of them did not join in the lesson at all, while others tried to monopolize the conversation or their teacher's attention in any way they could.

The lay out of the classroom was unsuitable for conducting the particular teaching method. At the back of the classroom there was a free space which proved quite convenient, because there, after rearranging the desks, we could place the cards and the apparatus during the lessons. In addition, there was a cupboard where the material could be secured for the time between the two lessons.

During these visits, the days and hours when the experimental lessons could be conducted were arranged. Since the class teacher did not object to the researcher's proposition to take up three of her four hours on Mathematics a week, at least for the beginning, it was agreed that the children would be taught from the SMP cards every Tuesday, Thursday and Friday of each week. At the same time, the class teacher rearranged her timetable, so that the children could attend their ordinary Mathematics lessons regularly. The proposition to apply a kind of co-teaching to the class found no positive response.¹⁹

In the course of the preliminary visits, the researcher, after discussing the children's competence in Mathematics with their teacher, divided the children in four groups.²⁰ Two teaching

sessions were devoted to explaining the new teaching project and the use of the apparatus to the children. During these two hours the desks were rearranged in order to form four separate sets for the four groups of children accordingly. The four groups were introduced to the respective four topics.²¹

Organizing the lesson.

Having decided to try group teaching we were obliged to move the desks and chairs during the break before each lesson. As soon as the lesson finished, desks and chairs were put back and children resumed their original places. The constant alterations to the classroom lasted for three weeks, only to give way in the end to the traditional furniture arrangement.²²

The tests given to the children.

It has already been mentioned (p.103) that in the course of the pilot study the children took three tests:

a. The first test: On January 23, 1984 and before starting carrying out the research the children of both second classes were given a test. The test was based on the material covered from their Mathematics book and was common for both B1 and B2 classes.²³

The purpose of this test was to assess the children's ability level and to mark out any differences in the competence of the children of the two classes. Moreover, the results of that test could be compared with the results of the final test²⁴ in order to measure the B1 children's progress in Mathematics.²⁵

b. The second test (based on the book)²⁶: The second test was given to the children of B1 class in April, before the Easter holiday and to the children of B2 after the holiday. It was based on the material the children had covered from their

books up to the moment the test was given.²⁷ The language of the exercises as well as the way of their presentation was that used in their books.

The object of the test was to assess the children's progress in Mathematics for the time the research lasted and to observe the difference in their competence level as shown through the two tests. A difference in the aptitude level of the two classes would possibly indicate the positive effect of the SMP method on the children.

c. The third test (based on the SMP cards). This test was given to the children of B1 only.²⁸ The objectives of the test were to decide the extent to which the children had assimilated the concepts taught from the cards, to mark out those units that gave most of the children difficulty and to find out the degree of their familiarity with the terminology and language used by the SMP project.

As expected not all the children had finished every card of the first section and, moreover, not all of them had covered the same topics. The test on SMP was uniform for all pupils regardless of the material they had covered. Naturally, it was stressed to them that they were not supposed to answer the questions based on topics they had not been through.

The questionnaires.

At the end of the pilot study the children and their parents were required to complete questionnaires. The object of these questionnaires was to measure the extent to which the children enjoyed working on the SMP project, what they particularly liked or disliked in the card work and to collect the parents' views concerning the system and its impact on their children's progress in Mathematics. The children's questionnaires were completed in class, whereas those of the parents were sent home to be filled in and were brought back to school by the parents

themselves on the day they were invited to attend a discussion on the research. In the course of that discussion, the teaching method and procedure of the study were analysed. Moreover, the assumptions drawn by both parents and teachers concerning the children's responses and reactions to the system were investigated.

MAIN STUDY

The permission for the application of the main study.

After the completion of the pilot study, the continuance of the research (during the school year 1985-86) was deemed worthwhile. A ministerial permission, which was a prerequisite, was granted as a renewal of the previous one and provided the same conditions were observed.²⁹

It was considered necessary to apply the main study to more than one school of Thessaloniki and in various areas of the city inhabited by different social class residents. It was thus decided that the schools involved in the research should be situated in areas representative of the middle, working and rural class people, if possible.

Having secured the ministerial permission for the study, we next contacted the L.E.A. of Thessaloniki to seek their permission to apply the research in more than one school and to determine the particular schools that would help us with the study.³⁰ The primary school board, assuming a very positive and helpful attitude towards the research, made a point of arranging for at least two of the schools to be situated in the same direction of the city and with the same hours of operation.³¹ Thus, and after contacting the teachers of the particular classes and securing their agreement for the research, it appeared possible for only one person to carry out the project.

The selection of the sample.

The main study involved a total of fifty-four children from three schools situated in different parts of the city. The schools were appointed by the L.E.A. of Thessaloniki, provided that they complied with the conditions mentioned on p.102. The sample was selected by chance among schools of the same areas. Therefore, in the centre of the city (urban area), the

41st primary school, with 25 children in the second class was chosen.³² The suburb of Phinikas was selected as a representative working class area and the school appointed was the 9th, with 17 pupils in the second class.³³ The three place school of Aghia Triada village, with 15 pupils in the second class was chosen as the rural area school.³⁴

Preparation of the teaching material.

It has already been mentioned (p.102) that for the purposes of the pilot study four series of the first section cards were prepared and used. Now concerning the main study, the three schools involved in it would be located in three different areas of the city. The study would last for one school year and since an integrated day approach was inapplicable, the tentative number of children in each class would be about twenty five. It was decided that the children would be allowed to take cards home and work there, if they expressed the wish to do so. This intention, however, along with the difficulties that were bound to emerge from carrying around the material from school to school, dictated the need of preparing separate cards for each school. Such an arrangement would hopefully solve the problem of their transportation, while allowing the pupils to take them home, whenever they wished to do so.

The pilot study experience suggested that it would be unwise to divide the pupils into separate working groups. Supposing, therefore, that each class would have approximately twenty five pupils, it was estimated that the content of one box would not cover the needs of a class. It was thus decided to provide each class with at least four boxes, so that four copies of each card would be available. Moreover, provided that two pupils would share the same card, it became obvious that, if necessary, eight children could work simultaneously on the subject of the same card. Finally, taking for granted that not all children would start working on the same subject³⁵ and that they could not proceed at the same pace, four boxes of cards

for each class were considered enough. Twelve boxes, then, would suffice for the three schools. Four boxes had already been prepared to cater for the pilot study needs. Therefore, it was necessary to prepare only the cards of the other two sections of the box. In this way, four complete boxes with the original SMP cards would be ready for use for each one of the schools and eight more boxes had to be provided.³⁶

It was deemed exceptionally difficult, very expensive and time-consuming to use the original SMP cards for the purpose again. It was, therefore, decided that the solution that would best meet the needs of the research was to produce photocopies of the cards; they would cost less and be ready more quickly. Having settled that, the options examined were to produce the photocopies on plain paper, on white cardboard, or on coloured cardboard.³⁷ The first option was rejected without giving too much thought to it, as the plain paper cards would have seemed trivial, could not have retained the original impression of the card model and would have posed difficulties in their use.³⁸ Of course, the photocopy could be stuck on cardboard and then cut to the size and shape of the SMP card. Nevertheless, without being markedly different from the second option, this procedure would have demanded more time, effort and money.

The second possibility was also discarded, even though it offered a very good format. It was noticed that even if the photocopy was rather similar to the original card, it still lacked tremendously in appearance. Isolated it seemed almost perfect, but when compared with the original card it looked like an unsuccessful imitation, a bad replica. Eventually, it was concluded that the photocopy had to be on cardboard on the one hand but differ widely in appearance, on the other. Thus, the third option was adopted. Three full series of photocopies were produced in blue, pink and yellow for the three schools respectively.³⁹ The original SMP cards were put in plastic cases in order to be protected. They ran a high risk of being destroyed, since the Greek text was often glued on them and in case of damage they were almost irreplaceable.⁴⁰ It was judged

unnecessary, though, to protect the coloured photocopies with plastic cases, as the cost of producing such a photocopy was lower than the cost of a case.

The series of cards were placed in plastic open-topped boxes.⁴¹ Twelve full series of cards had already been produced for the first and second sections, but for the third section each school lacked one series of cards. The thought behind this decision was that only a few children would reach this point and therefore, the demand for third section cards would be limited. Besides, in case the available cards were proved inadequate, it would be a very easy and quick matter to prepare new ones. It was also decided to ask children to take home the photocopied cards and not the original ones. Finally, the apparatus necessary for the project was prepared, so that it would be ready for the children to use from the beginning of the research.⁴²

The possibility of removing the card boxes and apparatus from each school at the end of each teaching session was considered from the very beginning. This, of course, would be the last alternative in case there were no proper storage space in the classroom. They would run a high risk of being destroyed, if used without the teacher's constant supervision. Furthermore, the idea of leaving the apparatus and cards exposed was out of the question, considering that two different schools shared the same classroom.

The procedure used for the main study.

Before applying the project to the schools, it was considered essential to arrange some preliminary visits in order to get acquainted with the school environment and to inform the principal, staff and teacher of the second class, in particular, about the aims and content of the study. Moreover, at least two visits to the class involved in the programme were judged necessary, so that the children would become familiar both with the researcher and with the new way of work.

After these preliminary visits and before applying the project, the children would be given a test based on the Mathematics syllabus they would have covered from their manuals. The object of that test would be not only to determine the pupils' competence level and their weaknesses in Mathematics, but also to use it as evidence of the children's prospective progress, after they had been taught through the SMP approach. The observations deriving from a comparison between the two tests, the initial and the final, would simply serve as an indication and not as a proof of the positive or negative effect of the use of SMP on the children's progress.⁴³

After the preliminary test, the children would be taught through the SMP cards. To this purpose, they would be divided in three or four groups, depending upon their total number. The groups would be formed by chance and would not be determined by the children's capacities in Mathematics. Each group of children would start working on a different topic. The pupil who would have completed all the first section cards would have to take the SMP test for section one and would continue with the second section cards. At intervening times, the children would be given various tests based on the cards they would have already completed, in order to check their understanding of the completed work. Finally, the children, parents and teacher of each class would be asked to complete questionnaires, concerning their impressions and views of the new system of Mathematics teaching through the use of the SMP cards.

The preliminary visits to the schools.

Before starting the research two preliminary visits were paid to each one of the three schools.⁴⁴ The purpose of these visits have already been mentioned (see p.104 above). In addition, during the first visit the principal's consent for the application of the research to his school was secured. It was also he who, after a common agreement between himself and the

staff, appointed the class that would participate in the research.

Also the class teacher was familiarized with the aims, content and teaching method of the project. She was assured that she would not be obliged to be present while her class was being taught, nevertheless, her presence would be welcome, since she could offer the children her efficient help. Finally, the teaching hours of the programme were fixed. The teachers of all three schools firmly rejected the idea of allowing the first hours of the day for the research.⁴⁵ They also stated that they preferred not to interrupt their lessons in the middle of the school day, so the only alternative left was to use the last hours of the day, which, of course, was not an ideal solution.⁴⁶ Additionally, the timetable had to be arranged in such a way as to allow the researcher some time to get from one school to another and teach in at least two of the three schools on the same day.

The second preliminary visit was devoted to the researcher's acquaintance with the school environment, as well as with the children who would participate in the research. The children were familiarized with the new project and teaching method. During those visits, it was speculated how the classroom could be best rearranged as to suit the demands of the research. Furthermore, the children were introduced to the way the teaching material should be used and the work procedure to be followed.

An opportunity was also given to the researcher to discuss with the teachers of the classes the children's competence in Mathematics. Some observations made during these visits revealed several common problems to all three schools, while some others concerned only one of the three schools. Thus, it was found:

a. The Principals' positive response to the research and their sincere efforts to provide at least the basic working conditions for the application of the scheme.

b. The somewhat reserved attitude of the second class teachers involved in the research. They were rather justifiably alarmed at the prospect of working on a completely unfamiliar material and teaching method. Therefore, naturally enough, they were dubious of the project's function and efficiency.

c. The inadequacy of all classrooms. It was judged that they were all far from ideal and none of them could provide the necessary conditions for the efficient application of the project. The arrangement of the desks, the lack of benches, shelves and drawers would unavoidably disrupt the children's work and provoke behavioural problems.

d. Teaching in groups was almost impossible to be employed, since each group would work on a different topic on Mathematics or on two different subjects, for example, Language and Mathematics, at each teaching session. In short, apply an integrated day approach where different subject areas are attended to simultaneously. To apply this method the teacher's consent and moreover, her assistance with the lesson had to be ensured.

Such a possibility was readily rejected from the very beginning. It was thought that unnecessary confusion might result in the daily programme and would also demand some effort of adjustment to it by both the teacher and the pupils, a process rather tiring, noisy and of doubtful effectiveness.

e. In the school of Phinikas the children's low level of ability was immediately marked out as well as the fact that some of them were completely illiterate. These pupils would likely cause problems when required to work on the cards. It was, therefore, inevitable to follow an alternative approach for these few children and treat them as a special case.

f. In the three-class school of Aghia Triada the first and second class children were taught together. We were, there-

fore, faced with the problems of keeping the first class children busy while the second class ones were engaged in doing Mathematics from the SMP cards. The teacher of the class rejected the suggestion that she might deal with the first class children, while the second class ones were busy doing Mathematics from the SMP cards.⁴⁷ Fortunately, we came up with a solution to this problem right from the beginning: the nursery school children left an hour earlier so their classroom was available during the last teaching session. It was, therefore, seen to be preferable to move the first year children to that classroom in order to let them do their lesson with their teacher undistracted.

The preliminary tests.

After the two preliminary visits to each one of the three schools, the children of all three schools were given a test as it had been decided in the original design of the teaching process (see p. 106). The exercises of the test were based on the syllabus the children had covered the previous year (first class) and the current school year (second class) and were all taken from the competence tests of their manuals. They dealt with concepts such as matching, money, tens and units, uses of symbols, horizontal operation of facts and problems on addition, subtraction and multiplication.

On the day the children took the test an opportunity was given to observe their behaviour and the difficulties they met in completing the paper.⁴⁸

Introducing the new approach to the children.

The children took the preliminary test at the beginning of October. After that test, and before the real work on the project started, a whole teaching session was devoted to ex-

plaining to the children the use of the apparatus and the teaching material.

Thus, during this introductory lesson the subjects of addition, time and length were mentioned and the children used apparatus to answer questions they were asked orally. They were also asked to pick up cards of their box or to put them back in order to get to know how to use the code number of each card.⁴⁹ After this brief introduction, the project started on a normal basis.⁵⁰

The tests given to the children during the study.

The tests distributed in the course of the main study contained either the same exercises or similar to the ones solved during the lessons. Some of the tests were prepared by the researcher herself and were either based on their manuals or the SMP cards. Again some others were translated into Greek and adapted to the Greek second class syllabus from the original SMP tests. Standardized tests or tests based on other projects were not given.

The tests distributed in the course of the school year were the following:

October test: The children took this test before the application of the research. It was based on the Mathematics syllabus already taught in class and was prepared by the researcher. It consisted of exercises found in their Mathematics manual; in fact, most of the exercises were taken from the book's competence tests. The objective of this test was to evaluate the ability level of the class in Mathematics and in particular, the extent to which the children had grasped and acquired the various mathematical concepts to which they had been introduced. Furthermore, after comparing the results of the first and the final tests, it would be possible to draw several conclusions on the children's progress. Moreover, the

subjects that the majority of the children found difficult to understand could be marked out.

End of the first term test: The test given at the end of the first term was based on the SMP material and was prepared by the researcher. Since not all pupils had covered the same material, six different test papers were prepared (A, B, C, D, E, F). Each test paper was addressed to the particular group of pupils the members of which had all covered exactly the same subjects.⁵¹ In these tests, exercises on subjects common to two or more groups were not necessarily the same. They expressed the same mathematical concepts and relations, but with different data.⁵² The purpose of the test was to assess the children's extent of comprehension of the concepts introduced to them through the cards and their level of familiarity with the terminology and symbols. In addition the subjects most difficult for the majority could be determined, so that they could be further explained and clarified.

End of the second term test: The test given at the end of the second term was based on the material taught with the SMP cards and was prepared by the researcher. Since not all the children had covered the same material, care was taken for the test paper to contain exercises on topics familiar to all pupils. The aims of the test were:

- a. to reveal those units that the children found easy and grasped readily
- b. to expose the concepts the children found difficult
- c. in case a lot of children happened to face difficulties on a particular problem, it was to be discussed and clarified further in class
- d. to give supplementary exercises to those pupils who encountered the same difficulties, so that they would be able to consolidate the various concepts and acquire the corresponding skills.

Tests on completion of section 1 (sections 2 and 3 correspondingly):

On completion of the cards of a section each child was required to take the SMP test corresponding to the section. The Greek version of the SMP test was identical to the original SMP tests, the only difference being that some exercises were exempted or replaced by others corresponding to the Greek syllabus. The object of these tests was to evaluate the extent to which the concepts given by the cards had been understood, so that the ones not fully assimilated could be revised and clarified before proceeding to the following section. Eventually, all the children filled in the test on section 1, a great number the section 2 test and only a few the section 3 one.⁵³

At the end of the school year the children were not given a common test. Since the test on the first section was the only one that all the children had taken, it was judged appropriate to use the results of this test in order to compare the children's progress and observe their responses and difficulties in working with the SMP cards.⁵⁴

Questionnaires.

Towards the end of the school year questionnaires⁵⁵ were distributed among the teachers⁵⁶, children and parents⁵⁷ involved in the research.

The children were asked to complete two questionnaires, one on their family background (number of children in the family, parents' occupations, etc.) and another about the SMP (what they liked, the difficulties they encountered, etc.).

The parents were asked to give their personal opinions about the project as they got to know it through the reactions and comments of their children, as well as through the cards and apparatus their children brought home.

Finally, the teachers' questionnaire was concerned with their aspects on the method (whether and how the children profited from the application) and of the possibilities such a project or some adaptation of it would stand to flourish in the Greek school. These questionnaires were to decide the children's, parents' and teachers' negative or positive responses to the method and to discern the units that were difficult or tiresome for the children, as well as those they found easy or particularly pleasing. Moreover, they might urge everybody involved in the project to express their reservations or/and objections to the system or the teaching method.

NOTES

1. School Mathematics Project.
2. See appendix C for an illustration.
3. Seven to eight year old children refer to a second class in the Greek school.
4. The application of the research in the second class was moreover determined by the regulations governing the research itself. It was necessary that the first box of cards should be used first, so that, in case the research in its first stage proved successful, it could be applied to subsequent classes.
5. Here, of course, there is something to be said for the opposite view. One could argue, for instance, that second class children have not yet got used to their new environment. They still feel insecure away from home, so they need to be in a place offering stability and a change of teacher and teaching methods would shake their newly acquired balance and make them feel diffident. On the contrary, older children, feeling tired of the same old method and environment would welcome the opportunity of a change.
6. A detailed description of the schools and sample is given in appendix A, pp. iii-lxvi.
7. For details about the various experimental groups see appendix A, pp. xxxvi, xlvi, lxv.
8. Description of the approach followed in this particular school and the reasons for its differentiation could be found in chapter III, pp. 138-145.
9. Details of these tests are available in appendix.
10. By the term "ordinary" we refer to every non-experimental school, that is, all the other state schools in town.
11. A detailed description of the classroom as well as the operation of the one-class school could be seen in appendix A, pp. ix-xiii.

12. Details on the procedure followed could be found in appendix A ,pp. xv-xxi.
13. a. There were only six pupils involved in the pre-pilot study, a number that allowed the researcher to sit at the same table with them during the whole session.
b. The teacher of the class was very cooperative and consequently the researcher's presence did not disturb but rather assisted him with his lesson with the rest of the class.
c. The children were used to sitting around a table and working in small groups quietly. They had also always been allowed to wander around in their classroom if necessary.
14. See pp.84.
15. In the Greek school system reference to other numeral systems except for the denary is made only in the fifth class and again very little time and only few pages of the manual are dedicated to this topic.
16. The SMP teacher's booklet itself referring to the two sets of cards on the addition leaves it up to the teacher to decide which of the two sets she will use always taking into consideration the policy followed and the apparatus available by the school.
17. Only a girl out of the twenty six children of the class finished all 123 cards and asked for more work.
18. Ability level determined by teacher's records.
19. The researcher's suggestion was to divide the children in 2 groups of 13 pupils. Group A would be taught Maths by the researcher from the SMP cards while group B from their books and by their teacher. In the next hour the two groups would reverse so group B would be taught from the SMP and group A from their books.
20. The children were divided in four groups, triangles, circles, rectangles and squares according to their competence in Mathematics. This evaluation was made on the basis of the children's ability on the material covered by their Mathematics book as well as their teacher's personal opinion.

21. The starting point of the research was signalled by the following topics: addition, subtraction, time and money. The groups that worked on these topics were the squares (seven children), rectangulars (seven children), triangles (seven children) and circles (three children).
22. A decision was made to return to the traditional furniture arrangement when it was realized that the changes attempted in the furniture lay-out and the pupils' positions did not yield the anticipated results, as they were proven to be too time-consuming and not particularly functional.
23. The second class of the 11th school was divided into two, so there were the B₁ and B₂ classes. The B₁ class would participate in the research while B₂ would proceed with its regular Maths lessons without coming into any contact with the SMP cards.
24. At the end of the term the children of both B classes were given another test on the material covered through the book and like the first one it did not make use of the terminology and exercises of the SMP cards.
25. Samples of the January tests can be found in appendix C, pp. xxiv-xxvi.
26. For a sample of the test see appendix C, p. xxvii.
27. The B₁ children had covered that material through both their books and the SMP cards.
28. For sample of the test see appendix C, p. xlii.
29. i. To avoid disrupting the regular operation of the class. ii. To teach the new project at the same time with the manual and in a relation of three hours a week from the book and two from the new project.
30. I would like to stress here the positive response, the understanding and spirit of collaboration exhibited by Mr. Karipides, principal of the Primary School Board of Thessaloniki during the school year 1985-86. Not only he accepted, but practically himself suggested the research to be applied in three and not only one school. He even thought that the three schools

should be situated in the same part of the city, something very convenient for the researcher who would be obliged to teach in all three schools on the same day. Considering, moreover, that schools operated from 8:30 to 12:10 and sometimes 13:00 (in case of five-hour lessons) and from 14:00 to 17:20 or 18:00 (again in case of five-hour lessons) and that the first teaching session was excluded for the research, one can easily guess that the time limits were very narrow. Furthermore, the researcher would inevitably take some time to reach the rural area school which was rather far from the city.

31. In the big urban centres with the serious problems of school housing almost all schools operate in two interchangeable cycles, one in the morning and another in the afternoon. Two schools, that is, share the same school building.
32. Details of the school and the pupils of the second class are available in appendix A, pp. xxxiii-xxxvi.
33. Information concerning the area, the school and pupils of the class are available in appendix A, pp. xlv-xlvi.
34. See appendix A, pp. lxii-lxvi.
35. Regardless of the children's competence, it was decided that they would be divided into three groups each one beginning with a different topic. Thus, a group would start with the cards on time, another with the cards on addition and a third with the cards on length.
36. As mentioned before (p.103), the original SMP cards were used for the pilot study, after they had been adapted to suit the Greek pupils' needs, even if their presentation was very much alike the corresponding English one.
37. In any case we would only obtain two colours (black-white), namely, we would be deprived of the red colour of the original version, since the cost of a coloured copy was much too high.
38. The soft paper would not stand up right inside the box and also the paper cards would get all mixed up, thus

making it difficult for the hasty and often awkward children hands to find the proper card.

39 The colours were chosen so that not only to please children, but be also bright enough to project the printed text.

40 The particular cards should be ordered from England, if, that is, only one item could be ordered separately and we would not have been obliged to order the whole series or at least the section to which the card belonged.

41 Not all cards were placed in the boxes from the very beginning. Originally there were only the cards of the first section. After several children had finished with the first section cards, two more boxes with the second section cards were put to use without withdrawing the first section ones. Thus, there were many more cards available for the pupils still on section one (four boxes now for a considerably smaller number of children) but also more boxes with cards (six in all) in the classroom. A little label was stuck on every box with the section to which its cards belonged.

Nevertheless, the children very often found it difficult to find the card they were looking for or were likely to place the card they had used in the wrong box.

42 All the necessary apparatus inaccessible in Greece were ordered from England (e.g., clock faces' stamps, uni-fix, coloured beads, etc.). Apparatus such as jugs, cups, egg-cups were bought in Greece. Some objects not available in Greece and impossible to be used in their English version were ordered and made in Greece (e.g., abacus, clock faces, etc.). The easily accessible materials (such as straws, counters, stamps) were available in each school and in such quantities that the pupils could take them home to work with, if need be. The other materials the number of which was limited, because they were either not easily obtainable (e.g., clock stamps), or too big to be stored in the classroom (e.g., cardboard boxes, jugs, glasses, abacus, etc.) were carried from school to school. Some apparatus

considered necessary by the original SMP version were eventually not used (e.g., the abacus with H.T.U.) as the Greek version abolished the cards for which they were necessary.

43. The children would be taught Mathematics from the SMP cards only twice a week, whereas from their manuals four times a week. Since, therefore, the subject would be taught by means of two completely different methods, it would be wrong to attribute the possible progress of the children to the positive effect of SMP, at least not on the whole.
44. The schools visited at the beginning of October were:
41st (in the town centre)
9th (at Phinikas)
1st (at Aghia Triada village)
45. The first two teaching hours were longer than the rest and they were usually devoted without any break to the instruction of Greek.
46. The last teaching hours, especially when the school operates in the afternoon, are shorter and the children are usually tired and fidgety. Naturally, any lesson at these hours is difficult.
47. It was considered impossible for two teachers to share the same classroom in order to teach two different subjects in the same teaching session for the following reasons: a. the first class children would be making a great commotion to let the second class children work in peace, b. the younger children not being accustomed to such a teaching scheme would ignore their subject-matter and concentrate on the action next to them; besides, the rich and attractive SMP apparatus would excite their interest and provoke them to use it.
48. A sample of the test is available in appendix C, p. xxxi. and the difficulties that the children were confronted with are mentioned in chapter IV.
49. Thus, the children practised "reading" the cards correctly. They should, that is, be able to use correctly the number referring to the topic where the

particular card belonged, as well as the order number of the card inside that topic.

50. The children's reactions, as well as the problems they faced on the first day of application of the programme are described in chapter IV ,p.136.

51. The topics that each of the tests covered were the following.

Tests	Topics
A	1, 2, 3, 4, 5, 6, 11
B	1, 2, 11
C	1, 11
D	1
E	1, 2, 3, 4, 5, 6
F	1, 2, 3

52. This process was followed in order to decrease the possibility of cheating, which would give a false picture of the class ability.

53. There are three SMP tests available, one for each one of the three sections into which the first box cards are divided.

54. Details on the results of the test and discussion on the findings are available in chapter IV, pp.182-198.

55. Samples of these questionnaires are available in appendix C , pp.iv-vii.

56. During the school year the teachers attended the lessons from the SMP cards several times and phrased their views and reservations about the project. At the end of the school year the research was discussed with each one of them. Details on these discussions are available in chapter IV , p.169.

57. The parents had the chance to express their opinion on the project and record their children's responses to it twice before during the school year, in the course of two meetings with the researcher. The parents evaluation of the project and the teaching method can be found in chapter IV , pp.160-167.

CHAPTER IV

Presentation of the Findings

DIFFICULTIES ENCOUNTERED DURING THE APPLICATION OF THE PROJECT

The application of the research gave rise to several problems. Some of them were already known or anticipated and provided for when designing the research, but they still emerged in the actual application of the project. Whenever it was feasible, several precautions and measures were taken in order to avoid these problems. At times, however, when no action seemed capable of changing the situation it was simply taken for granted. The latter problems were confronted when they arose and regarded as unavoidable and dealt with as such. Nevertheless, it could not be claimed that the course of action taken was necessarily the most appropriate for the occasion.

The causes of these problems lay:

- a. in the structure and function of the Greek school, in general, but also the peculiarities existing in some of the schools. The latter originated in either the population from which the school accepted its pupils or in special, isolated cases of particular children;
- b. in the application of SMP in the Greek schools or the particularities of the project itself.

Difficulties stemming from the function and the building facilities of the Greek School.

The Greek school building facilities are described at another point of this thesis.¹ Here, only these features of the building and the classroom, in particular, that hindered the efficient conduct of the research will be highlighted.

1. Lack of the necessary classroom facilities.

The Greek School classrooms are usually barren, uninteresting rooms. One or two metal cupboards for keeping the apparatus or teaching material are the only pieces of furniture apart from the desks and chairs. There are no shelves for displaying or

keeping the children's work or personal belongings. There is no sink or tap. No corners of work or free space are provided for in the Greek classroom, so the children are given no chance to either work in groups or move freely in class. Therefore, in order to meet the needs of the SMP card teaching system some of the classroom desks were turned into benches where the boxes with the cards were placed.² At the end of each lesson these boxes had to be secured in the cupboards or removed from the class until the next teaching session. As far as the apparatus was concerned, its nature and quantity made it necessary to keep it locked away. It was impossible, however, to store it all in the cupboards, so a part of it was secured at school and the rest was necessarily removed from the classroom until the next lesson. The lack of a permanent storage space where the apparatus could be kept or displayed created a number of problems to the normal conduct of the research. The teaching material necessary for the completion of the cards was carried from school to school in containers for each lesson. Most of this material remained in the containers during the lesson³ and the children had to search there in order to find the objects they needed. Naturally enough, then the inadequacy of the containers for safe keeping, on the one hand, and the children's impatience and haste on the other caused some disorganization each time. Because the children had to search for the necessary apparatus the lesson could not always proceed smoothly. Moreover, quite often the children came up with complaints of missing material and the researcher had to intervene. These difficulties deriving from the use of the apparatus resulted in a considerable waste of time, delayed the completion of the cards and irritated the children causing further difficulties in class. It should be noted that several objects necessary in particular for the consideration of volume and capacity were not supplied due to their size and the inconvenience of their transport.⁴

Whenever, therefore, the children worked on cards that demanded the material in question, they were obliged to take and complete the cards at home. Finally, the absence of water facili-

ties in all classrooms necessitated the children's occasional visits to an adjacent building, often in bad weather.

2. The furniture arrangement.

The desks were arranged in rows one behind the other.⁵ This arrangement certainly served the needs of the Greek teaching system but it was highly inconvenient for teaching from the SMP cards as:

a. The two children that shared the same desk faced serious spatial problems. Each child needed an exercise book, a card and the necessary apparatus. There was, of course, hardly enough room for all these and that often arose disputes that delayed the completion of the cards.

b. It so happened that four or five children needed the same piece of apparatus at the same time. The size of tables prevented the children from using the apparatus freely. Sharing was a serious delay, since the children were obliged to wait longer than anticipated, a fact that caused hindrances which resulted in inadequate completion of some cards.

3. The function of the big urban schools.

It has already been mentioned that in the big cities the number of the school buildings is inadequate and cannot meet the needs of children in either primary or secondary education. For all children to be accommodated satisfactorily it is imperative for a school building to be shared between two schools neither of which can claim independent ownership. Consequently, neither of the two teachers using the same classroom can determine the organization and arrangement of the furniture. Any exhibition of the children's work runs the risk of being destroyed by the children of the other school or at best creating some problems to the normal conduct of the teaching in the other school. No change should be attempted unless mutual agreement is reached between the two teachers.

In the course of the research:

a. As mentioned above the possibility of a continuous display of the teaching material and the apparatus of SMP was out of the question.

b. A basic decoration of the classrooms used for the research was attempted. The researcher herself drew characters appropriate for the work in hand on poster size cardboard. This exhibition aimed, on the one hand, at adding to the pleasant appearance of the classrooms and, on the other, at restoring a kind of daily contact of the children with the project since a display of the cards and apparatus had been deemed unfeasible. Unfortunately, however, most of the posters were destroyed or mutilated during the year's research.

c. The Greek School desk arrangement was preserved during the main study, after an attempt to create groups had failed during the pilot study.⁶ This arrangement, however, was quite inadequate for the teaching of Mathematics from the SMP cards since:

i. In the course of the 40 minute teaching session the researcher was obliged to go to every single desk and supervise each pupil's work separately. This enforced organization caused unnecessary delay to some pupils. Under these conditions the co-operation between the researcher and the children was far from substantial.

ii. The children had to move continuously in order to get hold of the cards and the apparatus, a fact that not only delayed the lesson but also distracted them from concentrating. To avoid delay some children took more cards than they needed and in turn other children were prevented from working adequately on their tasks. The formation of groups where each group would share their own box of cards would have minimized this problem. Finally, the teaching and supervision of the class would have been much more effective if the researcher had not been obliged to deal with so many groups of children.

4. Special circumstances under which the research was conducted.

In the course of the main study the researcher taught Mathematics from the SMP cards twice a week in each school. The fact that it was not the class teacher who applied the SMP project, as well as the radical difference of the procedure employed for the research made the children realize that the SMP project was only a temporary scheme unconnected with the ordinary curriculum. This of course posed several difficulties and limited the project's efficient application.

- i. Any rearrangement of the classroom was likely to confuse the children and undermine the class - teacher co-operation. Consequently, it became obvious from the very beginning that the research procedure was subject to certain limitations. Its original planning, that is, was to be modified and adjusted to the existing circumstances and methods of the Greek school.
- ii. The SMP card system was regarded as an intrusion in the normal teaching day. The ten minute break was the only time the children were allowed in order to adjust themselves to the philosophy of the project.

The lack of time, therefore, and the unfavourable conditions described above were some of the factors that obstructed the efficient application of the project.

Difficulties due to the project itself.

Apart from the difficulties which appeared as a result of the function of the Greek primary school there were others originating from the SMP project itself. The crux of these difficulties lies in the fact that SMP is a highly individualized approach which involves:

1. **A high standard of reading ability :** Some pupils' inadequacies in reading skills hindered their competence in Mathematics. Their dissatisfaction grew to frustration as

their reading inability slowed down their work on the cards considerably. That incompetence reduced the quality of the lesson since a lot of the already limited time of the teaching session was wasted on the pupils' effort to read and comprehend the cards.

2. The special way of introducing new concepts: The introductory text of the cards either referred to the presentation of a new concept or to the explanation of the procedure to be followed. However, even if the child was competent at reading, he could hardly understand a new concept from written words.⁷ Consequently, the child felt disappointed or anxious and in either case he turned to the researcher for explanations. Moreover, if it so happened that two or three children worked on the same card but at different times in the course of a teaching session the same explanations had to be repeated, the result being an unnecessary waste of time.

3. The problem of the appropriate allocation of the teacher's time: The teaching session was about 40 minutes. At least 5 minutes were wasted each time on various delays or activities irrelevant to Mathematics. It was doubtful, therefore, if 3 minutes could be allocated to each child, provided of course that the researcher was not busy introducing a concept or explaining something else. The researcher, therefore, did not have much time at her disposal to tutor children adequately.

4. The inadequate researcher-pupil interaction: The pupils were rarely given the opportunity to practice the mathematical language, discuss or explain the concepts they dealt with. The methodology of the research was such that the children seldom heard or interchanged mathematical terminology and ideas.

5. Inability to assess practical work: A positive aspect of the SMP project is that it involves a lot of practical work. The value of this work, however, was reduced because it was not

followed up by discussion on the children's findings. With the researcher being always busy, the children's conclusions were not thoroughly exploited. Thus it was not possible to give an accurate assessment of what the children had learned.

6. Organizational problems: For any individualized approach classroom re-organization is necessary. In the present study children who had hitherto been accustomed to a highly formalized approach where participation was actually banned, were required to participate and interact with their peers. The contrast in teaching styles presented disciplinary problems within the classroom.

Some difficulties that the children faced on the first day of the project's application.

In the main study the children took the preliminary test at the beginning of October. After that and before the research actually started, a whole teaching session was devoted to familiarizing the children with the concepts to be taught, the apparatus and the teaching material. Thus, during this introductory lesson:

1. the subjects, addition, time, and length were mentioned.⁸
2. the children used the apparatus in order to answer the questions orally put to them,⁹ and
3. they were asked to find and put back cards based on their order numbers.¹⁰

After this brief introduction, the project started on a normal basis. The children of one group (then of the second and lastly of the third group) were asked to stand up and take the first card of each topic.¹¹ They were thoroughly instructed as to how to use their exercise books and how to answer the questions. Nevertheless, some problems emerged when they started to work on the cards:¹²

1. Unfamiliar with the SMP working conditions and unaccustomed to sharing, children removed cards which other children happened to need at the same time or caused unnecessary delays by keeping apparatus longer than they actually needed it.
2. Even if they had been expressly asked not to write anything on the cards, but read only the directions on them and then answer the questions in the exercise-books they had been given¹³ for the purpose, still there were pupils who wrote their answers on the cards and yet some others who wrote both on the cards and in their exercise-books.¹⁴
3. The children had been used to filling in their answers in the appropriate blanks of their books, whereas, now they were put into a novel situation, where they were asked not only to copy the exercises, but to find the way to phrase their answers as well.

4. Several children, particularly the children of the 9th and Aghia Triada schools, faced problems in reading the texts of the cards. Thus, given a long text, they either did their best to decipher it, or they made no effort from the beginning but tried to interpret the text from the shapes or numbers that followed.
5. Some of the children who proceeded to a second card made the wrong choice taking another topic's card. Yet, they did not bother to look for the right one and continued working on the wrong one.¹⁵

Despite the difficulties that the children were confronted with and the problems that emerged on the first day of the application of the project, it could be claimed that the lesson was rather successful and it was welcomed by the children as a pleasant alternative to the formal approach to Mathematics.

Special problems posed during the main study.

1. The 9th school of Phinikas.

It was a representative working class school. The fact that several of the inhabitants of the district were Gypsies or very low income families was not unknown to the researcher who indeed expected to encounter an educational situation different from that of most of the city schools.

The second class involved in the research consisted of seventeen children only, an ideal number for such a research project. The children were divided into three groups according to their competence in Mathematics. The children of the first group were above the average at Mathematics. They grasped the new concepts quite effortlessly and worked very efficiently on their own. It could be claimed that the teaching system in use at the time restrained both their incentive and potentiality.

The children of the second group indicated, more or less, average capacity in Mathematics. Most of them were systematic and progressed slowly but surely, relying rather heavily on their

teacher's assistance. Finally, the four children of the third group were almost illiterate. Their ability level in Mathematics was minimal and that posed a great problem, since their backwardness hindered the progress of the rest of the class. Eventually, the problem was resolved by applying the same teaching method to the children of the first two groups and treating the four children¹⁶ of the third group separately.

2. The special approach followed for the four children of the 9th primary school.

During the first term an attempt was made to introduce these children to the SMP cardwork. This decision was mainly dictated by two reasons: first, the children's response to the SMP cards would possibly assess the efficiency of the project for such low attainment children, and secondly, these children's incompetence should not be stressed overtly to the whole class. It was considered necessary to give them the chance to experience working with the cards. Besides, it was expected that sooner or later, the children themselves would realize their inability to continue working with the cards and ask to substitute them with something else.

At the beginning these children worked with the simplest of the cards, but their weakness to cope with the project was soon exposed. To begin with, those children were unable to read, they could not even recognize the alphabet letters. How could they ever read the text introducing each exercise? We tried to resolve the problem by giving them the easiest of the cards with the shortest text. They contained mainly exercises with simple mathematical facts, but that again posed another problem: they were unable to recognize even the small numbers up to 10, or the various symbols (+, -, =, etc.). Despite their acute weaknesses, however, the children clung to the cards and would not hear of trying another approach. Their persistence was interpreted as a result of the fascination the SMP apparatus exercised on them. An attempt was made to give them some very simple oral or written exercises and they were encouraged to solve them by using

the apparatus. They absolutely refused to get involved in anything but the cards. The rich apparatus, the drawings of the cards, their lay-out, in general, their very dissimilarity to their manuals and the existing teaching system fascinated the children and made them prefer working with the cards, even if they could hardly understand them. They were thus allowed to work with the simplest of the cards for the first term with the continuous assistance of the researcher, of course, or, whenever that was possible, with the tutoring of their advanced classmates. They were, therefore, given the chance to experience the pleasure of working with the new material, while, at the same time, they were not made to feel inferior to their peers and were given time to admit their incompetence themselves. At the end of the first term, they were ready to accept and try another approach. On the other hand, we had the chance to draw several conclusions concerning those particular children:

- a. They obviously needed special attention. None of the existing systems designed for their age seemed to suit their needs.
- b. Any teaching approach followed for these children should be flexible and appeal to their interests and imagination. Above all, though, it should, in no case, be blatantly different and give the impression it was specially designed for under-achieving children.
- c. However, in relation to the project, it was obvious that even the simplest of the cards would not do for their competence level.

For the second school term, tired of their effort to keep up with the rest of the class and having tasted the experience of the cardwork, all four children readily accepted to follow a different approach. Their occasional objections were mostly pride-oriented and easily discarded. Having assessed their ability in Mathematics as practically non-existent, any teaching approach followed for their case should start by familiarizing them with the numbers, before attempting to introduce the mathematical symbols or concepts to them. Naturally, the children

were encouraged to use the SMP apparatus in order to reach their conclusions.

The fact that the teaching method proposed could only be applied twice a week, while the rest of the children worked on the SMP cards, was taken into consideration. The suggested method was certainly far from ideal, since it was not carefully designed for the particular children, but it was more a roughly improvised approach dictated by necessity.

The aim of the teaching approach was to help the children:

- a. recognize the numbers up to 10.
- b. connect the picture of the number with the arithmetic word and symbol.
- c. get acquainted with the Mathematical terminology (subtract, take away, minus, etc.).
- d. be able to verbalize and symbolize the various thinking processes as well as deciphering the ones expressed in symbols.¹⁷
- e. be happy through their active participation and the use of apparatus.

Special cards were prepared for this reason for the four children of the group. The cards presented either a mathematical symbol (+, -, =) or a number from 0 to 9. There were five cards for each one of the numbers and different colour markers were used for the numbers and symbols. Thus by the proper handling of symbols and numbers the children could symbolize relations between one digit at the beginning and two-digit numbers later on, after they had previously shown these relationships with groups of objects. Nevertheless, the children soon became tired of the above method, they started to leave the cards at home and quite a few of them were lost. The numbers, which were not very popular among them anyway, became tiresome because they kept them away from the colours and pictures of the cards, the pairs of scales, and the various fascinating objects of the SMP apparatus.

Moreover, the long absences of two children, Spiros and Vangelis, in particular, posed an additional problem. No sooner had the children made some progress than with a five-day absence from school all was forgotten and we had to start all over again. Naturally enough, the children were reluctant to co-operate regardless of whether they were in a position to recognize or use the various mathematical symbols. They had heard them so often that they lost interest.

A new teaching approach was tried out during the third term. It was decided to give the children simple worksheets, with the shortest possible text so that they needed the fewest of explanations. The decision to give the children worksheets was dictated by the following reasons:

- a. The material to be used by these children should look as much like the SMP cards¹⁸ as possible so that the children would not be made to feel inferior to their classmates.
- b. Each child could thus work at his own pace depending on his competence in Mathematics, as well as on his presence in class.
- c. The worksheets would relieve the researcher from the obligation to continuously supervise the work of the group. Of course, they would be given the necessary explanations but they would be then left to work on their own, something not feasible with the method applied in the previous term.
- d. The children's response to the demands of the lesson would be negative if it had to do with numbers only. Through the worksheets the children would deal with simple and pleasant topics such as the shapes, length, various comparisons, as well as basic processes of computation.

The worksheets were photocopies of various English books for children of about this age.¹⁹ All four children reacted quite positively. The worksheets looked similar to the cards, yet they offered the charm of the unknown. The text was within their grasp, moreover, they could colour the pictures of the worksheets, write on them, use them, that is, like copybooks even if they were not such. They could finish the task required quite easily and pleasantly and above all they felt productive

and useful, they made obvious progress and thus they did not differ from their classmates. It could, therefore, quite safely be claimed that this last approach was quite successful and satisfied the limited goals for which it had been planned.

3. The four children's reactions to the different approaches attempted during the research.

It has already been reported (p.138) that the four children liked the SMP project. Their incompetence in Mathematics had rendered both the book and the subject itself uninteresting. They were bound to react favourably to anything novel which, they hoped, could help them participate in the lesson and thus feel equal to their classmates. Had the new project been based on a manual similar to that of the Greek system, the children might have been suspicious or at best reserved, since they had already undergone the experience of a manual and been disappointed by it.

The attractive cards, full of happy figures, with the meticulous lay-out and the colourful apparatus which were easily taken for toys stimulated the children's imagination. The particular children, desperate in their inability to use the manual, would welcome any change. It was a real shame that their ability level was so frightfully low that they failed to understand even the easiest of the cards (and SMP contains a variety of such cards) and that the SMP project did not provide for children who were so weak academically.²⁰ Characteristic of their interest for the cards was their attachment to them and their refusal to try another teaching approach, even if they realized their inadequacy to work with them.

First term (work with the SMP cards).

The children almost desperately clung to the cards. They kept them on top of their desks, asked to take them home, even if it was certain that no one there could help them complete them. Above all, they did not want to lose the chance to be equal with their classmates in something that was new and unknown to all. If they had consented to be exempted from the use of the cards, they would not only have accepted their weakness, but they would also lose the opportunity to join in a pleasant activity which everybody else seemed to enjoy, be it only twice a week.

The children showed their preference for certain cards

- a. The ones which had a limited number of items. The ones, that is, which did not have any or had only a very short text, big numbers and the exercises were sparsely written.
- b. The ones which contained some illustrations that reduced the mathematical monotony and austerity of the card.
- c. The ones which required some activity, such as weighing, measuring, etc., because they took it for a game.
- d. The cards which required the use of apparatus. The choice of the card, that is, was mainly influenced by the apparatus it demanded rather than the concepts it introduced.

The children's reactions when working with the cards varied according to the difficulties they encountered. They were enthusiastic and became highly cooperative and industrious when they could understand a card, reach a correct solution and thus win approval and reinforcement. On the contrary, they became pathetic and passive and were not inclined to work, if a card other than the one they chose was suggested to them. Finally, they became aggressive whenever they needed help for an exercise and they were not given it at once.

Second term (work with the alternative cards).

The small cards with the mathematical symbols and equations were received very positively, even enthusiastically at the beginning. It was a new game which would moreover, secure the teacher's presence among them for a long time. Unfortunately, however, it came as a reminder of continuous failure in the past. It was difficult to dismiss their dislike for the numbers which they did not understand and consequently regarded with anxiety. If this approach had been considered more carefully, it would have required a thoroughly prepared method especially planned for these four children.

The children were given activities involving the formation and symbolization of relationships. However, when the children were asked to symbolize the results of their activities they

encountered the usual difficulties and their dislike for what they did not know returned. Their original enthusiasm soon vanished and they lost interest. An attempt to combine the symbolism of the various equations with pleasant familiar stories failed due to the long time lapse between two teaching sessions and their inability to get enough practice. The method they usually employed in symbolizing was that of trial and error. Having formed the right equation with the small cards and asked to depict it in their copy books, they wrote the symbols and numbers in such a way, that they were scattered on the page without any logical connection.

Third term (work with the worksheets).

The children's reaction to this last teaching approach was definitely positive. It was the most profitable method among the ones attempted for these children. The topics presented in the worksheets were the shapes, addition, subtraction and also comparison of sizes, length, weight and finally block graphs and time. They usually contained very short or no text. Even so, however, the children could not read them and the researcher had to explain what they were asked to do. The fact that there was hardly any text reduced the children's anxiety and influenced their attitude positively towards the worksheets. The children responded favourably to the presentation of the text and their work indicated that they understood what was required of them. Considering the children's enthusiastic response, the third term approach may be considered moderately successful.

The same problem of the long absences of Vangelis and Spiros was encountered in the third term as well. Given their infrequent attendance and their low competence level in Mathematics, it was next to impossible to expect those two children to make any progress. It was, however, satisfactory that at least one of the four children, Maria, made considerable progress and the rest of the children gained a little ground and what was more it was all achieved in a pleasant climate without pressure, insecurity or aggressiveness.

It is significant that most of the rest of the children who had access to the SMP cards asked to complete worksheets too. It was not that they lost interest in the card, but it was not novel any longer, it did not belong to them and they were not allowed to colour it. Several of the children then required and got worksheets, "tests," as they used to call them, supplementary to their work with the cards. The four children who had anyway ceased feeling inferior to their classmates took pride in owning and using something the rest of the children lacked and expressed eagerness to participate ..

Difficulties that the children were confronted with during the application of the project.

The first part of chapter IV dealt with the difficulties encountered in applying the research, difficulties originating either in the structure of the Greek educational system and the function of the Greek primary school or in the peculiarities inherent in the SMP project itself.

The second part of this chapter will include a short description of the difficulties the children themselves encountered on working with the SMP cards. These difficulties stemmed from either the content of the cards, namely the mathematical concepts or skills introduced, or the way these concepts were introduced by the cards.

In the course of the pilot study, but mainly during the main study, by observing the children's work and correcting their exercise-books it became possible to sort out those cards which caused them difficulty. The children's difficulties originated in:

- a. the way a particular subject or exercise was presented
- b. the introductory text which either set the theoretical framework of the exercise or offered instructions

- c. the mathematical symbolism employed to define relationships, operations or facts, and finally,
- d. the mathematical concepts which the cards introduced and which were beyond the children's level of cognitive development.

Here, selectively only, we shall refer to some of the first section cards which the children found difficult for one of the four reasons mentioned above, but we shall refrain from including suggestions of alternative ways of presenting or symbolizing the same concepts or exercises.

1. Difficulties due to the way a particular subject or exercise was presented.

Children at this age often rush to reply to questions they are asked or complete exercises they are given. Thus, they either do not read the text of the card very carefully or read it partly only. In the second case they may read the points they deem most important or read the text up to a point only and stop, assuming that it continues similarly.

The SMP project has seriously taken into account children's behaviours and tendencies and planned the cards accordingly. Anyway, the application of the programme proved that certain cards were too lengthy for the impatient and a usually careless child to deal with satisfactorily.

The children grew indignant with those cards (for example, 1-8* and 7-1) which asked them to draw charts in order to present their answers. Some of them considered the task too difficult, meaningless, and time consuming, while the perfectionists among them were in tears because the drawing in their copy-books did not satisfy them.

There were cards (such as 1-7* and 2-7) where the suggested exercises occupied an exceptionally small space, crowded in a corner at the back of the card, i.e., 1-7*. Thus, it so hap-

pened that the children became exhausted by the long introductory text and when asked to perform the suggested activity they disregarded the two or three isolated exercises squeezed at the bottom corner of the card. On other cards, where two alternative procedures were suggested for the same problem (i.e. 2-7 and 1-2*), they completely ignored the second procedure and followed the first one only. The characters or drawings on certain cards (e.g. 1-6 or 13-5 and 13-6), even if they were intended to facilitate the children in their answers, failed to do so. The picture prevailed over the symbolism or the concept the card attempted to present so it misled the children to the wrong answer. For example, in 13-6 the children's attention was drawn to the qualitative properties of the depicted object, an ice-cream cone, rather than the geometrical shape which it was supposed to depict. Thus, it was mistakenly assumed that cones could build towers since the ice cream cone had not a base and the one could be inserted into the other.

Finally, in some of the cards the questions were asked in such a way that they gave the impression that they were statements rather than requirements to be attended to mathematically. The children were used to a particular type of question which had the form of a statement and it only acquired meaning when the blanks it contained were completed with words or numbers. Consequently, when the questions did not appear in this form they were usually mistaken for statements by the children and were not completed with answers.

2. Difficulties due to the introductory text of the card.

In a number of studies²¹ on the "readability" of mathematical texts the way that a. the concepts, methods and explanations are presented, b. the instructions to the child are formulated, c. the examples or the exercises are introduced and d. the signals are manipulated by the mathematical text books (or worksheets, or cards) is judged of crucial value. The changes brought about in education in the past few years, the new teaching methods in Mathematics and, particularly, the ones based on individualized projects require a high reading and writing standard from children. Moreover, the child is often confined to silence, obliged as he is to work on his own on a worksheet or card. Therefore, he is not often given the opportunity to discuss the matter, exchange ideas, listen to and use the appropriate terminology, so as to develop not only his verbal and communicative skills, but also his ability to elaborate and solve problems.

In the course of the research the children's work in class showed that the long or detailed instructions offered by some of the cards confused them. The children often felt discontented by the elaborate introductory instructions and solved examples (fortunately characteristic of very few cards). They appeared to think that they had somehow been tricked into a lot of tiresome and unnecessary work, since the result was provided by the card anyway (e.g., 1-7* and 1-9*). The children were eager and anxious and moreover, they expected immediate results from their actions. Furthermore, being unable to keep two or three relationships in mind simultaneously, they read one of the instructions at a time fulfilling its requirements and then returned to the second one and, finally, to the third instruction. It was, that is, a process which took a long time to yield results. The children, therefore, often chose not to read the text at all, but tried to decipher the exercises from their symbolism. Alternatively, they read part of the text only or read it all but ignored it

completely. They considered themselves able to solve the exercises without following the instructions of the card. Thus, in order to complete the exercises, they implemented ways familiar to them or they invented methods of their own combining the knowledge they had already acquired with the information or instructions they had assimilated through reading the text. For example, in the 1-10*, 11*, 16* or 1-17* cards on addition, very few children employed the proposed apparatus, blue and red counters and this only after the researcher's intervention and encouragement. Most of them used only the symbolic depiction of the apparatus, blue and red dots in their exercise-books, without bothering to use the apparatus itself. As far as addition was concerned they judged they possessed the necessary skills or its operational mechanism, therefore, they deemed the apparatus a complicated process they could do without.

In conclusion, it could be claimed that a number of the erroneous answers the children produced should be put down to their difficulties in reading and fully understanding the text rather than to the mathematical concepts they were dealing with.

3. Difficulties due to the mathematical terminology and symbolism of relations and operations.

The statement "mathematics is a language in itself" is common. However, there are some who claim that Mathematics is not a language, but "it is an activity and a body of knowledge."²² Thus, various languages could be used to describe and express Mathematics. A system of symbols, signals and terminology has been developed to enact Mathematics and this system is not pure Mathematics. This symbolism, if used by an expert, could express mathematical ideas more easily and precisely. But to interpret meaningfully such a symbolism means that it is necessary to possess that mastery which enables a translation of the actual content of the symbolism into a spoken mathematical language and hence into the ordinary spoken

language and vice versa. Thus, it could so happen that although a child knows the mathematical principles involved in an exercise, he fails to give the appropriate answer because he is not familiar with the mathematical vocabulary or symbolism.

In the present study, some problems emerged due to the terminology and symbolism used by some cards. These were very few, yet the difficulties they caused were common to all children. Clarification about the symbolism was necessary before proceeding to the solution of the exercise. Apart from their reactions in class the children's answers in their exercise books further indicated the difficulties they faced. They invented a new form of symbolization, followed thought processes, used relations and they interpreted the terminology on the basis of their previous knowledge. By following faulty rules, which, however, had usually a sensible origin, they resulted in a new, false invented procedure.

Possibly the difficulties stemmed from the fact that several cards, the 1-1 card, for example, introduced a number of concepts simultaneously and in an unfamiliar way to the children. The particular card presented:

a. A binary operation (two members, a and b of a set are combined according to a given rule, addition, and produce a third member to the set, x).

b. The ordered pair notion (a pair of numbers which must be taken in the given order. According to our example, b must be added to a to yield x as a result).

c. The open sentence exercise (a sentence, neither true nor false, until a numeral has been put into the place holder).

The exercises of the card are given in an open sentence type, so that if the child interprets the symbolization correctly, he must then have an equation of the type: $a + b =$

□

d. Symbols expressing relationships. (Suppose the child must relate something given on the left of the arrow to something he is asked to find according to a given instruction and depict it on the right of the arrow, e.g. (a, b)

add $\rightarrow$ 

e. A way of recording (an elementary form of mapping is introduced to encourage children to record their activities involving addition).

Considering that 1-1 is the first card of section 1, the children encountered most of the above concepts and symbolisms for the first time or at best for the first time in the new school year. Naturally enough then, they posed so many problems to the children.

Now, in 1-4 the children faced more serious difficulties. This card also presents too many concepts and symbols simultaneously. Moreover, we believe that the symbolism is not clear enough and it confuses rather than facilitates the children in the retention and recall of information.

a. In symbolizing the binary operation, for example, the card places the constant addendum +6 at the end of the arrow and not on its top i.e.

$\bigcirc \longrightarrow +6$ and not $\xrightarrow{+6}$ so that it looks as if it is the result of a given correspondence and not the rule of this correspondence.

b. There is no affinity between the law of correspondence and the elements of the two sets (domain and range). For example, the child sees a number (5), corresponding to another (11), which units turn corresponds to a number he is required to find but cannot see how to find it.

c. If the purpose of the arrow outside the closed curve is to denote the correspondence, then it is superfluous, since the correspondence has already been depicted inside the curve.

Therefore, the particular arrow could: i. be omitted and +6 could be put outside the curve ii. Be put but have +6 along its line and not at the arrow's point iii. both the arrow and +6 could be omitted and +6 could then be placed on top of the arrow of the first correspondence enclosed inside the curve.

d. If the closed curve denotes a set, then is this symbolism important? Having the circumstances as a guide-line, the writing of the numbers as well as the drawing of the arrows follow a circular direction. What is the purpose of this symbolism? Would then be preferable to use a linear form instead? That is:

$$5 \xrightarrow{+6} 11 \longrightarrow \square \longrightarrow \square$$

Here also we have a set of numbers the cardinal number of which is 4, the numbers-members of the series follow a given law and mapping is employed to record results.

e. One may wonder whether so much diverse data should be crowded into children's heads so soon. The concepts included in 1-1 as well as the method of their symbolization have already been mentioned. The 1-2 card presents simple horizontal additions. Card 1-3 suggests a solution for first degree equation (the property of inverse operation in the addition) and we have already discussed the concepts and symbolism included in 1-4. Is it expedient to present the children with so many concepts in such a short span of time?

Moreover, in several cases difficulties arose because of the introduced terminology. Take subtraction, for example: too many terms referring to this mathematical concept were crowded into a very short time span. After the children had been introduced to the terms take away, subtract, the difference of, they then had to discover the concepts underlying those terms and assimilate them on the basis of already known schemata. Therefore, the children were not given the opportunity to familiarize themselves with one term at a time, but were bombarded with a number of them simultaneously. This haste resulted in faulty interpretations of the implied concepts and

to a complete confusion concerning the roles of subtrahend and minuend.

In conclusion, it could be argued that the root of the children's difficulties and mistakes lay in their inability to relate the various terms and symbols to their underlying concepts. It appears, therefore, that for satisfactory progress to be made and permanent learning to be established, the comprehension of the denoted conceptual transformations is imperative.

4. Difficulties due to the mathematical concepts.

In their effort to complete the cards, the children encountered several difficulties due probably to the fact that the concepts and operations introduced by the cards were beyond some children's cognitive level. Thus, for example:

a. several difficulties appeared in the cards on the addition of two-digit numbers or a two-digit with a one-digit number with a remainder. Also several mistakes were made concerning the function of zero in additions. At times, the sum would be smaller than one of the addenda, a fact that did not seem to bother the children. It became obvious that the children were not familiar with the idea of estimation yet and furthermore, they could not perceive that the total class, being wider, includes the parts, they could not see, that is, the relation between the whole to its parts. According to Piaget, "for them, wholes are not logical classes, but elementary schemata of assimilation or syncretic aggregates, in which the relation between the part and the whole is not yet a quantitative relationship, or even 'intensively' quantifiable, i.e., is neither part nor inclusion, but merely qualitative participation."²³

Most of the children had not yet familiarized themselves with the process or the operation of addition. Place value was a rather misunderstood notion and the relation between tens and units was not established yet. Thus, the children either

treated the two-digit numbers as if they were two separate ones,

e.g.,

$$\begin{array}{r} \text{T U} \\ 7 \\ + 43 \\ \hline 14 \end{array} \left. \vphantom{\begin{array}{r} \text{T U} \\ 7 \\ + 43 \\ \hline 14 \end{array}} \right\} (7 + 3 + 4 = 14)$$

or they add the units only, ignoring the numerals referring to the tens 24

e.g.,

$$\begin{array}{r} \text{T.U.} \\ 29 \\ + 4 \\ \hline 13 \end{array} \quad \text{or} \quad \begin{array}{r} \text{T.U.} \\ 42 \\ + 7 \\ \hline 9 \end{array}$$

Finally, zero presented a problem to several of the children, either when it represented the unit digit of one of the addenda or the unit digit of the sum. Thus, at times zero would assume its multiplying property and in other instances when the sum of the units was 10 the child would decide to write 10 at the units column and thus modify the result:

e.g., T.U.

$$\begin{array}{r} 43 \\ + 27 \\ \hline 610 \end{array}$$

b. A lot of difficulties appeared in subtraction when it was given as follows: $a - \square = b^{(a)}$ or $\square - a = b^{(b)}$. The most common mistake was the interchanging of the given numerals (as if they had been put in the wrong place). Thus the first equation would become:

$$a - b = \square \quad \text{and the second} \quad b - a = \square.$$

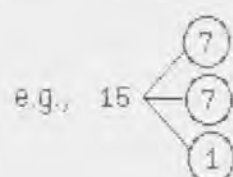
The children had not reached the Piagetian stage III yet, namely, the level of operational thought, therefore, they were

unable to think of three numbers at the same time, i.e. the whole and its subclasses.

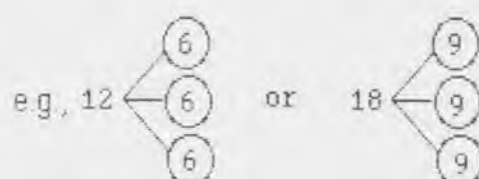
It might be useful to mention here that sentence (b) presented more difficulties than sentence (a). In (b), the parts were given and the whole was asked. In order to answer this sentence correctly, the pupils should be ready to see the whole as the result of an additive composition of the parts, however, the children failed to see (a) and (b) as parts of a whole.

With sentence (a) the children who performed it successfully employed decomposition. They started from the given number 'a' and by taking away one after the other the units, they finally reached the given number 'b'. The children found it easier to decompose the given whole than to compose it from the given parts, which, in any case, they did not perceive as such.

c. Another difficulty the children were confronted with was that of sharing elements of one set into three or four equal subsets. The commonest mistake was that the children attempted to achieve trichotomy via dichotomy which either leaves a remainder representing the elements of the third subset:

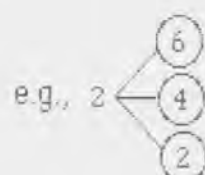


or it leaves them with nothing to give the third part. In this case they would divide the whole into two equal parts and repeat the same number in the third subset as well:



These children were obviously unable to keep the two requirements of the exercise in mind. Consequently, they could not make the parts equal, and as many as the problem required. The children seemed to think of dichotomy automatically whenever they were asked to subdivide a given whole. But in this case the procedure to be followed should be that of dividing the whole into two sets, the first of which should be half of its complementary. Evidently the children had not acquired the one-to-one correspondence yet or the equivalence of two, three or more sets.

In a few cases children applied additive equivalence (that is the equivalence in respect to one attribute) instead of the multiplicative equivalence, where two attributes are involved:



The children here depicted a qualitative trichotomy ($B = A + A' + A''$) and not a quantitative one: $A = A' = A''$ ²⁵

d. The 6-6 card proved to be a pitfall for almost everyone. It required the children to find the smallest number of coins necessary to form a given amount of money. Almost none of the children took into account the two restrictions posed by the exercise. Thus, there were those who managed to form the given amount using coins, only did not take care to use the least possible, while there were others who did not even bother to use coins, but employed integers which made up the given number instead:



5. Difficulties due to various reasons (other than the ones already mentioned).

Other sources of difficulty for the children were a. the language used in the card and b. their inability to symbolize or record the results. In certain cards the English text was unsuccessfully translated into Greek. This unsuccessful translation produced a rather vague Greek text which often led the children to handle the exercise erroneously. In card 7-4, for example, the children misinterpreted the terms *middle-size* (doll) and the (doll) *in the middle* and consequently made quite a lot of mistakes. Only after relevant explanations did they understand exactly what the card meant.

Another difficulty which also led to errors stemmed from the children's incompetence to manipulate numerals, numbers and symbols, and to record relations. Some children's difficulty in lining up the numbers correctly became apparent. Even when the numbers were already aligned, some children would change the vertical alignment for the horizontal one, e.g.

$$\begin{array}{r} \text{D. U.} \\ 9 \ 6 \\ \hline 1 \ 5 \end{array} \text{ instead of } \begin{array}{r} \text{D. U.} \\ 9 \\ + 6 \\ \hline \end{array} \text{ or } \begin{array}{r} \text{D. U.} \\ 178 \\ 16 \\ \hline \end{array} \text{ instead of } \begin{array}{r} \text{D. U.} \\ 1 \ 7 \\ 8 \\ \hline 1 \ 6 \end{array}$$

or would move the numerals from their given places: e.g.

$$\begin{array}{r} \text{D. U.} \\ 9 \\ 6 \\ \hline 15 \end{array} \text{ or } \begin{array}{r} \text{D. U.} \\ 9 \\ 6 \\ \hline 15 \end{array}$$

Obviously, all the above examples reveal that the children had not grasped yet the concept of place value, but they also indicate the children's wrong manipulation of numbers.

Once more, the difficulty that children of this age have, that is, to keep in mind more than one relationship simultaneously, and their tendency to focus on one of several data presented to them, became obvious.

In conclusion, it was shown that several of the concepts, relationships and operations introduced through the SMP cards were beyond some children's ability level. Needless to say that several children's cognitive development being rather limited made it hard for them to keep up even with mathematical concepts corresponding to their chronological age.

DISCUSSION ON THE GIVEN QUESTIONNAIRES

The parents' questionnaire

The parents' answers to the questionnaire²⁶ they were asked to complete at the end of the school year are discussed here: a. both separately for each school, and b. generally as a summing up of the procedure. This diversification was judged necessary after realizing that the parents of the downtown school were more critical (towards the system and the approach followed) than the parents of the other two schools whose judgement of the project was mostly positive. Unfortunately, of course, not all parents answered the questionnaire. Few of them accepted our invitation to come to school on a definite day to discuss their aspects or objections concerning the application of the SMP project.

1. The 41st School.

Sixteen out of the twenty five parents (64%) completed the questionnaire. Fourteen of them reported that their child enjoyed working with the cards. Their view was that children were attracted to the cards because:

a. They were original, interesting and were regarded as a play activity rather than a lesson of instructions. The cardwork offered their children the satisfaction that they proceeded at their own pace relieved from the teacher's pressure or guidance. Moreover, the cards gave birth to a kind of competition among children something that, in their opinion always, was positive.²⁷ Out of their own free will they progressed fast conquering rather effortlessly and in a certainly very pleasant way the various mathematical concepts.

b. Even if the cards presented a wide variety of concepts, it was done in such a pleasant and interesting way, that the children were eager to know what the next card contained. Moreover, the apparatus was proposed as an integral part of the learning process. The apparatus did not consist of vague, incomprehensible objects which could perplex or confuse the child. They were simple, familiar, everyday objects, pleasant to deal with, so the

children actually learnt by playing. They welcomed the chance they were offered to move around the classroom freely, to act independently, to research personally, so that they reached their own results and conclusions. In short, on completing a card they felt the satisfaction of success which built up their self-confidence.

c. It was a novel, different approach, suitable for every competence level. Quite unrepressed, they were able to proceed at their own pace, and thus they had no reason to develop negative attitudes towards Mathematics.

Concerning the teaching method the parents considered that it helped their children:

a. to become acquainted and acquire concepts and relations beyond the four basic processes of mathematics.

b. to combine knowledge with pleasure and play.

c. to conquer knowledge themselves through action and experimentation and not as a passive audience of listeners (arising from uninspiring teaching). As a mother characteristically reported, "it is a simple, attractive but also interesting approach to Mathematics, initiating the child into concepts beyond the four basic facts. The cards as well as the apparatus combine learning with play and that is the reason why. I think, my daughter who has always disliked Mathematics came around loving SMP 7-13."

d. It aroused their interest, thus they found it easy and comprehensible.

e. Starting from very simple, easy to perceive concepts they were thrilled with their success, their self confidence was strengthened thus they felt competent and eager to proceed further. Their initiation to more complex and difficult concepts was smooth after continuous revisions and consolidations of the same concepts which did not seem to bore or confuse them.

Naturally, opposite views were expressed as well. For instance, two of the parents answered that their children liked working with the cards occasionally only. In their attempts to clarify their responses, the first one explained that her daughter

preferred working on the manual and the second specified: "The cards as material plus the teaching approach are appropriately efficient and satisfactory. Of course, the apparatus is indispensable if one wishes to attract the children's interest and urge them to action. Nevertheless, I think that: a. sometimes the exercises could be solved in more than one way, which made them rather vague, b. since the apparatus was considered necessary for the solution of exercises the child could not work efficiently if he took cards home but could not get hold of the corresponding apparatus, as well, c. the cardwork was undoubtedly extra work for the child. At times the concept introduced by the card coincided with the corresponding Greek syllabus thus, offering a chance for consolidation and reinforcement. My daughter was then eager to work with the cards as she felt she was progressing faster and more effortlessly. When, however, it so happened that she was obliged to work on different concepts in the two systems then they weighed as two completely diverse subjects on her and tired her out."

The problems pointed out by the particular mother originated in the way the approach was applied rather than the SMP 7-13 itself or the teaching method it adopted.

Question 3 explored the children's response to the fact that two extra hours of Mathematics were added to their normal programme. Eleven of the sixteen parents answered that their children preferred doing Mathematics from both systems simultaneously. Four out of sixteen that they wanted to work with the cards and only one did not mind which of the two systems would be used.

Finally, the fourth question inquired whether the children sought their parents' help in order to complete the cards. Five of the sixteen parents answered negatively explaining that their children regarded the cards as a game and consequently faced no difficulties in understanding and completing them. Unfortunately, very few of the rest of the parents who replied positively bothered to report the reasons why their children needed their assistance. The few explanations given implied that the

children's difficulties stemmed from their inability to draw certain shapes or get hold of the appropriate apparatus, or finally, to understand the introductory text of the card either because it was not clear enough or because its formulation was incomprehensible.

2. The 9th School.

Nine parents out of the seventeen (53%) replied to the questionnaire here, but in comparison with the parents of the 41st school many more responded and indeed very enthusiastically to our invitation to come and discuss their views or objections concerning the system.

To the first question eight of the nine parents answered that their children enjoyed working with the cards. Only one parent reported that his son only occasionally liked the cardwork and explained that certain of the cards seemed easy to him while he faced difficulties in others. All eight of the first category of parents considered that their children's enthusiasm for SMP 7-13 was due to the possibility it offered them to do Mathematics through play. Thus, the children had fun and learnt Mathematics effortlessly in a very original and unusual way. Now as far as the teaching method was concerned they found it very effective. Their view was that it helped children learn more in a shorter time and in a much more pleasant and easier way than the traditional methods.

To the third question seven of the nine parents answered that in their opinion their children would like to study Mathematics through both systems simultaneously while two of them replied that their children would prefer to be taught through the cards only.

Finally, to the fourth question five of the nine parents answered that their children needed help in order to complete the cards, but unfortunately, they did not refer to the causes of their

children's difficulties. Only one of them wrote characteristically that his child rarely asked for help, whenever, that is, he could not find at home the apparatus he needed to fill in the cards. The remaining four parents reported that their children considered the cardwork as a game rather than homework, consequently they met no difficulties and never sought help.

3. The Aghia Triada school.

Here ten of the fifteen (67%) parents completed the questionnaire and most of them responded to our invitation for discussion.

To the first question eight of the parents answered that their children enjoyed working with the cards because:

- a. even if the SMP cards initiated the children in mathematical concepts, yet they were so pleasantly presented that they did not become tired but on the contrary had fun.
- b. the pictures and figures on the cards as well as the nature and variety of the apparatus attracted the children and made them regard the cards as a game.
- c. compared with their Mathematics manual exercises and the monotonous traditional teaching methods employed, the card based teaching approach was a pleasant surprise which helped the children work in a specially cheerful mood during the whole school year.

Concerning the teaching method all parents responded that it was right, effective, the most appropriate for this age.

One of the two parents who answered that their children liked working on the cards occasionally only revealed that his son did not feel at ease with too much writing so he took care to avoid it by taking home cards containing pictures or figures!

The second parent reported that his child found the syllabus tiresome due to the frequent revisions it included. That, he held, decreased his child's interest for the cards and accounted

for his occasional unwillingness to work with the particular material.

To the third question, seven of the ten parents replied that they believed their children would rather be taught through both systems simultaneously. two answered that their children preferred the SMP method and one reported that his son would like to have worked with one of the two approaches.

Finally, to the fourth question, nine of the ten parents replied that their children sought their help for the cardwork and only one wrote that his son did not ask for help because he understood the theoretical context or the instructions of the cards because of previous, relevant work at school.

In summary, reviewing the responses given it could be claimed that the majority of the parents of the children of all three schools (80%) held the opinion that their children liked working with the cards.

This, they presumed was a result of a. the original and pleasant way in which the cards presented the various concepts, as well as the variety of apparatus made available by the system. Working with the cards gave the children the impression they were involved in a fascinating game rather than in a Mathematics lesson, b. the teaching approach was so different from the traditional method that it offered the children the opportunity to move freely, act, and assume personal responsibilities.

Some reservations were expressed concerning the syllabus of the cards and the frequent revisions imposed on the child. Several obscurities were also mentioned concerning the instructions given as well as the phrasing of the questions which at times led to more than one solution.

Most of the parents thought that their children would prefer to have Mathematics using both approaches at the same time. A few parents expressed the view that the lesson should be solely based

on the SMP project but very few believed that their children should be working through one of the systems only.

Finally, the majority of the parents reported that their children needed help in order to complete the cards they took home. Unfortunately, very few of them referred to the particular difficulties encountered by their children. Several parents, however, acknowledged that their children sought no help since they found the cardwork especially attractive and did not have to try hard to understand a concept.

The meetings with the parents - those of them who responded to our invitation, of course - were very enlightening, since they were indicative of their attitude towards the material and the teaching method adopted for the research. It could be claimed, therefore, that the parents of the children of the Aghia Triada school and especially the ones of the Phinikas school were definitely more enthusiastic and open to change. They perceived that their children took real pleasure in working with the cards which they regarded as play rather than lesson. Many of them saw that their children assumed a positive attitude towards Mathematics. They worked happily and consequently made considerable progress which filled them with satisfaction and encouraged them to proceed further. The children's attitudes towards the project influenced their parents' opinions who almost unreservedly accepted the new approach. They were only a little sceptical about the project's possibilities to be applied successfully. A child, for instance, who working at his own pace and according to his abilities, completed in the course of a school year the first section cards only, could not possibly cover the required Greek syllabus in Mathematics.

The parents of the 41st school pupils, who mostly came from a professional background, were basically positive towards the new system, they were, however, more reserved and critical towards both the material and the teaching method employed. They were certainly pleased to see their children thrilled with Maths, even if a bit concerned by their willingness to work on the plan, when

no one forced them to do so, whereas they grumbled about the rest of their school subjects.

The particular parents took personal interest in the cards, supervised their children's work and several of them had the chance to witness for themselves the class atmosphere during the SMP hour as they visited the school while their children were working on the new Mathematics project. They were equally sceptical with the parents of the other two schools about the applicability of the system throughout the whole primary school years and its effectiveness in covering the syllabus for every ability level of the children. Moreover, here, however, the expediency of the system's persistence to use arbitrary counting units was questioned. They considered that certain concepts continued to be rather too simple and sterile with regard to the kind of knowledge they provided children with. Lastly they observed the possibility that the children's unprecedented enthusiasm about the new approach might be due to the fact that they regarded it as an activity outside their school obligations, and moreover, felt secure to face it being well-prepared by their work on Mathematics through the traditional method.

Definitely, however, all parents agreed on one point. Not only were their children reconciled to Mathematics, but they also enjoyed it, considering it to be one of the most pleasant school activities. Even with the critical comments made, there was a general impression gained that the use of the SMP was a satisfactory approach to Mathematics although such an introduction would require further investigation before it were generally accepted in Greek primary schools.

The teachers' questionnaire.

Judging by the answers given by the teachers in each of the three schools on the completion of the main study, it became evident that:

a. All three agreed with the way in which the various mathematical concepts were conveyed by the cards. They believed the cards to be instrumental in helping the pupils to master knowledge on a par with their individual capacities. The cards also offered them the satisfaction that they were quite competent, liberating them from any feelings of inferiority.

b. The children enjoyed the session of this particular programme, mainly because there was ample apparatus that they could easily use (in order to answer the questions posed by the cards) but also because the tasks appealed to them. Like some of the parents, they mentioned the competitive spirit among the children that the cards produced as well as the fact that even the most uninterested pupils of the class were attracted to the activity.

c. The children, in their opinion, had not profited very much on an academic level because there were not many chances for dialogue, and there were not any questions asked or opinions stated. Concerning the social level, the two teachers found the activity worthwhile, while the third held the view that the system's demand for personal work offered slim chances for co-operation and collective work. Finally, with regard to the pupils' advantage on a personal basis all three answered unhesitatingly that the use of the SMP cards was beneficial.

d. In most instances teaching with the cards really helped the children understand and enjoy Mathematics.

e. Compared with the previous system, SMP was much more effective because it offered the children a responsible role to play, it gave them confidence and regardless of their intellectual capacities, the satisfaction of success.

f. The use of apparatus was indispensable in the understanding of the various mathematical concepts, and they themselves admitted the beneficial use of the apparatus in their Mathematics class.

g. A system of teaching like SMP could be applied to the Greek school under certain conditions: i. that its application should be limited to the lower forms in a school ii. the number of children per class should be small iii. the hours of Mathematics teaching should increase iv. certain school rules should change in order to facilitate the use of SMP.

h. They themselves would not object to the introduction of a system like SMP , in case the Ministry of Education decided it, provided that they were offered special, intensive, in-service courses for their orientation towards the programme.

It should be noted that apart from their answers to the questionnaire, in the course of private discussions, the teachers expressed some second thoughts both in regard to the effectiveness of the teaching methodology and to the possibility of its application in Greek schools.

Some of the reservations they expressed concerned:

a. A general restlessness in the classroom as well as the constant noise the children made during the session, which, in their opinion, was very tiresome both for the teacher and the pupils and it could be exhausting for the teacher, if it went on throughout the teaching day.

b. A very limited chance for communication between teacher and pupils and among the pupils. They claimed that the system offered the teacher few chances to elucidate a new concept with the entirety of the class, to use the blackboard, to initiate a dialogue, and generally to create such situations that would enable the students to use the mathematical language and allow them to communicate with each other with mathematical terms and symbols.

c. The fact that the teacher was obliged to repeat the same analysis or explanation two or three times in the same session to different children and this naturally went on for weeks or months.

From a certain point of time onwards, they maintained it would be very difficult for the children to remain in the same group, as the children within one group would progress at different rates than others and, thus, they would deal with different topics at the same time. The teacher, therefore, would have to check daily which children would be working on the same topic before she could make her theoretical introduction. Even in this case,

nothing could guarantee that all the children would have listened to the theoretical analysis on all topics throughout the year.

d. The few chances the system offered the children to familiarize themselves with numbers and mathematical facts, as well as with the solution of mathematical problems. On the contrary, they believed that the system persisted and consumed too much time on concepts, such as capacity, weight, money, etc., implementing, moreover, arbitrary units.

e. The applicability of the system, even if the teachers were well disposed towards it, unless the function of the Greek elementary school was revised and some changes were attempted to the system itself or the existing system was combined with some other teaching approach.

f. The teachers' unwillingness to exchange the security of their old and tried working conditions for a radically new teaching approach which they considered would be definitely much more demanding.

Conclusively, it could be argued that the teachers saw both the SMP project and the teaching method employed positively, even though they were sceptical as to whether it was a system that could be effectively applied to the Greek primary school at present, considering the existing structural and functional conditions prevailing in the sector.

3. The children's questionnaire.

It was also decided important to gauge the pupils' reactions to the project by means of a questionnaire. From so doing, it was hoped that the children would indicate their feelings and thoughts about the work they had completed during the project, since the children's attitudes to Mathematics are as important as their competence in the subject. In the APU Mathematical Development (p. 114), it is stated that

the thoughts and feelings of pupils towards the activities they engage in at school are an important feature of their learning.

not only because of evidence that they interact with attainments but because positive attitudes are considered a desirable accompaniment to learning.²⁸

Another aim of the questionnaire was the selection of information on the difficulties that the children encountered in dealing with the various topics of the first section cards. Finally, it was seen as important to know the pupils' personal views concerning the project itself and its application in class.

a. The questions asked and the replies made by the children.

The questionnaire consisted of eight main questions all of which referred to the experience the pupils had in using the SMP material for a whole school year. Fifty four children in all completed the questionnaire, in particular, twenty five in the 41st school, fourteen in the 9th and fifteen in Aghia Triada school. Several questions went unanswered by some of the children, therefore, the number fifty four is not accurate for all eight questions. Nevertheless, the number of children who answered each particular question is given.

In general, the children's answers in all three schools were rather contradictory and to record them in a diagram was deemed rather difficult and pointless, since it would neither give a clear picture of the children's evaluation of the project, nor offer grounds for discussion and comparisons.

It was, therefore, considered more appropriate to present the pupils' answers in a tabular form being thus able to discuss and compare them. The particularly interesting answers are discussed in some detail. However, as previously stated, certain opinions are contradictory in nature, so even if the children's answers are of interest and in certain cases illuminating they should be interpreted with caution.

The children's responses to the questionnaire might have been influenced by certain factors which are mentioned here.

1. When asked to answer the questionnaire the children had already finished the first section cards and some of them had proceeded to the second, even the third section. It would, therefore, be very natural for them to have forgotten several of the cards they had worked on, at the beginning of the project, thus one might argue that their answers were given at random.

2. The children's positive answers probably reflect their eagerness to please their teacher, or, moreover, their attitude that everything introduced at school is right.

3. Certain children, in their effort to appear as equally good, enthusiastic and careful as their bright classmates, copied their answers. Others, on the other hand, in an attempt to be different gave highly improbable answers.

1. Did you like doing Mathematics from the SMP cards?

Answers	YES	NO
41st	25(100%)	-
9th	14(100%)	-
Aghia Triada	15(100%)	-

2. Name the cards that you liked most.

Answers:

Schools	All	Vol. Cap.	Money	Measure	Weight	Time	Shape	Math. Skills	Meaning- less
41st	9				5	7		6	
9th	3	5		1	1	3	1		1
A. Tr.	12			1				1	1
	44%	9.3%	0%	3.7%	11.1%	18.5%	1.9%	13%	3.7%

Note: In this question two pupils of the 41st school and one pupil of the 9th school named cards on two different topics and thus the answers appear to be twenty seven instead of twenty five and fifteen instead of fourteen correspondingly.

3. Which of the cards did you like least?

Answers:

Schools	None	Vol. Cap.	Money	Measure	Weight	Time	Shape	Math. Skills	Meaning- less
41st	14					4	1	6	
9th		5	1	1	1	1		4	1
A. Tr.	11			1				2	1
	46.3%	9.3%	1.9%	3.7%	1.9%	9.3%	1.9%	22.2%	3.7%

Note: In this question the pupils who answered "None" actually meant that they liked them "All."

4. Name the topics you found particularly difficult.

Answers:

Schools	None	Vol. Cap.	Money	Measure	Weight	Time	Shape	Math. Skills	Meaning- less
41st	9		1		1	6		8	
9th				2	1		2	8	1
A. Tr.	15								
	44.4%		1.9%	3.7%	3.7%	11.1%	3.7%	29.6%	1.9%

5. Why, do you think, were these topics so difficult for you?

Answers:

Schools	No diffi- culties	Difficulties related to the mathematical content	Difficulties related to the practical work	Personal views
41st	25			
9th		12	2	
A. Tr.	15			
	74.1%	22.2%	3.7%	

6. Which of the subjects did you find easier to understand?

Answers:

No of Pu	Schools	None	Vol. Cap.	Money	Measure	Weight	Time	Shape	Math. Skills	Meaning-- less
25	41st	8	1			5	4	1	6	
12	9th	2	2		2		1		4	1
15	A. Tr.	10					2		2	1
52		38.7%	5.8%		3.8%	9.6%	13.5%	1.9%	23.1%	3.8%

Note: In the 9th school, two pupils (namely Vasso and Vangelis) did not answer the questions from 5 onwards. Thus, the answers produced by the 9th school pupils appear to be twelve instead of fourteen from question 5 below.

7a. Would you like to be taught Mathematics from the SMP cards more often?

Answers:

<u>Schools</u>	<u>YES</u>	<u>NO</u>
41st	25	
9th	12	
A. Tr.	12	3
	94.2%	5.8%

7b. If your answer is "YES" what else would you like the cards to include?

Answers:

Schools	Nothing else	Math. skills	Practical work	Appearance of the cards	Personal views
41st	5	3	4	2	8
9th	1	2	5	4	
A. Tr.	4	1		4	4
	19.2%	11.5%	17.3%	19.2%	23.1%

Note: This question was not answered by all the children. Thus, three pupils out of the twenty five of the 41st school and two pupils out of the the fifteen of Aghia Triada school did not answer the question.

7c. If your answer is "NO" explain why.

Answers:

<u>Schools</u>	<u>About the project</u>	<u>Personal views</u>
41st		
9th	2	1
A. Tr.	2	1
	7.7%	3.8%

Note: All the pupils of the 9th school had already answered the questions 7a(that is, that they would like to spend more time on the SMP cards) and consequently they should not have answered question 7c. Nevertheless, there were still three pupils eager to justify their dislike of some aspects of SMP.

8a. What did you like most about the SMP cards?

Answers:

<u>Schools</u>	<u>Everything</u>	<u>Math. skills</u>	<u>Practical work</u>	<u>Appearance of the cards</u>	<u>Personal views</u>
41st	9	3	4	3	6
9th			7		5
A. Tr.	1	1	3	5	5
	19.2%	7.7%	26.9%	15.4%	30.8%

8b What were the things you did not like?

Answers:

Schools	We liked everything	Math. skills	Practical work	Appearance of the cards	Personal views
41st	17	1	5	1	1
9th	2	4	2		4
A. Tr.	10	1			4
	55.8%	11.5%	13.5%	1.9%	17.3%

b. Discussion on the children's questionnaire.

1. The cards were favoured among all children.
2. The answers of the children of the 41st school were all to the point, whereas the children of the other two schools even at very low percentages (3.7% at the most) went astray.
3. The most diverse answers came from the children of the 9th school, while the Aghia Triada school children gave very general answers of the type "all of them," "none".
4. 44% of the children responded positively to the second question, that is they answered that they liked the SMP cards, whereas to the 3rd question a 46.3% of the children actually produced the same answer.
5. In the questions concerning volume and capacity a 9.3% of the children claimed that the particular cards attracted them more but the same percentage of children rejected the very same cards.
6. The subjects money and shape were the least popular among the children. Money in particular was the subject not even once mentioned favourably while a 1.9% of the children reported it as the subject they liked least. As regards shapes a 1.9% of the chil-

dren referred to them as their most favourite subject and the same percentage reported the opposite.

7. The cards on weight, time and the various mathematical skills were the most favoured by the children according to their answers to question number 2. The percentage of the positive responses were correspondingly 11.1%, 18.5% and 13%.²⁹

8. The subjects the children liked least were obviously the ones on mathematical skills. The negative responses came up to 22.2% in contrast to 9.3% for volume and capacity and 9.3% for time, the immediately less popular subjects among the children.³⁰

9. The most difficult subjects may safely be considered the ones concerning mathematical skills (29.6%).³¹ The second hardest subject was time, despite the fact that its cards came first in the children's preferences (positive responses 18.5%).³²

10. Even if 44.49% of the children reported that they faced no particular difficulties in any of the subjects, nevertheless, this percentage could not be considered accurate since, it increased up to 74.1%, when the children were asked to mention the causes of their difficulties. Therefore, according to the children's responses the difficulties were mainly due to the mathematical contents of the cards (22.2%) and to a lesser extent to the practical work the cards required.

11. The subjects the children found easier to grasp were the ones concerning the mathematical skills and time at a percentage of 23.1% and 13.5% correspondingly. The same subjects were also the ones which, as the children confessed, caused the greatest difficulties (29.6% for the mathematical skills and 11.1% for time).

12. 94.2% of the children wished they could have spent more time on Mathematics with the cards, while the remaining 5.8% who responded negatively came from the Aghia Triada school.

13. 26.9% of the children liked the practical work required by the cards more, while 7.7% liked the mathematical skills and 15.4% liked the lay-out of the cards. Now the percentages of the children who, on the contrary, disliked the cards for the very same reasons were 13.5%, 11.5% and 1.9% correspondingly. Finally.

14. Many children (19.2%) expressed their wish that the appearance of the cards might be improved and 17.3% demanded more practical work.

c. Some comments on the children's answers.

A comparison of the replies the children of the three schools produced and the formulation of those replies would yield the following results:

i. The children of the 41st school produced elaborate replies, neatly phrased and made an attempt to present difficult things easily. They had no difficulties in expressing their opinions concerning the project and the teaching approach. Thus they stated that they "would like the cards to have more humour" and that "they wished there were less noise in the classroom".

ii. The responses of the pupils of the 9th school show that the elements of the project that particularly attracted them reflect their deficiencies, while the elements they rejected denote their cognitive weaknesses. Their replies reveal their need for action and movement. They apparently face problems in justifying their opinions or attitudes. Their vocabulary was rather poor, their answers were often vague and very few were correctly formulated and to the point. To the question "What else would you like the cards to include?" they responded with a request for more apparatus and pictures more colour, drawings, activities, more toys, "things" and dolls.

iii. The replies of the Aghia Triada school pupils were rather general indicating a sort of laziness or covering their weak-

nesses to express themselves accurately. Still there were some children who had the honesty to admit they would not like to spend more time doing Mathematics from the cards and quite frankly gave their reasons for that: ("Because Maths are more difficult," "Because I had other homework to do," "Because they would be more difficult.")

Depending on the answers the children gave we can divide them into categories:

i. The ones who surpassed themselves, eager to express their enthusiasm and gave answers of the type:

"I wish they (the cards) were more difficult."

"I wish they had more exercises."

"I would like to write more numbers."

ii. The pupils who "got under the skin" of the system and expressed their sincere desire that the cards were better, in their opinion always. Answers of this category include:

"I wish they had more colours,"³³

"... there were 4 sheets (as with the cards on diagrams)."

"I would like to do more maths from the cards."

iii. The children who either encountered difficulties or worked quite smoothly but with no enthusiasm gave answers of the type:

"I wish they (the cards) were easy."

"I would not like to do more Mathematics from the cards."

"I had difficulties to understand."

The answers to 8a especially (what did you like most about the SMP cards) describe some of the main characteristics of the SMP project which influenced the choices of the project for our research. A close examination of each one of the children's answers assesses our very reasons for adopting the SMP project.

The children's answers

"The pictures"

"The colours"

"We count with things"

"Because I count
with my fingers."

"That I made progress"

"Because I weighed"

"That I could go out"

Reasons for adopting SMP 7-13

The simple friendly drawing of the card and the recurring characters give the project its identity.

The cheap, familiar apparatus employed by the children for the completion of the cards associates Mathematics with everyday life. Furthermore, the child feels encouraged, comfortable to use any piece of apparatus available.

There are cards suitable for every ability level.

Individual learning satisfies the needs of every child.

The children learn Mathematics through practice. Instead of solving or completing exercises in their books they acquire knowledge through experiences deriving from their occupation with everyday activities.

The fact that the children were not confined to their desks and could move freely suited the needs of their age.

Finally some of the answers to 8b highlight those characteristics of the project that are particularly tiring or unpleasant to the children.

Answers like:

"the questions"

"Because there were too many (cards)"

"Because they were difficult"

"Because the teacher was not there to show me"

show that the long and sometimes incomprehensible text is annoying in an individualized system that substitutes the teacher. The children being accustomed to their teacher's explanations find it hard to read, understand and answer the questions. The very short time that the teacher can devote to each child, a problem anyway in an individualized project, becomes more acute when a class has a greater number of under-achieving pupils in reading and/or Mathematics.

Thus children's reactions to the project and their answers to the given questionnaire serve as good indicators for the advantages and positive characteristics of the project itself and the teaching approach as well as for the deficiencies of the project and the problems that occur during its application.³⁴

Discussion on the children's responses to the first section test.

The children's responses to the first section test. 35

It has already been mentioned that forty nine children out of the fifty seven participating in the research project took the test on section 1. Five of the remaining eight children did not complete the test because of difficulties already described (p.137). Finally, the three other cases were children who worked at such a slow pace that the material they had covered at the end of the school year did not qualify them to take the test. Thus, our sample, small to begin with, was further limited. Despite the small sample, however, an evaluation of the test results was deemed of great importance. A closer examination of the erroneous or unanswered replies could be indicative of the difficulties the children faced in tackling the particular subjects.

Moreover, several conclusions could be drawn by examining the different difficulties faced by boys and girls in the same or in all three schools of the research project. Finally, the possibility that the children's social class might have influenced their performance in Mathematics could be examined.

For all these reasons we examined and included in column diagrams the following cases:

1. The sixteen most difficult exercises experienced by the girls/boys of each school separately.
2. The common most difficult exercises experienced by girls/boys.
3. The number of unanswered questions by girls/boys.
4. The three schools' pupils' progress over the year.

Each case is deliberated separately followed immediately afterwards by a parallel presentation and discussion of the corresponding bar charts.

1. The sixteen most difficult exercises experienced by the girls/boys of each school.

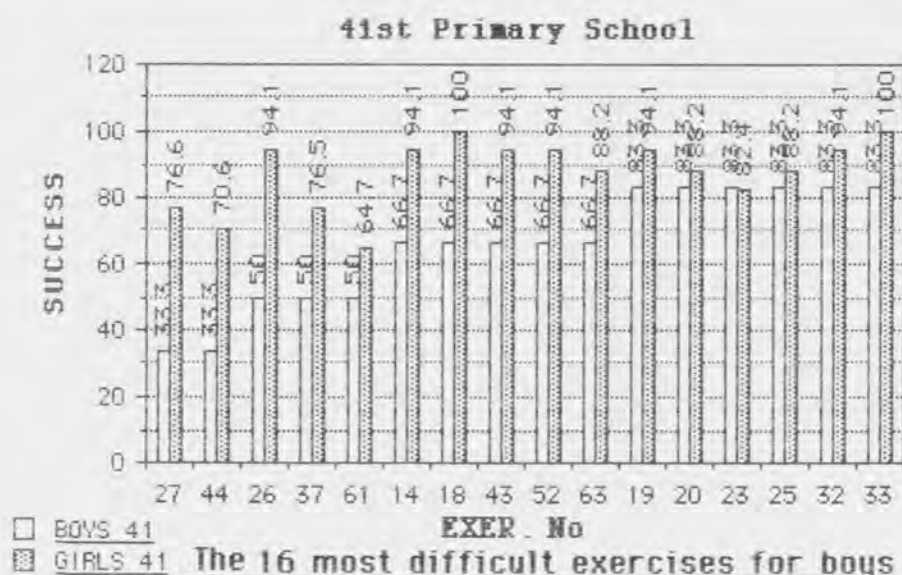
Each test paper consisted of thirty two exercises based on the material taught through the use of the cards. It has already been mentioned (p.119) that the test given was the original SMP test translated into Greek with only slight changes in places in order to take account of the Greek syllabus (this, after all, had been our main concern in adopting the SMP cards to Greek).

Several exercises included three or four questions, so that the total number of questions came up to sixty eight. Each question, regardless of its difficulty, was marked with one point, thus, by securing sixty eight points, the pupil was considered to have understood and mastered all the mathematical concepts involved. The first sixteen most difficult questions experienced by boys and girls of each one of the schools are separately scrutinized here. There were certainly more questions causing as many difficulties as the sixteen selected, yet they were not included in the diagrams. Moreover, the children seem to have encountered the same amount of difficulty in the four or five last questions.

In an effort to determine the sixteen most difficult questions, we calculated for each question the percentage of success for the boys/girls of each school. The analytical results for each school are as follows:

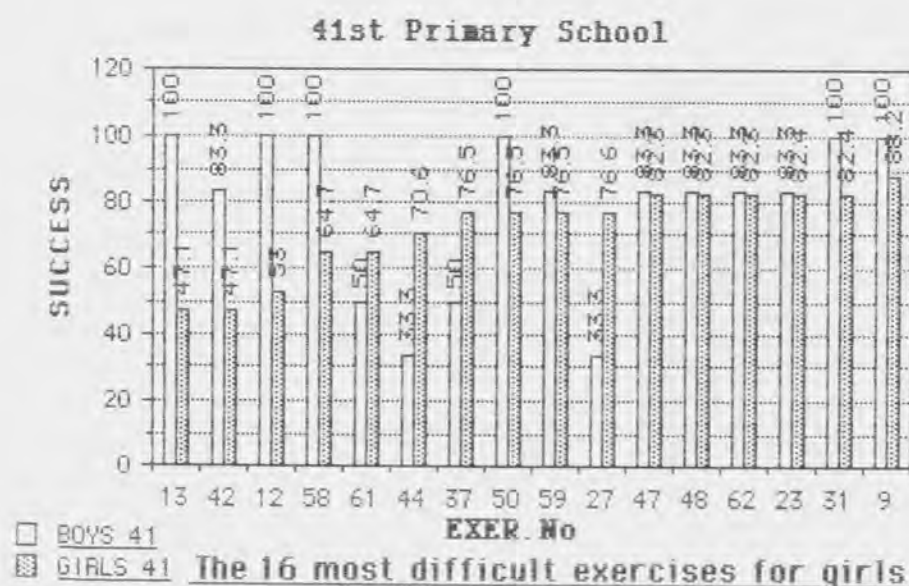
a. 41st primary school.

1. The sixteen most difficult exercises experienced by boys.



The most difficult exercises for the 41st school boys appear in bar chart P1. The success percentage for boys and girls in every exercise is also displayed. The numbers on the horizontal axis represent the corresponding exercise in the test sheet. (1) Thus it becomes obvious that in exercise numbers 20, 23, 25 boys and girls faced the same difficulties. On the contrary, in exercises 27 (a coin problem), 44 (a coin exercise), 26 (an expression of subtraction) the success difference between boys and girls was considerable and the girls rather than the boys dealt more successfully with these exercises.

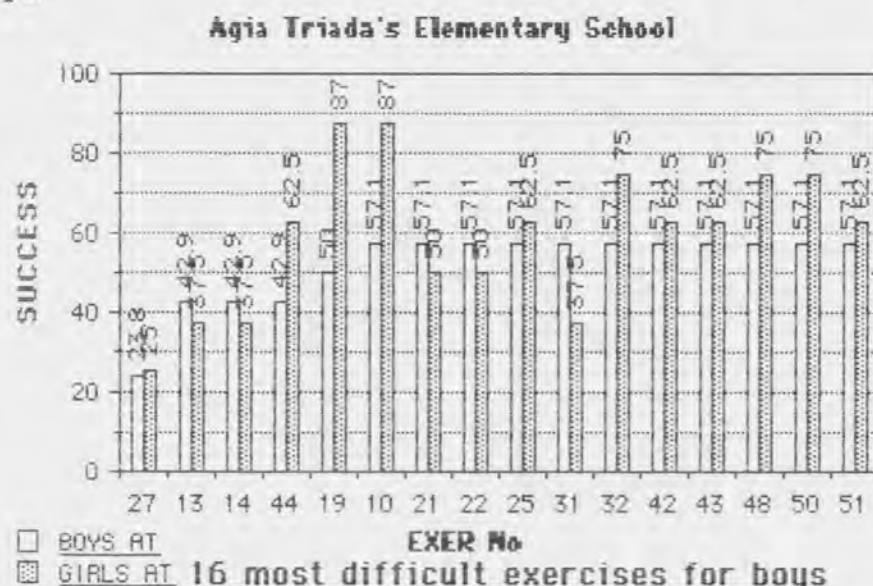
2. The sixteen most difficult exercises experienced by girls.



What we can observe here is that in exercises 47, 48 (subtraction with the symbolization of correspondence), 62 (a subtraction-addition problem) and 23 (counting up by two in the number line) boys and girls encounter almost the same difficulties. Nevertheless, in exercises 13 (fractions), 42 (a coin exercise) and 12 (subtraction with the implementation of the term "take away") the girls undoubtedly face more serious difficulties than the boys.

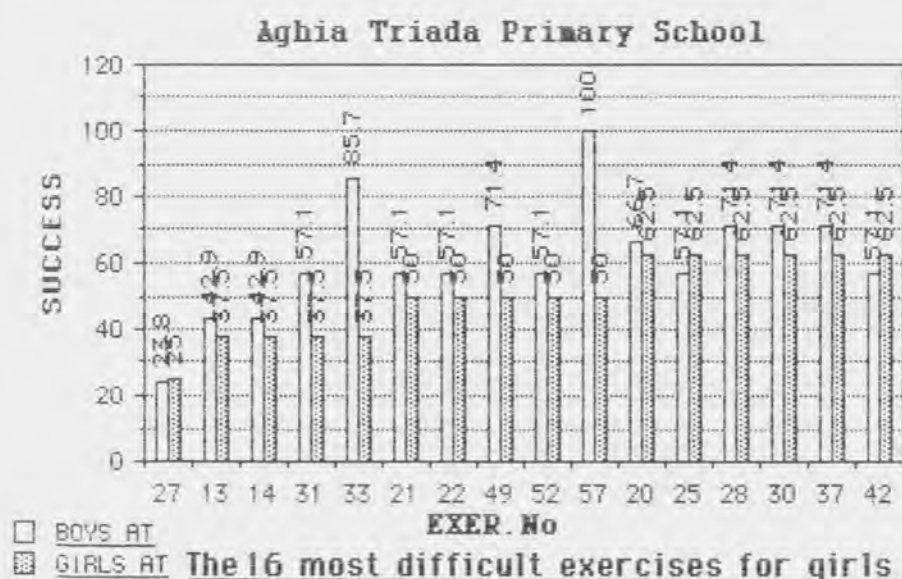
b. The Aghia Triada primary school.

1. The sixteen most difficult exercises experienced by boys.



From bar chart P3 it becomes obvious that in exercises 27 (a problem on money, which can be graded as the least successful exercise among the boys), 13, 14, 21 and 22 (fractions), 25 (counting up by four in the number line), 42 and 43 (exercises on money) and 51 (the turn on the right) boys as well as girls experience the same degree of difficulty. In general, what the diagram suggests is that for the particular exercises the difference of performance between boys and girls is rather insignificant. A considerable success difference can be detected only in exercises 19 (fractions) and 10 (subtraction with correspondence symbolization) where girls are certainly more successful than boys.

2. The sixteen most difficult questions experienced by girls.

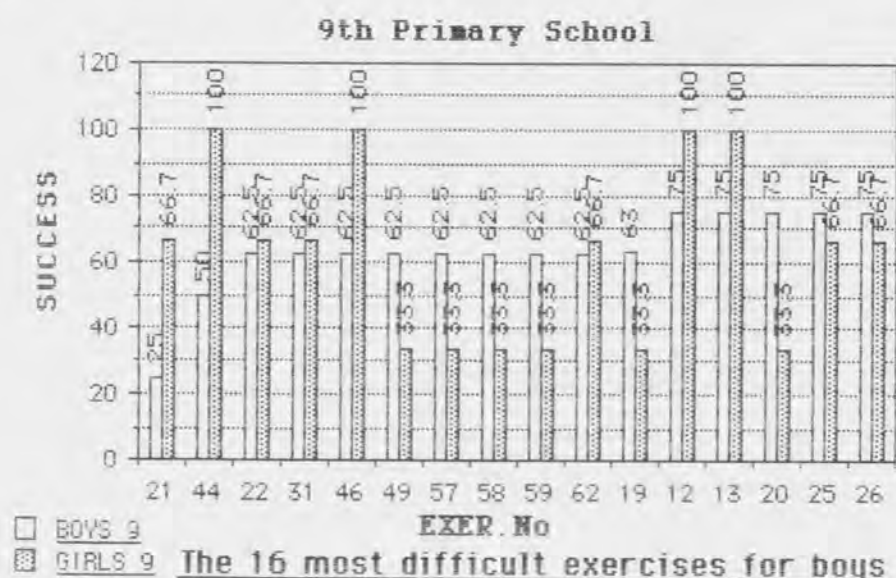


In column diagram P4 we can observe once more that in most exercises the difference of the success degree between boys and girls is minimal. In exercise 27 scores of boys as well as girls were at the lowest point. In short, only in four out of the sixteen exercises characterized as the most difficult for the girls did the boys score much higher than the girls. These were exercises 31 and 33 (the use of the abacus and the symbolization of a two-digit number), also 49 (a division problem) and 57 (the difference of two given numbers). In fact, in the last exercise, 57, the success rate of the girls was 50% as opposed to the boys' 100%.

The above scores do not indicate that there exist such topics where boys' achievement rates are markedly different from those of girls'.

c. The 9th primary school

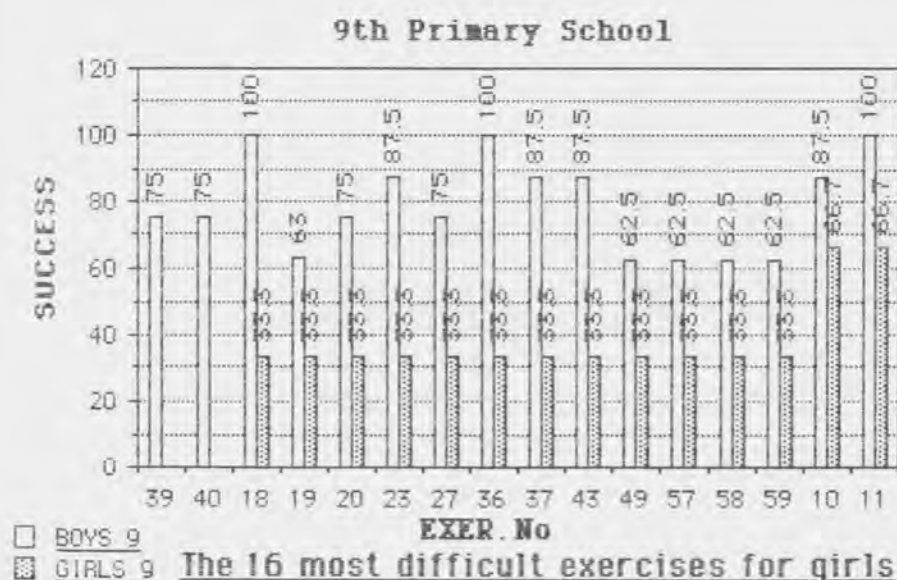
1. The sixteen most difficult exercises experienced by boys.



In column diagram P5 it appears that in eight of the sixteen exercises characterized as the most difficult ones for the boys the success rate of the boys was higher or even much higher than the corresponding one exhibited by the girls.

Exercise 21 (fractions) gets the lowest scores while in exercises 12, 13, 44 and 46 the girls are 100% successful, whereas with the boys' scores being 75%, 75%, 50%, 62.5% respectively their degree of success was clearly lower.

2. The sixteen most difficult exercises experienced by girls.



Column diagram P6 shows that in all sixteen exercises considered as the most difficult ones for the girls the boys gathered from higher to much higher scores. In particular, in exercises 39 and 40, which dealt with time, the success percentage was 0%, while for the remaining exercises the success rate was 33,3%,³⁹ except for 10 and 11, where they were 66,7% successful.

The above percentages point out that at the particular topics the girls encountered significantly more difficulties from the boys. Perhaps, this is due to the fact that the number of girls who participated in the research was very small.

2. The common most difficult exercises experienced by boys/girls.

Table 1 shows for each one of the sixty eight exercises the success rates expressed in percentages for boys and girls of the three schools separately. From this table we distinguished

those exercises in which boys/girls of all three schools scored the lowest, in the hope of discovering the specific topics which caused difficulties to both boys and girls. If such topics existed and we managed to identify them, teaching strategies could be adopted which would perhaps lead to an alternative approach and the provision of supplementary activities.

The diagrams highlighting the common most difficult exercises experienced by boys/girls are presented below.

a. The common most difficult exercises experienced by boys.

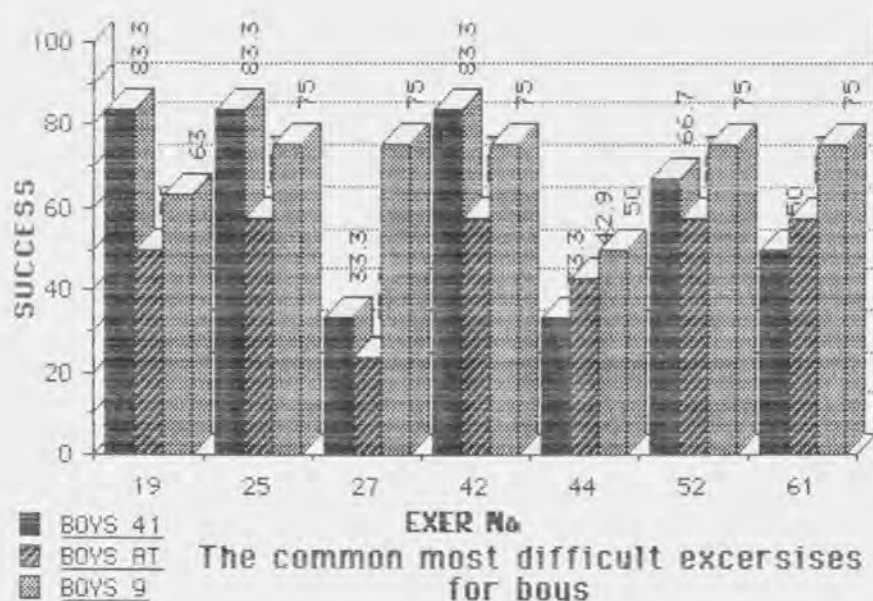


Diagram P7 indicates that exercise 44 (on the use of coins) was the one that the boys in all three schools found most difficult.

Furthermore, it appears that with the exception of two exercises (44 and 61) the boys in the Aghia Triada school scored the lowest in the common most difficult exercises.

Exercise 27 (on the use of coins) was the one among the seven common most difficult exercises for which the success rates among the three schools differed most greatly. Thus, while the success rate of the 41st and Aghia Triada schools were rather

low but close, the corresponding success rate for the 9th school was much higher.

b. The common most difficult exercises experienced by girls.

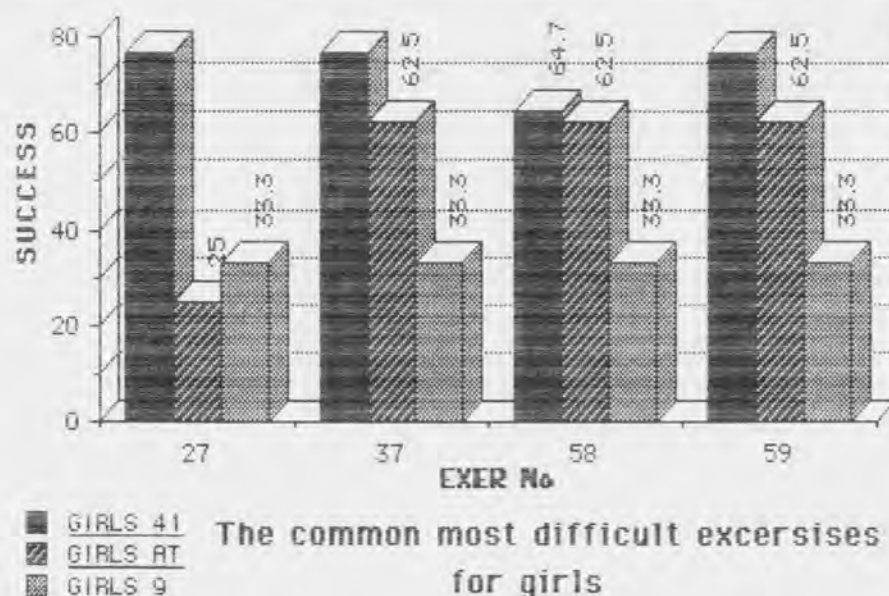


Diagram P8 shows the four most difficult exercises for the girls. In all four exercises the 41st school girls scored higher than the rest. The 9th school girls, with the exception of one exercise, scored the lowest.

The progression here is quite clear. At the top of the success scale came the 41st school girls, followed by the Aghia Triada school girls but not with a big difference between them (except for exercise 27) and last came the girls from the 9th school.³⁷ We should perhaps stress the fact that the results might have been different if the number of the 9th school girls who participated in the test had not been so limited.

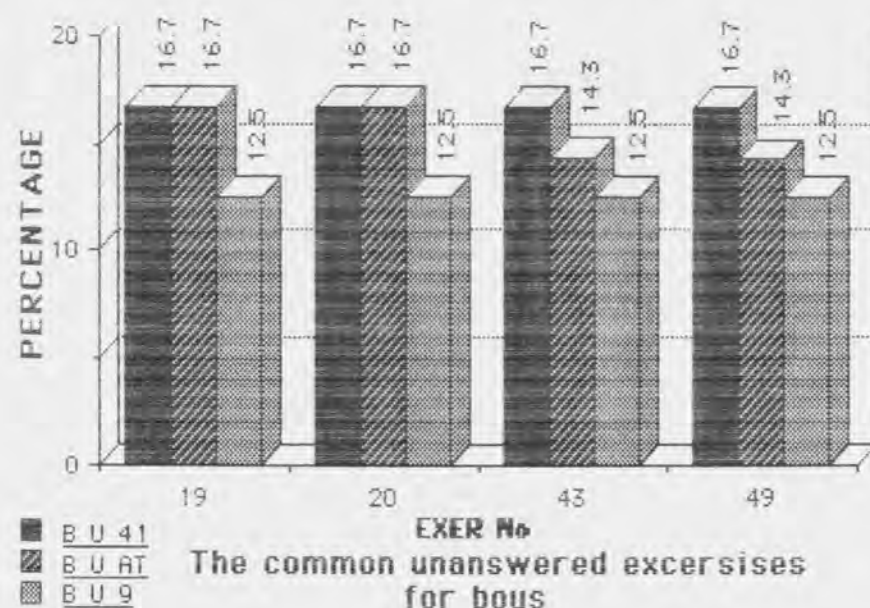
Furthermore, by considering the results of diagram P8 and those of diagram P7 (referring to the boys' results) it can be observed that the success rates of the 9th school boys gave a much better picture than the corresponding one of the girls, while the reverse was true for the Aghia Triada children.

3. The common unanswered exercises by boys/girls.

Some of the exercises went unanswered by both boys and girls. It was considered that a close examination of those exercises might prove useful. By pin-pointing those particular exercises and the topics to which they referred the reasons which might have influenced children's attitudes to those particular items could be highlighted.

The column diagrams P9 and P10 display the common unanswered questions by girls/boys.

a. The common unanswered exercises by boys.

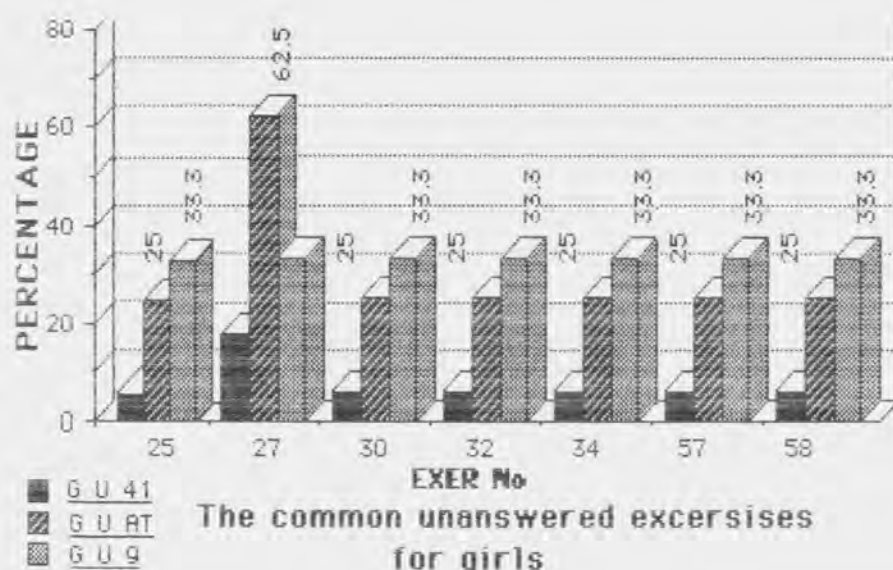


The exercises which a number of boys in all three schools did not answer were numbers 19 and 20 (on fractions), 43 (on the use of coins) and 49 (a division problem). In those particular exercises the 41st school steadily presented the highest degree of unanswered exercises, with the boys of Aghia Triada school coming next and the 9th school last with indeed the smallest percentage in all four exercises.³⁸

One possible explanation for the above results is that the 41st boys did not risk to give an answer which they did not feel certain about, while the 9th school boys did not elaborate their answers so much.

Of course, an alternative interpretation might be that the 9th school boys found the particular exercises less difficult than the 41st school boys.

b. The common unanswered exercises by girls.



Column diagram P10 shows the common questions to which a number of girls in all three schools did not answer.

It can be noticed that the 41st school girls were able to answer more questions, therefore there were fewer unanswered questions overall. The Aghia Triada school girls are less successful (with the exception of exercise 27 which deals with the use of coins and in which they exhibit the highest percentage). Lastly, the 9th school girls follow with a stable percentage of reluctant to reply pupils (one out of three girls) which is also bigger than the corresponding percentages of the other two schools.

Finally, a comparison of P9 and P10 diagrams indicates that the 41st school boys reveal the highest percentage of unanswered exercises, while the girls of the same school display the lowest percentages in all cases.

4. The three schools' pupils' progress over the year.

In diagram P11 the progress of the three schools' pupils is displayed through the three tests given in the course of the school year.

Test 1 is the pre-test given in October, the beginning of the school year, and before the research commenced. The questions of test 1 were based on the Mathematics syllabus covered the previous school year, as well as the period up to the day the SMP project started.

The children were given test 2 at the end of the second term. The questions included in the test were based on the material taught through the use of the SMP cards up to the time the test was given. The test was not common for all the children, since, being an individualized programme, SMP allowed the children to work at their own pace and thus proceed accordingly. Therefore the children were divided into groups according to the section 1 topics they had covered and the researcher prepared a different test for each group (eight tests in all).

Finally, test 3 is the test each pupil took on completing the section 1 material. Consequently, not all children took this last test at the same time.³⁹

Test 3 was a translation and adaptation into Greek of the test furnished by SMP 7-13 on the section 1 material. By adaptation we mean the researcher's decision to leave out those questions that referred to a syllabus different from the one prescribed by the Greek curriculum and to insert exercises based on the mate-

rial the children had covered through the Greek version of SMP instead.⁴⁰

Before the findings of diagram 11 are deliberated some clarification concerning the size and distribution of the sample are in order here.

a. The number of the children in the 9th and Aghia Triada schools was limited, eleven and fifteen pupils respectively. Considering that the normal class is usually made up of twenty five to twenty eight pupils⁴¹ it becomes obvious that the particular sample, especially the 9th school's, is by no means representative of the total population.

b. The proportion of boys/girls of the three schools involved in the research was not proportionate (that is, approximately equal number of children of both sexes in each class). Thus: i. in the 41st school the children that took the test were seventeen girls and six boys. ii. in the 9th school the test was completed by three girls and eight boys and finally iii. only in the Aghia Triada school the number of boys and girls that took the test was in an acceptable proportion (eight girls and seven boys).

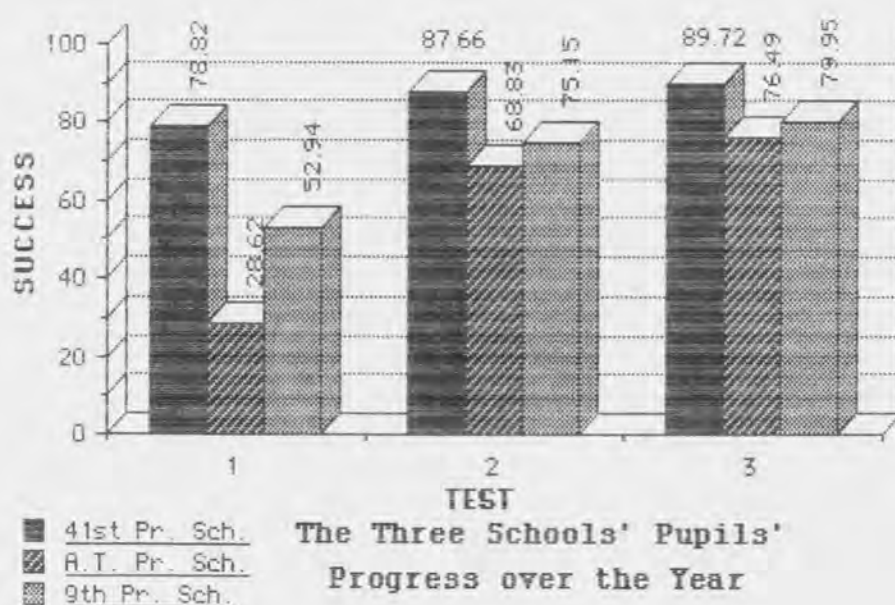
In conclusion, the total number of girls who took the test is bigger compared with the number of the boys (twenty eight girls/twenty one boys).

c. The teaching session devoted to the SMP project was not only short but it was also the last of the day, thus it so happened that several children did not have enough time to complete the test, particularly in the case of the third test. Hence in an effort to give all the children adequate time to answer all the questions, they were allowed to finish the test in the next teaching session. The time allowed, therefore, could not be the same for everyone, but it was deemed ample and ranged from less than a teaching hour to one and a half hours.

d. The children were taught from the SMP cards twice a week. At the same time, however, according to the Greek curriculum, they were taught Mathematics from their prescribed books three or four times a week. Thus the time allowed for the SMP approach was considerably less than that spent on Greek curriculum Mathematics.

e. The 9th school children experienced a pronounced reading disability; in consequence, when the first test was given they were unable to read and understand it. That reading inadequacy caused them a lot of anxiety which often resulted in tears. Those children needed and demanded special treatment different from the one followed for the other schools' pupils. Their class teacher usually volunteered to read and further explain the text of the exercises, an act which possibly influenced the children's responses positively. One might argue, therefore, that their 52.94% success score did not represent their understanding and mastery of the corresponding mathematical concepts and had they been left to complete the test alone they would not have achieved such high scores.

Bar chart P11 shows the progress made by the children of each school, compared at the same time with the corresponding progress of the other two schools.



Taking into consideration the data depicted in the chart the following observations can be noted:

a. The initial success order of the three schools (the 41st leading, with the 9th following and the Aghia Triada school coming last) remained unaltered to the end of the research.

b. In all three schools children steadily improved with the Aghia Triada school children exhibiting the most obvious progress (from 28.62% in the first test to 76.49% in the third) and the 41st school children achieving the least significant one (around 10%). This may be due to the fact that their success percentage was high enough from the very first test (78.82%) and definitely much higher than the corresponding ones of the 9th (52.94%) and the Aghia Triada schools (28.62%).

c. The achievement differences of the three schools gradually decrease and the distance of the two schools from the 41st (which constantly remains at the top) diminishes. From the columns representing the success percentage of each school in test 3 it appears that despite their remarkable progress, the success rates of the 9th and Aghia Triada schools hardly approach the success of the 41st school in the first test (the 9th surpasses the 78.82% success percentage of the 41st school by 1.13% and the Aghia Triada school lags behind by 2.33%).

d. The achievement difference marked between the 9th and the Aghia Triada schools gradually diminishes. Thus, while for test 1 this difference (even if not absolutely accurate for the reason mentioned on p.196), is 24.32%, it is reduced to 7.32% for test 2 and becomes 3.46% for test 3.

[Further discussion on the findings and the possible reasons that influenced them is offered in Chapter V.]

Finally, the total degree of progress made by the pupils of the three schools was measured by calculating the differences of the

scores achieved in the three tests. There were a number of weaknesses innate in this procedure and an analysis of co-variance could be a more accurate method. A statistical analysis of the findings was considered pointless at this phase of the research, as i. the samples of the present study were very limited, therefore they could not have been representative of the population, ii. parallel to the application of the card based teaching approach the children were being taught through the use of their Greek Mathematics books in order to cover the syllabus prescribed by the Greek curriculum, iii. the time devoted to the research was not adequate. Should we be given the chance to examine in depth our present findings with a view to conducting a more elaborate research programme, with a greater measure of control, a more sophisticated statistical analysis of results would be appropriate. Thus the findings and their interpretations should be considered in relation to the acknowledged limitations of the present study.⁴²

NOTES

1. See appendix A , pp. x, xxxiii, xlv, lxiii.
2. At the beginning of the main study, these boxes were four, they became eight later and finally, towards the end of the year, they became ten.
3. The short teaching session (40'), the teaching discontinuity (only twice a week) and finally the notion of the temporary that the teaching of Mathematics from the cards pertained (it was not the only approach followed and it was not carried out by the class teacher) made the continuous display of the SMP apparatus rather impracticable.
4. It was extremely difficult for materials such as wash-basins of different sizes to be carried around.
5. See appendix A , pp. xxxii, xlv.
6. For details see ch. III, p. 106.
7. See *Mathematics Counts* (Cockcroft Report), p. 91.
8. At the beginning of the research and in order to make the cards of the four boxes suffice, it was decided to divide the children into three groups, according to their competence in Mathematics. So very briefly we discussed the addition of numbers up to 20, time, the week, days and hour (both whole and half). Also, the longer-shorter relations, where some arbitrary units of length were mentioned.
9. Unifix and counters for addition, cardboard clocks for time and ribbons and sticks for length were used.
10. Thus the children practised "reading" the cards correctly. They should, that is, be able to use correctly the number referring to the topic where the particular card belonged, as well as the order number of the card inside that topic.
11. It was stressed that at least for the beginning the two children of the same desk would share the same card. It would be thus possible for one of the two children to go and search for the card they needed.

12. The children of the pilot study faced the same difficulties at the first day of the application of the project.
13. An exercise-book was bought and given to each one of the pupils. Their names, as well as the indication SMP were written on the jacket label and on the inside page of the jacket, their progress record for the first section with their names on top were stuck.
14. In several cases, they even tried to write on the original SMP cards which were - fortunately - protected in plastic cases. It so happened that a few children came up to me holding the white card inside its case and asked:
"Miss, I've been trying to write on this card but the letters do not show well on the plastic. Shall I take the card out to write on and then put it back in its case?"
15. The mistakes were due to the wrong interpretation of the card numbers. We could claim that the children ignored the number referring to a particular topic and considered the ordinal numbers on the cards the only valid ones. Thus, instead of taking the 1-2 card after the 1-1, they would take the 2-1 or similarly the 7-1 instead of the 6-2.
16. For a brief description of these four children, see appendix A ,pp. xlviii-li.
17. For example, "if I have 7 sweets and I give Maria 3, how many will be left?" or "what can the symbol equation $7-3=4$ mean?"
18. Here we do not refer to the external features of SMP, the lay-out, the material, pictures and colours of the card, but to the philosophy of the system (individualized teaching, work through cards - worksheets and not through manuals, generally, through pleasant activities for the children).
19. Most of these photocopies came from the books: *Mathematics for Schools*, A. Howell, et al. (London, Assison-Wesley, 1979) Level I, Books 3,4,5.
For samples of these worksheets, see appendix C ,p. xii.

20. It is a comment on the children's disappointment for something that could have set them in action and it definitely does not imply that the SMP project should have provided for something and it did not.
21. See, in A.W. Bell, et al., "A Review of Research in Mathematical Education," in *A Research on Learning and Teaching* (Windsor, NFER-NELSON, 1983) p. 278, a reference on Rothery's et al. report on the factors affecting the readability of Mathematical texts.
22. Ibid., p. 283.
23. J. Piaget, *The Child's Conception of Number*, 3rd ed. (London, Routledge and Kegan Paul, 1965), p. 171.
24. It should be mentioned here that only very few children used the blue and red counters in the way recommended by the card. Written Mathematics acquires meaning only when the child can relate it to concrete things. In order to comprehend and learn abstract mathematical notions children must previously have had the appropriate specific and concrete experiences.
25. J. Piaget, *The Child's Conception of Number*, p. 182.
"The qualitative correspondence between the two classes F and F1 merely means that those two classes have the same hierarchical structure, the same classification, but not the same number."
26. For a sample of the questionnaire see appendix C, p.v.
27. There was no intention in the researcher's mind to encourage competition among the children but it seemed that competition was considered as a positive characteristic of a project by the parents.
28. Department of Education and Science, Assessment of Performance Unit, *Mathematical Development, Primary Survey Report*, London, HMSO, 1980.
29. It should be noted here that 11.1% of the 13% relating to the cards on the Mathematical skills came from the responses of the children of the 41st school and the rest from those of the Aghia Triada school children, while none

- of the 9th school children reported they liked the subject.
30. Here the corresponding percentages of negative responses per school were: 24% for the 41st school, 28.6% for the 9th and 13.3% for the Aghia Triada school.
31. This percentage is the product of the responses of the 41st school children (32% of the class) and the 9th school children (57.1% of the class). The Aghia Triada school children reported no particular difficulties in any of the subjects.
32. Here the children of the 9th school quite consistent to their answers to the fourth question (where they referred to difficulties on several of the subjects) justified the difficulties they encountered. Moreover, the children of the Aghia Triada school made no reply, since they had already stated they had faced no difficulties, a statement they repeated in question number 5 as well.
33. Their want for more colour is natural considering that only a series of cards, the original, was printed in two colours - black and red. The rest of the series were produced in coloured cardboard but the typing was only in black. Their Mathematics manual, on the other hand, was colourful, with pictures which the children were free to colour, something they were not allowed to do on the cards, as they were common to all pupils.
34. Discussion on the problems faced during the application of the research are available in ch.IV. pp.146-159.
35. See appendix C, p.xlii, for a sample of the test with the exercises.
36. It should be noted here that the girls who participated in the test were only three, thus the 33.3% success percentage actually refers to one girl.
37. It should perhaps be stressed again the fact that the results might have been different if the number of the 9th school girls who participated in the test was not so frightfully limited.
38. This stable repetition of the same percentages might be attributed to the size of the samples. It is possible,

therefore, to put the particular percentages down to one or two pupils correspondingly.

39. It so happened that the children of the three schools would take the test by groups, as quite a few children would finish the section 1 cards simultaneously.
40. Samples of the three tests are available in appendix C, pp. xxxi-xlv. Tests 2 and 3 were not completed by the four children of the 9th school, for whom, as it has already been mentioned at another point of this thesis, a different teaching approach was followed.
See chapter IV, pp. 138-142.
41. This usually applies to urban schools. Schools of the inlands or islands of Greece are usually much smaller.
42. For suggestions see chapter V.

CHAPTER V

Discussion of the Findings

The purpose of the present study was expressed in the introduction of this thesis. In particular, it was mentioned there that the research aimed at examining if, and under what conditions and in what exact form an individualized Mathematics programme could be applied in Greek primary schools.

An opportunity was given from the research: 1. to observe and analyze the reactions of the teachers, children and their parents to the new system of work, 2. to ascertain what progress in teaching took place, 3. to gain an insight into the difficulties pertaining to the application of an individualized Mathematical programme under the existing Greek conditions of school building facilities and the organization of the Greek school, 4. to examine whether the children profited from the particular programme. From such an examination the applicability of the programme for the Greek school curriculum could be considered, a recommendation of a specific type of an individualized project could be offered, proposals of suitable methods for the application of the particular individualized programme could be made. Additionally, the prospects that the introduction of the programme in all Greek primary schools might have, provided that all ability levels and geographical areas are included.

The individualized project chosen to serve the purposes of the research was SMP 7-13 (see introduction to the study). The procedure followed in applying the study is described in chapter III, while in chapter IV the findings of the research are reported.

In the present chapter the findings described in chapter IV will be discussed in an attempt to answer the questions posed in the introduction. Furthermore, several suggestions will be presented as to the type of the individualized project needed in Greece and the way of its application, in case, that is, the findings of the research allowed for such planning.

However, the fact remained that the present research was more of an investigation of the field, an inquiry into the possibilities of a change in the curriculum of Mathematics in Greece. If the implications of the research allowed for an introduction of a definite programme this should then lead to a large scale research programme meticulously planned and executed by a group of trained researchers. The first proposal, therefore, would be to attempt to follow up the research at a second, more elaborate stage where more schools in different areas of the country could participate. Only after such a systematic investigation of all possible difficulties and problems pertaining to its future application could the results be substantiated and further suggestions for innovation could be considered.

Before starting the discussion on the findings of the research it was judged useful to refer briefly to the existing Greek educational system and to the reasons dictating a change of the existing Mathematics teaching method to a child-centred individualized approach.

The existing educational system.

According to the existing educational system, a child attends primary school for six years. Children are first admitted to school after their sixth birthday. They all have to start school in early September, at the beginning of the new school year. They are allocated to classes according to their chronological age. All children are promoted to the next class.¹

Classes are 'closed', they do not communicate with each other, they have no access to common spaces and every subject of the curriculum is taught by the same teacher.

The curriculum is strictly prescribed by the Ministry of Education and is uniformly applied in each and every area of the country. The educational system is totally centralized, always directed from the centre to the periphery. The Local Educational Authorities have never had the freedom to either decide

their own curriculum or foster teaching styles and individual curriculum procedures different from those prescribed by the Ministry of Education. It should be realized that these restricting conditions were present throughout the research.

After carrying out the main study for a whole school year considerable experience was gained about the difficulties that would possibly emerge if a change were attempted in the syllabus and methodology of one subject of the curriculum only, namely Mathematics.

Bearing all the above restrictions in mind, the possibilities of applying an individualized programme in the Greek primary school will be discussed. To begin with, it is believed that despite the existing difficulties deriving from the way the Greek school functions and also the insufficient building facilities, the potentiality of applying an individualized programme in Greek primary schools is possible and relevant.²

Before attempting an elaborate discussion of the findings of the research and before offering suggestions on the type of the individualized programme and the way of its application it was considered necessary to briefly state the reasons supporting the proposal of adapting an individualized approach³ in the teaching of Mathematics.

The reasons dictating an innovation to the teaching of Mathematics.

The need for an innovation in the teaching of Mathematics is certainly not a new issue. Relevant researches and discussions have taken place in other countries, i.e. England, but as yet the subject of Mathematics teaching has not been resolved.

Considering the individual differences of primary school pupils, a scheme had to be introduced that would allow for children's varying skills and abilities. Different children placed in the

same carefully designed situation react differently. The maturation process is a complex mechanism and each child's transition through it is unique. The child's experiences as well as his family and social background directly affect his emotional and psychological growth, that is why a teaching method might be individualized, allowing children to progress at their own pace.

The suggestion for the choice of the Mathematics syllabus as well as the appropriate teaching style to be followed should be made keeping in mind the primary school children's early age, their needs and their growth processes.

The Greek educational system is knowledge-centred and ignores children's individual needs. The whole class has to work on the same subject (i.e. Mathematics), making use of the same manual and obliged to work at the same pace.

Keeping all the above in mind, it becomes obvious that 1. more attention should be paid to children's individual needs, interests and capacities 2. Children should be encouraged to express themselves freely and thus develop their creativity and imagination. 3. Each child's varying emotional, psychological and social background should be taken into account. 4. An environment which builds self-confidence, encourages co-operation in learning situations and establishes respect for persons and existing rules should be created. 5. The teacher should avoid intervention but try to interact with the children. 6. A more flexible teaching method which would strengthen the children's sense of security and offer them a reference point should be followed. 7. The process of a child's understanding of a subject such as Mathematics through gradual stages should be recognized, understood and respected.

All the above reflections advocate the innovation of the existing educational system and in particular of the Mathematics syllabus. This innovation could be realized by following a 'power coercive' strategy.⁴ It was in this way that the "New Mathematics" was introduced in France, Federal Germany and also most re-

cently in Greece. In countries where education is centralized it is easy for an educational authority (the Ministry of Education in the case of Greece) to impose changes. Nevertheless, this research was not initiated by the Ministry of Education, so it was our task to try and persuade all those involved in planning the educational changes of the country to consider the innovation an absolute necessity. The first step in our effort to bring about the innovation and to change the prevailing attitudes towards Mathematics was a small scale research designed to apply an individualized programme of work in Mathematics, namely SMF, for a short period of time (one school year), with the prospect of bringing to the notice of the Ministry of Education the benefits of such an innovative approach.

The reasons dictating an individualized programme

It has already been explained⁵ why the existing educational system should change and a development of the curriculum should be attempted. The very reasons dictating the innovation, advocated the use of an individualized approach.

Moreover, there were additional reasons supporting the idea of a change. For instance, children normally spend a lot of time doing Mathematics and perhaps they should spend even more. Mathematics activities make more sense to the children than activities on any other subject of the school curriculum. The system that requires all children to cover exactly the same material at the same pace is unfair to the slow learners, but even more so to the quick ones who very often get bored having to work at too slow a rate for their intellectual capacity.

Each pupil in a class is a unique person, leads a different life, is brought up by different people who do not expect the same things from their children and therefore do not offer them the same degree of support and encouragement. In a class, children are always occupied in a common programme, their individual differences are ignored and no time is spared in devising

schemes that could take care of their special needs. The able, interested children should be supported and encouraged to proceed further, whereas the less able children should never be made to feel inferior. On the contrary, they should be stimulated, provided with alternative interests and expected to further their knowledge, scope and involvement. The teacher, therefore, should not envisage children as replicas of the same pattern, but take care to discern their special needs and treat them accordingly.

Citizens of various areas of the country have varying experiences, interests and needs and accept different systems of values. Similarly, the schools in these areas face different problems, serve and encounter various needs. The existence and enforcement of a national curriculum should provide for certain interventions on the part of local authorities allowing them to slightly diversify the curriculum taking into account the special needs of their regions.

Pupils in a class are never at the same competence level. Since, however, they are obliged to cover the same syllabus, they should at least be allocated work of appropriate difficulty. In Mathematics, therefore, there might exist a curriculum framework which could secure equal access of curriculum opportunities to all pupils introducing all children of the same age in every school of the country to the same basic concepts, skills and rules. Each child, however, should be given the chance to elaborate and comprehend the various subjects according to his capacities, so that not only he is not discouraged, but, on the contrary, he often tastes the fruits of success.

The process of learning is, (according to the relevant literature)⁶, dynamic rather than static. Pupils' capacities are not stable and, moreover, being of the same chronological age does not necessarily imply that they can perform the same tasks. Furthermore, challenged by a certain stimulus, children do not respond in the same way. Some children seek the teacher's instruction and guidance, others need to move freely, to take the

initiative, to be independent. The traditional curriculum does not allow for any of these differences. On the contrary, an individualized programme aims at catering for children's special needs. After having assessed children's abilities it proceeds to challenge them with the appropriate activities so that they develop their skills and knowledge.

Preparing a child to meet the needs and circumstances of the future society means teaching him to respect several rules but also to trust and rely on himself, to be able to express his opinions on various subjects and take the initiative. The traditional approach relies on authoritarian principles. The teacher is the source of "ultimate knowledge", he makes all the decisions and children owe him unquestioning respect and obedience. An individualized programme, on the other hand, is based on children's co-operation and participation. The teacher acts as a guide and an assessor who encourages children to interact and co-ordinates activities.

An individualized system which employs either books or cards allows pupils who were absent to pick up where they left off. This helps children follow the continuity of the topics.

For all the above mentioned reasons, we would suggest that an attempt to change the traditional Greek direct teaching of Mathematics in favour of a child-centred, individualized programme of work would be a worthwhile undertaking.

Conclusions drawn from the application of the project.

As mentioned in chapter IV, in the course of the research several difficulties emerged due to the function and the building facilities of the Greek primary school, as well as the individualized programme (SMP) implemented. Certain of the factors that caused difficulties or created problems in the smooth conduct of the research are not likely to change and must be taken for granted in case any innovation is to be attempted in the near future (e.g., the school building facilities and the function of

the school as an organization). Other factors, even if they could not be changed radically, nevertheless, they could be modified in order to facilitate the application of the project (e.g., the organization of the classroom and the provision of teaching material and apparatus).

Finally, a number of factors would rather change in order to create the possibility of a successful application of an individualized approach (e.g., teaching method, the development of a Mathematics syllabus and teachers' attitudes towards the teaching of Mathematics).

The obstacles encountered in the present research could undermine any effort to introduce an innovation in the future. These restrictions were:

1. Practical restrictions.

a. The school building. As Norman Kirby⁷ points out the new educational trends based on respect for children could affect the school building and furniture. A rearrangement of the classroom furniture could abolish the teacher's desk and the fixed idea that a classroom must have a front and a back. The Greek school building, however, was constructed to serve the needs of an authoritarian, 'closed', teacher-directed teaching method, (based on a knowledge-centred philosophy and relying on class instruction).⁸ Thus it should be taken for granted that co-operation will be limited among the children of one class only and the teaching material as well as the apparatus necessary could not be shared among the children of different classes.⁹

b. The teacher. Very few, if any, teachers have attempted to challenge direct-teaching, the method prescribed by the Ministry of Education and adopt a different teaching method that would provide for their pupils' varying skills. Provided that teachers would be prepared to update their knowledge of Mathematics and would introduce appropriate teaching approaches and also that they would be willing to accept and carry out a proposed

innovation, it would be extremely costly to train all teachers in a reasonably short time in order to familiarize them with the new trends in the curriculum. If innovation was seen to be acceptable, short courses for teachers of primary education could be arranged, even if head teachers were the only ones to be trained initially. Later, other primary staff would be invited to attend courses.

c. **The material.** The apparatus needed for the application of an individualized approach (especially SMP), with the possible exception of a few items, is not particularly expensive or difficult to acquire. They are usually everyday materials which can be obtained easily and cheaply. Thus even if each class might need their own apparatus, supplying the material could not be considered a barrier to the application of an individualized project. On the contrary, however, the teaching material, i.e., SMP cards, certainly may be an obstacle to the acceptance of the approach. The fact that in Greek schools the syllabus must be exactly the same for all pupils of the same age all over the country, as well as the fact that Mathematics manuals for the primary school have only recently changed¹⁰ makes the proposal for the introduction of a new teaching scheme¹¹ rather unlikely. If an individualized approach, for example, SMP, were used it would be necessary for the Ministry of Education to supply all schools with the appropriate equipment.

2. Psychological restrictions.

a. **Teachers.** Teachers themselves had undergone a particular training which had not prepared them for such an innovation. For years they had been confident about Mathematics teaching, they had been happy and secure tackling something familiar to them.¹² A few years ago the school curriculum changed. New books not only on Mathematics, but on the other subjects within the curriculum were introduced and new teaching methods were suggested. They had only recently been through the ordeal of an innovation with all the insecurity involved in it. The system with which they had been familiar for years collapsed. New con-

cepts very often totally unknown and new teaching methods with which they did not always agree arrived suddenly, the upheaval being too much for them. Having no personal profits to expect from the proposed innovation, teachers felt their authority threatened, they feared they might be considered inadequately qualified, or even lose control over their classes. Several of the teachers expressed their reactions (see appendix B, p. iii) nevertheless, the innovation was uniformly applied as it was enforced by the Ministry of Education.

Any proposal, therefore, for a change in Mathematics teaching (i.e. the present research) should be designed in detail and explained fully and clearly so that it might convince all those concerned about the necessity of its application. Paul Hurst characteristically notices that: "officials may issue reformist instructions until they are blue in the face, but unless teachers have the will, the knowledge, the skill and the possibility to change ... mere orders will accomplish nothing."¹³

b. Children. Accustomed to their teachers' norms of behaviour, children usually comply to certain rules in order to please them. The teaching method followed does not for the most part create the appropriate atmosphere for the children to develop their initiative, learn how to interact, build up their self-confidence and attain knowledge through personal choice of resources.

The objective of any individualized programme is to allow children to move freely in the classroom, acquire experiences through the use of everyday common objects and by tackling numerous activities. In such an environment children may feel liberated, but, on the other hand, at times they perhaps find it difficult to get used to the change, so they are likely to become nervous, excited and maybe tired. The result, of course, is the disruption of the normal, smooth course of the lesson, which becomes noisy. Noise, according to teachers and general belief, hinders the learning process as it interferes with the teacher's instruction and the pupil's concentration.

Any attempt to introduce an individualized approach for one subject of the curriculum only would disrupt the children's system of values, since the scheme enthusiastically adopted for a small portion of the school day would be brushed aside for the rest of their schedule. Behaviours and attitudes fostered for one subject of the curriculum would not be maintained for the rest. Naturally enough then, children could get confused and miss the desired behaviour expected from them, become tired and irritable, moods which create a learning atmosphere far from ideal.

3. Ideological restrictions.

The majority of teachers and parents had grown up in an authoritarian, austere, competitive, knowledge-centred educational system. The educational innovation introduced in the primary sector in 1981 has caused numerous reactions on every side. People's reactions varied greatly, affected by their political beliefs, ideologies, interests, family and social background (see appendix B).

Concerning the attempted research, teachers expressed their scepticism about the efficiency of the new approach, hesitated to undertake its application, nevertheless they were never negative. All of them conceded that in order to put the method into practice all teachers would have to go through in-service training to be familiarized with the philosophy of the system and get to know the way of its application. We might point out the fact that the teacher of the central school, where children maintained the highest performance throughout the research, was more critical towards the programme. Also the parents of the same school, even if they were positive towards the project and admitted its effectiveness for their children, nevertheless they were somehow reserved and criticized the teaching method and material more severely than the parents of the other two schools.

The reactions and reservations expressed for both the innovation imposed by the Ministry of Education and the application of the research foreshadow the response laying in store of a change of the Mathematics syllabus. Different people influenced by their political beliefs and ideologies are likely to exert their power to cancel the curriculum development and restore "balance" in the classroom, the school and social environment.¹⁴

4. Obstacles due to the individualized project itself.

The SMP 7-13 had been designed to serve curriculum needs other than the existing Greek ones relying on different building facilities. Of course, this was taken into account on deciding the research. Moreover, care was taken to moderate the problems when possible. Except for these practical problems though, which were known to us anyway before we started the research, several functional difficulties innate in the philosophy and structure of SMP emerged. These difficulties should not be related to the particularities of the Greek educational matters or the special conditions under which the research was conducted. Most probably, the same or similar difficulties were detected in the English schools which made use of the SMP cards with the method suggested by the SMP project. If a decision was taken to introduce SMP with a class in a Greek school, some modifications of several of the cards should be considered. Also the teaching method proposed by SMP and the material supplied should be reorganized and used differently from the method followed in the present study.¹⁵

Possibilities of applying an individualized programme in the Greek primary school.

After the brief reference to the structure and function of the Greek educational system (see chapter II, p.20 and chapter IV, pp. 129-132), the presentation and discussion of the findings of the research, despite the difficulties expected to stem from at-

tempting an innovation (see chapter IV, pp. 129-138) an effort to reform the Mathematical syllabus in favour of an individualized programme was considered both imperative and feasible.

A clarification of the meaning invested in the term "individualized programme" would be necessary before the examination of the prospects that an individualized programme would have to succeed under the existing conditions in the Greek primary school. Also the advantages and disadvantages of such an undertaking as well as the type of individualized programme suggested should be indicated.

It could be argued that any programme could be characterized "individualized" as long as the people involved in it perceive it as such¹⁶, since different people might have varying opinions about individualization.¹⁷

In the present study the term individualized programme refers to a scheme that could be applied to only a part of the school programme and one area of the school curriculum, namely Mathematics, leaving the rest of the items of the school schedule intact. Such an individualized programme could be conducted by the class teacher, who, for the other subjects of the curriculum would follow the traditional teacher-directed mass instruction system.

Each pupil would be allowed to proceed at his own pace, but he would be required to cover the same syllabus making use of the same teaching material and apparatus with the rest of the class. Thus, at the end of the school year, the whole class should have covered the same subjects only not in the same depth. The difference, that is, between low and high attainment pupils will not refer to the theory but the practice of the introduced concepts.

Keeping in mind the situation existing in primary education, its history (tendencies, innovations, reactions) as well as the experience gained by the present study and the reports on relevant

researches concerning individualization, the type of individualization we feel inclined to suggest is an active method of an individualized instructional programme¹⁸, a teaching programme, that is, which will be teacher rather than pupil directed. It may be modified for each individual pupil or based on class or group instruction. Specifically:

1. It could be considered rather forward to allow teachers to select and design the content of the mathematical syllabus as it would raise a storm of reactions; besides, teachers seem rather unprepared to take the challenge. Instead the Ministry of Education could prescribe the content, a sort of framework that would facilitate the teacher's role in Mathematics teaching. Similar schemes seem to prevail in England, where the most progressive and liberal systems in primary education have been applied for years. An example of these trends is given by Richards who argues that "curricula are considered to the extent that all pupils at a particular stage, whether in the same or different classes are introduced to a similar set of curricula elements."¹⁹

2. The choice of the teaching material²⁰ will not be left to the class teacher's absolute judgement. A variety of schemes of work, approved by the ministry, could be suggested and each teacher could choose the one she deems appropriate for her own temperament as well as the nature of her class. This material could be the guide to her lesson, but she may also omit or add material depending on the needs of her class.

3. Instruction could be addressed to either the whole class or groups of children. For example, after a concept has been introduced to the whole class, the teacher can then go about assisting groups of pupils or individual children who need her.

4. The children can proceed at their own pace, reaching the stage of difficulty that best suits their abilities. The gifted children who have completed a particular topic in the set time

can choose to work from sections that are not prescribed, but might attract their interest.

5. The children can keep records of their work which, of course, will be corrected by their teacher. Thus, the teacher has the chance to pinpoint each child's weaknesses, define his abilities and make sure that he has achieved the optimum work according to his potential. Furthermore, the teacher's immediate availability to each pupil helps him clarify his difficulties and recall already acquired knowledge in order to apply it to new learning situations.

6. The lesson could not be organized, at least not at the beginning, on an integrated day²¹ basis as the innovation concerns Mathematics only. Nevertheless, if a teacher, despite the restrictions posed by the Greek school, judges that a modified form of an integrated day would be beneficial for her class and is ready to take the challenge, then she could attempt it. This scheme would allow her to have half of her pupils working on Mathematics, for instance, and half on Language, facilitating their work in both subject-areas. The lesson pattern then could follow the procedure: introduction of the new concept (class instruction), further elaboration of the subject (group work), pupils' work on the subject-matter (individual pace), reinforcement (individual or/and class work)

Our proposal, that is, formulates a type of individualization that would be innovative, as it would pay attention to individual differences, but it would not attempt to abolish the traditional class instruction. It is a "moderate" suggestion and as such has limited influence. The teacher will be the main decision-maker playing an active role but being aware that children will make their own decisions as well.

The suggested form of individualization has certain limitations, most of them resulting from its dependence on the traditional system. For instance:

1. It assumes that a body of knowledge and skills must be identified as essential for all pupils.
2. It accepts that the development of knowledge and skills must follow a specific sequence.
3. It does not give individual children the freedom to choose the task they are interested in.
4. It requires, even if not blatantly, pupils' obedience.
5. It does not offer children the opportunity, at least not very often, to explore Mathematics in other areas of the curriculum.
6. It stresses the mathematical efficiency of the project, ignoring the intellectual and social development of the child or his autonomy.
7. It cannot boast of its flexibility and it does not allow the necessary time to cover a topic.
8. To a large degree, it urges the pupil to learn for others and not for himself.

Despite, however, its disadvantages the suggested programme does have certain qualities to exhibit as well:

1. It is simple, as it concerns one area of the school curriculum only and could be accepted without too many objections by all those concerned. Besides, it might easily persuade teachers who lack the experience and knowledge on similar methods to give it a try.
2. It is easy to organize. It could be applied without causing much disruption to the rest of the school programme, which literally remains intact. Principals, staff and pupils could adjust to it quite effortlessly.

3. It does not demand absolute conformity but it rather offers a framework within which a degree of consistency is sought.

4. It gives the teacher the opportunity to plan for her own pupils, according to their needs and interests.

5. It secures a minimum of knowledge, skills and experiences for every child allowing him at the same time to proceed at his own pace.

6. It is easy to assess the pupils' progress and to organize the appropriate set of materials for each individual child.

7. It is readily acceptable. Educational innovations have been invariably received with scepticism and reservations in Greece, but other countries as well. This experience suggests that any attempt at innovation should proceed cautiously, slowly, but firmly.

Possible difficulties -not directly related to SMP- an attempted innovation might face.

After reporting the particular problems confronted during the research (chapter IV, pp. 129-159) and after examining some of the factors that caused them (chapter V, pp. 212-216), we could refer to the difficulties an attempted innovation might encounter. Most of the reactions or difficulties stemmed from the function and structure of the Greek centralized educational system.²² Every change is decided by the Ministry of Education and enforced in every school of the country. Any important innovation should be supported by the Government and should also secure the silent consent of the opposition party. The fact that different political parties hold varying notions about the educational system, practically eliminates the probability that a change could take place in successive stages. The fear that a change would be never realized unless applied immediately often

necessitates its uniform application from the very beginning.²³ On other occasions, when it is judged that an experimental stage of one or two years could be afforded, a small scale research precedes the application of the innovation. Thus the programme is adjusted or improved where necessary, before its final application to every school of the country. Apparently, therefore, any proposed change should be supported by influential people and, of course, its necessity should be manifested to those interested.

Up till now every attempt at educational innovation has been received with a strong opposition by the conservative forces of the country, consequently most of them have failed (see chapter II, pp. 20-27 for a brief history of the Greek primary education).

Possible reasons for this sort of reactions have almost always been the same:

1. The fear that any change could disturb the balance of power. Educationalists, parents, organizations, all those concerned in the educational matters felt they would lose their privilege to influence, control and guide. Furthermore, in the future, the balance of the political forces and social structures of the country might be threatened.

2. The insufficient or inappropriate education of teachers. This gives them a sense of insecurity preventing them from being open to changes, feeling rather incompetent and uninformed about new trends. They suspect that by adopting a "novel" method they might lose control over their class and their image of absolute authority would fade.

3. The fear of the unknown. Both teachers and parents prefer to practise the familiar, tested recipes of the traditional curriculum, instead of experimenting with something new, which, of course, entails possible failure.

4. Suspicion, a common reaction to every change that professes good intentions. Even if an innovation sincerely intends to help children progress more securely, correctly and without anxieties, this is often misinterpreted as an attempt to broaden the gap existing among the social classes. Children coming from a poorer social background may, in their parents' view, need to be continuously pressed to do more and more at school (because a tutor could not be employed) and, therefore, parents would not appreciate the value of a system that would allow children to proceed at their own rate in a curriculum such as Mathematics. They would feel that their children would be unlikely to aspire to higher education. All the above should be kept in mind if a proposal for innovation of the curriculum is submitted for discussion and a decision is taken later. Moreover, if the proposal is likely to be realized and put into practice it should be designed, recorded and presented under certain conditions:

1. It should not suggest the cancellation of the existing educational system, nor the rejection of the curriculum in use. A radical departure from the traditional norms could arouse a storm of reactions from all sides. It could be conceded that curriculum consistency is necessary as it ensures equal opportunities for all pupils. Pupils should be introduced to the same content and skills and tackle the same activities.²⁴

Thus the proposal should focus on a specific area of the curriculum (i.e., the teaching of Mathematics or the Mathematics syllabus), it should be suggested by experts, be absolutely clear in its intentions, set the objectives (those referring generally to Mathematics and those referring to the content of the syllabus), the attitudes and methods of work²⁵ and have the power to persuade all those interested about the necessity of its use.

2. The conditions of the school buildings and the needs they serve should be taken into consideration. It has already been mentioned that school buildings were constructed in the past to provide for the needs of a certain educational philosophy. To-

day's constructions are designed so as to promote the growth of a different spirit in the school environment. The majority of old and new buildings, however, facilitate the operation of two different schools under one roof. Therefore, even if formally the building belongs to one school, in fact, it is also ceded to another one as well. Often the same building accommodates different age ranges. It could so happen that a primary and a secondary school share the same building. Hence any proposal should take into account this particularity pertaining difficulties for both teachers and pupils to use their space as they wish.

3. The cost of the suggested innovation should not be too high. The fact that the Ministry only recently attempted a change of the primary school curriculum should be considered, because universal as it was, it was costly, so that the Ministry would be unlikely to provide for the change.²⁶ A proposed teaching scheme, therefore, should in no circumstances exceed the cost of the existing one, on the contrary, it should preferably be cheaper so that it becomes more attractive, price wise at least, and likely to be selected. If the application of the proposed scheme of work demands the use of apparatus, this should be easily obtainable, priced at an affordable cost and, if possible, allow for teachers to produce their own apparatus and resources.

4. The function of all schools is wholly determined by the Ministry of Education. The latter is the centre which decides the subjects, concepts and skills to be introduced and moreover the space the curriculum should allocate to these topics and the method of their presentation to the children. Thus the number of teaching sessions that each subject should take up is prescribed by the Ministry of Education. The only difference likely to exist between different schools is the timetable. The school curriculum is subject-centred, it consists, that is, of small parts, unrelated and isolated one from the other. Furthermore, with the exception of Language to which two continuous teaching sessions are usually devoted the limits are strict for the rest of the subjects which cannot extend to more than one

session.²⁷ This means that in planning the particular proposal some time limits should be taken for granted and the extra time that might be needed should be sought and found through careful organization of the lesson and/or the re-organization of some routine activities of the school day.

5. The geographical peculiarities of Greece should also be borne in mind. Greece does not face the problem of diverse communities or races. Even if it is small, though, it presents a number of problems due to its geographical distribution. The mainland, mostly covered by mountains, gathers the population in and around the big urban centres. The mountainous villages, poor in their majority, are inaccessible especially in winter and are gradually being abandoned. Their inhabitants are old people in their majority, except for a few children. The needs of these villages are usually met by one class schools (see appendix A, pp. 13-15) even if their maintenance demands an extremely high cost.

The same situation applies in the numerous islands of Greece. Even big islands present a picture of abandonment during the winter months. Communication with the mainland, especially in bad weather, is not always easy. Thus, inhabitants prefer to move to Athens or Pireus during the winter months, or, if this is not feasible, to send their children there in the hope of offering them the opportunity of a more complete education. Thus, schools on islands present similar problems to those in the villages.

Any proposal for change, then, should provide for all those peculiarities, since a new syllabus or scheme of work would not be addressed to children of the cities only, but to the children of the areas described above. Naturally, the latter have lived different experiences, they hold different beliefs and their attitudes towards and needs from the various subjects of the curriculum differ greatly from those of city children.²⁸ Those differences, then, should not only be taken into consideration,

but perhaps special material, more suitable to the experiences and needs of these children, should be prepared.

Certainly, apart from the above considerations, it is also necessary to examine contemporary educational conceptions, international research results, modern attitudes appearing on a universal scale and the most recent theories on curriculum development. However, all the above should be viewed in relation to the Greek reality. The role of the political parties, the religious and other organizations, all those who hold and can exercise power and make decisions should be carefully considered. Also the nature of the education provided today as well as the various innovations attempted - when, under which circumstances, how many, their aims and objectives - should be scrutinized.²⁹

Keeping all the above in mind and having conceded that education should always proceed with a continuous view of the future but enriched by past experiences, the latent attitudes for innovation should be exploited. A programme of work which will not be an adaptation of a "foreign"³⁰ one, but which will either have been adjusted to the Greek socio-cultural conditions or designed for the Greek reality. Only under these conditions is any proposed innovation likely to be successful.

Deficiencies due to individualization.

The thought that the current educational system should change has been expressed and the reasons dictating this change were reported. The difficulties and objections likely to arise from an attempt for innovation have been pointed out. The conditions under which a proposal for change should be made have been indicated. Finally, the sense of the term 'individualized programme' in the present study has been clarified.

Individualized programmes, however, are not free from disadvantages or deficiencies and their application in any class, not necessarily Greek, is not a simple matter. The new programme

should be introduced in such a way that any prospect of failure is minimized. Deficiencies should be discovered and analyzed and ways of eliminating errors should be developed. The obvious risks that should be foreseen and dealt with from the very beginning are:

1. In the name of individualization children might be left to work at such a slow pace that at the end of the year they will not have covered the prescribed material.

2. If the teacher adopts the self-correcting method, she should make sure that each pupil corrects his work after completing two or three pages (cards), so that he will not miss the chance of practising further a concept he has not fully grasped.

3. The teacher must take care that the weaker and less motivated pupils do not disturb some of their classmates continuously by asking for help or copying their exercises, without even having tried to grasp the meaning or complete the exercises themselves.

4. The teaching material must have been organized very carefully, so that it meets the needs of every achievement level in the class; furthermore, a rich variety of extra materials should be available in the classroom, since their lack could be a deterrent to the programme.

5. The less able children or the children who lack self-confidence tend to seek their teacher's help and attention much too often. A teacher must, therefore, organize her time so well that she will be able to respond to the needs of slow children as well as timid ones and try to build their confidence in order to make them increasingly independent.

6. It should always be kept in mind that in a class no child should be made to feel isolated. As Kirby points out it is wrong to treat an individual as being "in some mysterious way locked up in a hard cocoon of self, with the rest of the world

shut out, and that it is to this impervious ego that individualized teaching is directed."³¹ Individualization does not mean that when a child faces difficulties, he will not be permitted to address and consult another person, who could be a classmate or the teacher herself. It is good to teach children to trust themselves and try to face their problems alone but at the same time they should be confident that their teacher is always ready and willing to assist them in their need.

7 Individualized programmes are much more demanding for the teacher than the traditional direct methods. They ask not only a careful organization but also the teacher's capacity to establish close relationships and rapport with every pupil. Teachers should always be aware and alert to children's possible problems, needs and progress.

8 If children are not sufficiently motivated they may resort to wasting time on talking on matters irrelevant to the lesson activities (see Neville Bennett, *The Quality of Pupil Learning Experiences*, p. 153). The teacher must be always watchful to children's misdoings and seek to encourage them to work hard without, however, suppressing them.

All the above should be carefully examined so that any prospects of failure are dispersed from the very beginning and the expected reactions of everyone concerned anticipated.

Potentialities of an individualized programme in Greek primary schools.

In this chapter so far an attempt has been made to explore the field to which the proposal for innovation is addressed. All the potential difficulties expected to arise were reported. Most of these difficulties are latent in the socio-economical, political and educational conditions in effect in Greece today, thus they are not directly related to the individualized programme itself. They would occur anyway as a response to any

proposal for innovation. Fewer difficulties are rooted in the nature of any individualized programme in general and especially in some ready-to-use projects available in the market. The problems encountered while conducting the research, problems due to either the structure and function of the Greek educational system or the individualized project implemented were exposed. The progress made by the children involved in the research as well as their impressions and reactions towards a new scheme of work were observed. The view expressed was that despite the potential problems pertaining in the introduction of an individualized programme in the Greek primary school, this would not only be a worthwhile endeavour, but fertile and successful as well.

Next an attempt will be made to describe the way an individualized programme, as it was envisaged in the present study (see pp. 217), could be introduced in the Greek primary school.

It has been already stated, (p. 205), that the present study's proposal for innovation referred to Mathematics only, no provision was made for the rest of the subjects which will continue being taught traditionally. Obviously, when individualization applies for a limited portion of the school day only, the effectiveness of the innovation is questionable. The conflict and contradiction between the two systems (traditional and innovative) cancels the advantages of the new scheme. This is an additional problem to the ones already described, therefore, any suggestion for individualization should be backed up by a meticulously planned proposal as to the classroom organization, time allocation, the teaching materials, the activities as well as the purpose of the lesson and the teaching method.

1. Organization of the classroom.

In most Greek primary schools pupils are confined to specific classrooms, where they usually sit at specific desks for the whole school year. Since at a preliminary stage the proposal for individualization concerns Mathematics only, it would be in-

convenient, if not irrational, to require a re-organization of the desks inside the classroom, unless, of course, the class teacher judges that such a rearrangement suits her own needs as well. Nevertheless, to rearrange the desks just for the Mathematics session would be a difficult as well as inapplicable scheme (see p. 106, description of the Pilot Study). If, however, a more flexible programme was introduced the organization of the classroom could be modified to assist the teaching of Mathematics. Besides, if the teacher, in introducing a concept, chooses to follow a class rather than a group teaching there is less need to rearrange the furniture. A bay, however, where all the necessary apparatus and teaching materials (cards, books or worksheets) could be kept for children to help themselves, would be an indispensable comfort. By encouraging her class to find the material they need themselves, the teacher saves herself a lot of time which, subsequently, she can devote to slow or confused pupils. Undoubtedly, it will take a teacher time, persistence, patience and perseverance to train her class to delegate their work and duties and even then there is no guarantee that they will always feel sufficiently confident to react positively at all times.

Nevertheless, the fact remains that even under the adverse and most intractable conditions of building facilities in Greece and without radical rearrangements inside the classroom, an individualized programme can be realized without disrupting the normal, routine function of the school.

2. Organization of the teaching material.

The content of the Mathematics syllabus is prescribed by the Ministry of Education and it is common for all pupils. Thus the teacher must prepare her teaching material with a view of the varying abilities of her class. The material should be organized in graded stages, easily recognizable by the children. A system of colour coding might be adopted to enable children to recognize the various stages. For example, red could be employed to indicate the basic cards, common and obligatory for

each child. Green could represent the cards of the second stage, which the children tackle only after they have completed the first stage cards. Finally, blue could characterize the third stage cards, which could be attempted by the brightest children of the class who have either finished the cards of the two previous stages or followed their teacher's advice and took on the third stage cards ignoring the transitional stages.

On deciding the teaching material (cards, worksheets) the teacher must pay special attention to their use of language. The text of the first stage should be short employing the simplest possible language. It should be thus formulated that even the weakest pupils in the class, excepting the ones facing special problems, could read the text, understand the given instructions and be able to tackle the practical work or the required activities successfully. The goal pursued is to facilitate children to read, comprehend and solve the problem presented by the card on their own. If it is necessary for the teacher to explain the content of each card to every child to set him going on an activity, then the philosophy underlying the individualized programme is lost. Therefore, there should be provision for simple cards not only as to their mathematical content, but also as to the reading ability they demand. Pupils who face reading problems are usually not very competent at Mathematics, just because at a young age children read to learn and learn to read at the same time. In Mathematics the problem becomes more complex as the vocabulary used there is extensive and unusual, children, that is, do not use it in everyday conversations or encounter it in their early readings. The text as well as the Mathematical concepts should proceed with gradual difficulty demands, so that children are encouraged to improve their skills and enrich their intellectual capacities in a pleasant way. In addition, the teacher should provide children with a sufficient supply of material (adequate copies of the cards or worksheets).

3. Teaching

All schools in Greece are organized on the basis of a well structured schedule which dictates the number of hours to be devoted to each subject. The only initiative the teacher is allowed is the schedule planning. All subjects are taught in the traditional, formal method of class teaching which obliges all pupils, regardless of their needs, skills, interests or limitations to attend a uniform pattern. Thus a proposal for an individualized programme in Mathematics might be narrowed because of the strict, unavoidable time limits posed for the duration of a teaching session. Furthermore, it is a compulsory requirement that by the end of the school year all children will have covered the same syllabus.³²

Under these circumstances it would be hard to expect children to react positively when exposed to extremely different methods (formal class teaching -individualized instruction). Similarly it would be difficult to organize the class, the teaching material and the classroom for a group instruction session. It appears that the safest and simplest way of applying an individualized programme is to turn from time to time to class teaching. The teacher could lead children through the stages of the syllabus introducing the whole class to the new concept or technique, giving examples and explanations. This approach, however, does not preclude the teacher from taking small groups of children to explain a task and it does not suggest that the children in some occasions do not work in groups. Such an arrangement would meet the requirements of the syllabus and encourage children to work at their own pace at the associative practical activities.

The teacher must make sure that each child works within his abilities and is given the time to practise adequately in order to consolidate his understanding of new concepts while at the same time he draws satisfaction and a sense of achievement through his involvement in meaningful tasks.

4. The teaching method.

After having prepared her teaching material according to stages of difficulty, the teacher may then decide on the approach that will best accomplish her objectives. She must always take the opportunity to invite children to talk about what they have done and what they have achieved. In this way the less able children may listen to their peers and may become more competent when tackling the same problem.

It has already been explained that it is rather problematic to permit children to recognize their own problems and try to solve them themselves. It would be wise on the teacher's part to rely upon a semi-active, semi-permissive method. She may use, that is, the class teaching technique but also allow for group and individual teaching when she thinks it advisable and profitable for the children. She may turn to class teaching whenever she wants to present a new concept or activity of the syllabus (e.g. move from addition to subtraction), but work with groups or individuals the rest of the time.

When the teacher introduces a new concept she must encourage discussion and listen to suggestions as to how the particular topic should be tackled. She puts a proposed solution into action using the appropriate apparatus. She uses symbols to depict the children's experience in operating facts. After this introduction she asks a group of children, possibly the most able ones, to go to the bay with the materials and pick up the appropriate cards to start with. The rest of the children are given more examples by the teacher until they feel competent to take up the activities set by the cards on their own. Each child is given the choice to select from a range of cards the ones he prefers to complete.

There is, however, a limit as to the minimum number of cards he should fill in on the given task. The more advanced children, after having finished the prescribed amount of work, can proceed to the next stage cards which again refer to the same task, only

they are more elaborate. Again, when they have accomplished a certain amount of work they can continue with the third more complex and demanding set of cards.

On the days following the introduction of the new topic and which are allocated for its consolidation, the teacher may work with a group of children who she realized faced common difficulties and made similar mistakes in order to further the subject with them and give them the chance to practise more, while the rest of the children go straight to their cards to work on their own. When the teacher is not given to class or group teaching she may help individuals who need her or appear not to progress satisfactorily.

Thus the teaching method could be a mixture of active (class teaching, prescribed material, predesigned sequence of concepts' introduction) and permissive (choice of cards, rate of work) schemes.

Preferably the proposed project should comply with the assumption of the Greek curriculum that a body of knowledge, skills and experience (which has been predetermined) is essential to every pupil, and to follow the sequence of the subject-matter the Ministry of Education has prescribed.

Even in this strict and limited framework the suggested method should give children the opportunity to proceed at their own pace and deal with work as close to their capacities and level of development as possible, while working within their peer group. It should also allow children a degree of movement and action and promote a learning atmosphere which builds up the child's self-confidence offering him a sense of achievement and satisfaction.

The applicability of SPH 7-13 as an individualized programme in all types of primary schools.

1. Urban schools.

The children admitted in urban schools come mostly from middle class families. The number of children per class ranges from twenty-five to twenty-eight. It has already been mentioned that central schools, in particular, present certain common characteristics:

a. They are rather more attached to the traditional educational system and less liable to foster and promote innovative conceptions in educational matters.

b. Parents take a lot of interest in their children's progress and exhibit eagerness for their intellectual development. They are ambitious, generously support and encourage their children, nurturing high aspirations for their educational future and professional occupations.³³

c. Mothers are usually educated themselves, so they are able to tutor their children quite adequately. Moreover, they are nearly always aware of their children's level of development.

d. Teachers usually have high expectations of their pupils, they often give them supplementary work and try to raise the class' standards.

e. Children also share their parents' high aspirations for their future, most of them take it for granted that they will continue in higher education and there is only a small percentage of low attainers in a class.

Any class in an urban area presents a marked range of intellectual ability, promotes high ambitions and competitiveness not only among children but among parents as well. The latter in particular, urge their children to accelerate their pace of work

and enrich their experiences. The educational system, however, is such that it obliges all children to the same speed of work, thus confining faster learners to a dull pace and oppressing slower learners to proceed even if they have not fully assimilated the taught concepts. SMP would release the bright pupils and facilitate them in progressing at a pace suitable to their needs and abilities. On the other hand, the less advanced children could absorb the material to be learned at their own speed.

Moreover, as most children's aspirations are rather high, the application of SMP could develop a personal competitiveness, that is, each individual child will be motivated to proceed as far as his capacities will allow. This is not to say that motivation among all the pupils will be similar.³⁴

If SMP were applied in a Greek urban school, it could be faced with similar difficulties that might be encountered in any English school - provision of appropriate work for each individual child, continuous assistance in his difficulties, assessment of his progress - plus the peculiarities existing in Greece - school building facilities, rigid timetable, centralized curriculum.

SMP could be applied provided teachers were persuaded of its efficiency to help pupils of all abilities grasp the mathematical concepts more thoroughly deriving pleasure from mathematical activities at the same time. Cardwork should be so organized as to persuade a. the parents of advanced pupils that their children will be given the chance to progress according to their ability, b. the parents of low attainers that their children will be facilitated to comprehend and enjoy Mathematics avoiding simultaneously to expose their differences from their peers, c. all parents that SMP excels the valid Greek system because apart from offering pleasure to children from their work it provides them with more than the basic Mathematical concepts motivating them to progress a step forward. SMP, therefore, could be applied in Greek urban schools, after, of course, the appropriate changes and the provision of certain conditions.

2. Rural schools.

As it was previously mentioned in this chapter (p. 225), schools of sparsely populated villages situated on the mainland or on the islands of Greece are in the majority one class schools. Naturally, the children of these schools have different experiences, needs and interests from the children in the big urban centres. A different scope and method, therefore, should be built in for mathematics of these areas, closely related to their development, needs and environment. The form of Mathematics should not be unrelated to the culture and philosophy of the people it is addressed to. The way in which a person acquires his mathematical skills may affect his perspective about economic, political and social issues, thus influencing his contribution to the development of the area in which he lives. Ideally, the Mathematics programme should deal with everyday life within the rural community. It is a challenge, therefore, to attempt a ruralization of the Mathematics curriculum, as far as its content and teaching methods are concerned so that it can meet the needs of village people. By ruralization we definitely do not suggest enlarging the curriculum with additional subjects nor adjusting the existing ones so as to make them relative to agriculture or navigation. The form and content of the curriculum should make provision for the peculiarities existing in the areas where it is offered, so that it becomes stimulating and meaningful and promotes learning activities. The decision of such a radical curriculum change is certainly hard considering the political and financial costs it involves and this is probably why the Greek government has always relied on a uniform curriculum for urban, rural and city areas.

The teacher who works in rural schools, even today is at a disadvantage compared with her colleagues in big cities. Being isolated, she is not given the chance to develop relationships with any of her associates in order to communicate her thoughts or problems, she has no access to teaching aids and resources to broaden her scope, or extend her professional expertise. Moreover, she usually faces more complex situations than her city

colleagues. Most of the time she is obliged to teach a vertically-grouped class, a class, that is, which is made up by children of all age groups.³⁵ These schools were established and have been maintained in compliance with the Greek law according to which primary education is compulsory and they usually have very few pupils. At times, some of their classes may be rendered obsolete, or have one or two pupils only. By necessity, then, the teacher improvises and applies an individualized programme, since she is obliged to teach children of different ages and abilities on different topics, within the same teaching session. Of course, the size of the class is usually small, often twelve to fifteen children whose ages, however, range from six to twelve years. At times, therefore, the teacher might have to tackle six different tasks in the same teaching hour, she applies, that is, a more liberal and less structured scheme of "integrated day."

Similarly, in larger villages or small towns there exist two and three class primary schools.³⁶ In these schools the teacher handles fewer subjects (two or three) within the teaching session, but, on the other hand, the size of the class can be as big as twenty eight children, a usual number in a town school class.

Hence in the case of rural schools the potentialities of applying an individualized programme have been explored and assessed. The question remaining open, though, is to what extent the innovation suggested by the present study - applying, that is, an individualized programme for Mathematics only - could prove fruitful in these schools.

Perhaps it would be useful to classify rural schools into two categories, one or two-class schools and three up to six-class schools. In the first group of schools as it has already been explained the programme of an "integrated day" system of organization is necessarily employed for children of different abilities and chronological ages. In these schools our proposal for the application of an individualized programme for the

teaching of Mathematics is likely to be inapplicable due to the following reasons.

a. The teacher's role in these schools is highly demanding. She is obliged to cover the syllabus of six different classes in the course of one school year. It would be rather preposterous to suggest the application of an individualized programme in Mathematics entailing the application of six different individualized programmes for the six classes for her.

b. The number of pupils per class is very small, usually one to five children, and it often happens that there is not even one pupil in a class. Normally, the teacher is aware of her pupils' weaknesses and needs in Mathematics and provides them with the appropriate activities, practice and assistance. She already, that is, applies a teaching method based on individualized instruction. Consequently, it would be meaningless, very expensive and difficult to accommodate the teacher of such a school to prepare different teaching materials for the children of each class. She could perhaps use the Mathematics manual itself adopting the philosophy of an individualized programme. Thus she could allocate one child two pages of work, another four or two, perhaps other than the ones she has given to his peer, depending upon the individual child's abilities.

The peculiarities existing in these schools, therefore, deter us from suggesting the application of an individualized programme in Mathematics, such as SMP, but it does not preclude the teacher from adopting a flexible organization of the lesson in which children are given some choice of activities arising from the work suggested in their manuals.

The schools of the second category - excepting the six class schools which operate similarly to the urban schools - again by necessity confine to the application of some form of individualization. Since the children of a class are of two subsequent ages, attending two different classes, the teacher is obliged to teach different subjects in the same teaching session, there-

fore, she automatically turns to group teaching. In this instance, an individualized programme, as it has been described, not only could but also should be applied. If the teacher were convinced that such a scheme would facilitate and expand her work, the children would benefit and would be greatly encouraged to work on their own, or interact with their peers rather than referring to their teacher for guidance all the time.

Indeed the teacher could set the children of one-class practising on their own through the use of the appropriate worksheets in order to consolidate a previously taught subject, while she devotes her whole attention to introducing a new concept to the other class. Thus, a simultaneous diversity of activities could take place in the same classroom, and children would enjoy a sense of freedom and satisfaction through meaningful learning tasks while the achievement of understanding becomes a reward in its own right.

3. Labour areas.

The "labour areas" in big urban centres all over the world share some common characteristics. These include densely populated homes, high-rise flats and numerous small dwellings. Children usually have to play in the streets outside their homes and in addition schools are likely to be housed in very old, poor, dull buildings.

Initially, but even today in some areas, working class families are usually larger than middle class ones. Naturally enough, these are usually poor families. Indeed the father may need to find a second job in order to provide adequately for his family. Schools in these areas are not very easily managed because children have frequent absences from school, sometimes due to environmental conditions and lack of support and aspiration from their parents who do not always appreciate the necessity of schooling. As Olive Banks notices "poverty can make a parent less willing to keep a child at school, can make it difficult

for him to afford books and toys or expeditions which help a child to learn. . . . Moreover, even when these conditions are no longer present, the fact that they have existed in the recent past or were a feature of the parents' own childhood, may exert an influence on attitudes, values and aspirations for a generation or even more."³⁷ Even today, then, some children in this type of area often lack the motivation and the opportunity to develop intellectual interests, as they are not normally given encouragement and reinforcement by their home makers. Thus they cannot envisage education as a means of improving their future prospects and life chances. The ideas, beliefs and attitudes fostered by school may come into conflict with those valued at home.

It would be impracticable and perhaps impossible to extend these children's abilities so that their potential is reached. Moreover, it would be a mistake to force them into a scheme which requires abstract thinking when what they need is a concrete programme dependent upon practical operations. The programme to be planned and followed for these children should be limited to modest goals, at least for the first years. These children need independence, structured play, an opportunity to talk, to deal with imaginative, meaningful work.

The traditional teaching method confines them to inactivity and passive attendance. All they are asked to do is listen and write facts that are not meaningful to them and fail to stimulate their interest, since they are cut off from their world and the lives they lead.

SMP proved beneficial³⁸ to these children since it responded to their needs, habits and values. Moreover, it helped them create a positive attitude towards Mathematics, it reconciled them with the subject affecting their attainment level positively.³⁹ It is, therefore, suggested that in these schools an individualized programme, such as SMP, not only could but should definitely be tried.

The applicability of SMP 7-13 in Greek primary schools.

In applying the research a number of problems were observed. They were not the problems latent in the structure and function of the Greek school and the building and classroom facilities which have already been discussed, but they were problems connected either directly or indirectly with the philosophy, structure and teaching method proposed by SMP. The indirect problems derived from certain characteristics that the programme regarded essential for its efficient application and which referred to the organization of the lesson and the teaching system. The circumstances under which the research was conducted, as well as the functional peculiarities of the Greek school in general, did not guarantee these prerequisites.

Characteristically enough, the issue might be further elucidated if it was reported that SMP has been mainly implemented a. by schools which resort to a programme of integrated day which means that not all children use the cards simultaneously, b. by more "liberal" schools where the same teaching materials - the cards in this case - are used by two or three classes at the same time, c. by schools which do not hesitate to expand the teaching session in order to round off an activity, d. in schools where the curriculum is child-centred for every subject and not only for Mathematics, e. by schools which adopt it for all and not only for one of their classes, f. in a country where Local Educational Authorities and the school itself may determine their own educational policies or design their own curriculum for any subject. Specific guidelines are produced for their own use and implementation. It could not be claimed, however, that unless all the above conditions are observed the application of SMP is unsuccessful.

A whole schoolyear's experience of the project's application though, under the already described conditions and bearing in mind that this was the first opportunity children had experienced in organizing their own work and time proved that the

application of SMP is not an unrealistic prospect. Nevertheless, a reference to the problems witnessed during the application of the SMP project is in order here.

Difficulties connected to the Greek educational reality.

Organizational problems emerged because all children used the cards simultaneously. Even if care was taken that children started working on different topics in order to secure a sufficiency of cards and apparatus and the contents of four boxes were used, some problems were unavoidable. A lot of activity was in progress as all children had or invented some need to go to the bench where all the materials were displayed ready for use. Several disputes and quarrels arose since it often so happened that two or three children claimed the same card or apparatus.

In addition, almost every child voiced a complaint about the limited time they were allowed which was seldom adequate for the completion of an activity. By the time they had located the card they needed, grasped the exact meaning of the particular card and started working, time was up and they had to stop.

The atmosphere often became very tense due to the children's anxiety to finish their tasks within pressing time limits but also due to their inability to interact. They had already formed a system of values and rules for themselves and clung to it. This system, however, had little or no relation with practices such as co-operation in learning situations, sharing equipment, respecting other children's work and attitudes, putting their independence to good use. Naturally, the radical change of approach affected the children's behaviour; pupils who were never asked to take the initiative but were usually strictly guided by their teacher, were encouraged for a small part of their weekly schedule only to make decisions, organize their work, build their self-confidence, all in a highly active, but not disorderly classroom atmosphere.

It was noticed that at the beginning of each lesson the children needed some time to adjust themselves to the different attitude the lesson required. This transitory stage varied in length. It depended directly on their previous occupations and activities and the session the SMP lesson took up. If the children had been "charged up" by being confined to their desks, obliged to pay attention without having a chance to participate, forced to work silently, the SMP lesson offered them a chance to move around, talk, relax a bit until they settled down to work productively on their task. This commotion often observed in class, the continuous action, the murmurs, at times disturbed and distracted the children who had been used to a motionless working environment. As the teachers of adjacent classrooms characteristically commented "we could never stand this noise! This moving to and fro and the continuous buzz would drive us mad!" This comment, except for the covert advice to keep the pupils quiet, implies the disapproval of a lack of control in the classroom.⁴⁰

Moreover, the children had been used to referring to the teacher for instructions before taking any step, seeking her confirmation that they were doing well. The new approach asked them to make their own decisions, wait for a long time before the teacher could come up and offer them assistance, thus they often felt ill at ease. That usually resulted to either a low attainment level or the creation of commotion which aroused the protests of several children who could not work under such conditions.

There was a difficulty in supervising the children's work. At the beginning, care was taken that the children whose work revealed weaknesses should discuss their problems with the teacher who would try to clear up any misunderstanding or reinforce the comprehension of a particular subject. It was soon realized, however, that time was never enough to conduct all the personal contacts undaunted. Even if the teacher was aware that a child needed to resolve an issue she was often unable to deal with the

problem as she was continuously diverted by other children who sought her assistance. The weakest children in Mathematics could be waiting for a considerable time, in which case their attention was distracted and their work experience curtailed. Therefore, some of the pupils ran the risk of repeating the same mistakes even after the teacher's corrections in their exercise-books and thus misunderstand some of the concepts.

Maybe most of the difficulties described above occurred due to the particularities under which the research was conducted. Perhaps none of these problems would have emerged or they would have been minor if:

1. the instruction through the cards had been offered not only twice but four or five times a week, so that a continuous routine was established.
2. there had not been two different persons, the teacher and the researcher, one for each teaching approach, but rather the class teacher had taken responsibility for the application of the SMP Mathematics.
3. the individualized programme had been the only method followed for Mathematics throughout the year and not a parallel task to the traditional book-based method. Only then, the transition from one system to the other would have been smooth and, moreover, children would start to regard it as a routine. They might have adjusted themselves more naturally to the atmosphere of independence and freedom the method required. The sense of security offered by a steady, permanent, unique experience could have changed their behaviours and liberated them from their feelings of uncertainty. Nevertheless, even if SMP were applied under normal conditions in the Greek school the absolute individualization it promotes would be in contrast with the directly controlled learning supported by the Greek educational system. Thus the proposal to apply a commercial scheme like SMP, at least at an early stage of experimentation would be

likely to create too abrupt a transition from one approach, the traditional system, to another, that of SMP.

Such a suggestion might lead to strong objections, thus become rejected or at best attract little support. Alternatively, a smoother transition to a more flexible, less authoritarian curriculum which would provide for children's individual differences and abilities would be likely to gain support more readily.

Difficulties directly connected to SMP

The second category of problems emerged from the conduct of the research and were in direct relation to the philosophy, design and arrangement of SMP. These problems were due to the fact that SMP:

1. is a highly individualized card-based system which means that children can work on their own, in pairs or in small groups without referring to the teacher for assistance, as it is maintained in the teacher's handbook. This, of course, supposes that children should be competent in reading and understanding the instructions and explanations preceding each exercise as well as the exercise itself. However, if the child's reading ability is low, this demanding characteristic of the project is likely to hinder his progress or might establish a dislike for Mathematics. Moreover, it will obstruct the teacher's task, since she will be obliged to spend a good proportion of her time with certain pupils, explaining the text of the card to them in order to enable them to tackle the associative activity. Considering that in a mixed ability class the teacher has the problem of allocating a reasonable amount of time to each child it could be assumed that this problem becomes more acute when a number of pupils in a class face reading difficulties.

In the present study this problem arose in the rural but mainly the working class school. In these schools the average reading

ability level was rather low, a fact that complicated the card work, often caused commotion during the lesson and limited the teacher's chances to discuss the other children's problems or offer them assistance. For this reason a Mathematics project which would make provision for the slow learners should not depend on reading but should be presented in a physical way, otherwise their lack of reading competence would result in a lack of mathematical achievement.⁴¹

Of course, it could not be claimed that reading backwardness does not constitute a problem in another teaching method, such as the one based on class instruction, nor can it be assumed that it does not hinder the understanding of other subjects within the curriculum. On following class instruction, however, the teacher explains a concept and the activity related to it to the whole class, thus the children's possible failure to proceed is not normally blamed on their reading incompetence but mostly on other factors, usually listening skills for the most part. This disadvantage of the individualized project becomes more acute in the Greek school where the comfort of the extra or remedial teacher is unknown. It is difficult for the teacher, therefore, to clear up the pupils' misunderstandings or confirm their knowledge, so pupils definitely need the help provided by their home makers.

2. presents several problems connected with the readability of the mathematical texts. The way some concepts are presented and instructions are given is long, detailed and confusing for a number of children. This might at times discourage children, who may even choose to ignore the perplexing introductory text and theoretical explanations and proceed to complete the proposed activity, which they try to decipher by the lay out of the card. On the other hand, several children who make an effort to read and comprehend the text soon get tired and give up or others after having exhausted themselves on the effort to read the text, finally realize that the mathematical meaning has escaped them.

In the present research a number of exercises were misunderstood because either the text and explanations of the card had been ignored or they had been partly read or misinterpreted. Also at times the apparatus proposed by the card was not exploited so that the philosophy of the project to approach comprehension through practice before achieving the abstract theoretical conception was lost to them.

3. requires a lot of copying. Children are sometimes obliged to copy the content of the whole card in their exercise books. Thus a lot of their time -indeed most of it- is consumed in reading, copying and operating the number operation through the implementation of the suggested apparatus rather than to understanding the concepts involved or the processes employed. The children's time often happens to be spent productively, "but much of this effort is concentrated on the production features of the task rather than on progress through the exercise."⁴²

This is another feature of SMP which discourages low attainers. The latter are usually confronted by reading and consequent writing difficulties. They often waste most of their time in meticulously copying the text or the exercises of the card, a process which requires an awful lot of effort on their part, since their memory span is short lived and they cannot rely on it and transfer what they have seen onto the paper. Furthermore, when the card demands the copying of tables, things become worse. Their inability to use a ruler with ease obliges them to write and erase countless times. Thus most of their energy is consumed in copying the table or shape and not in the acquisition of the concept or skill that is involved. Moreover, they do not gain any sense of satisfaction through the cardwork since many a time they do not fulfil their goal, namely solving a problem or tackling an activity.

Finally, the activities proposed by several of the cards through the use of some apparatus, activities that are meant to precede the elaboration of the given exercises, are so complicated and time consuming that often children decide to ignore them.

In the present study, it often happened that after copying the table of a card and judging by the effort they had put to it, the children considered they had finished with the particular card and proceeded to the next one disregarding the exercises. Similarly, on certain occasions the suggested apparatus was not used. The children went straight to the factual operation, because in their view, the apparatus had nothing to offer them, since they found it hard to understand the instructions concerning its use; besides, they judged they had already classified the relative skill and technique in their repertoire. Not only low attainers but many of the children experienced the above described difficulties.

4. has not provided for a teacher's guide where the philosophy of the project as well as its objectives and the logic underlying its selection of topics⁴³ could be explained. A completely novel scheme was suggested without any theoretical support for the learning process or cognitive development involved. The stand taken or the method adopted towards the learning and teaching processes was not analysed. No attempt has been made to support the teacher in understanding and realizing her role. The mathematical content and targets aimed at in each card were not explained, nor parallel examples or activities that could yield the same results were volunteered.

The teacher's handbook accompanying each box of cards is excellent for the dealer selling the product but inefficient for the teacher who will use the material as a means of teaching Mathematics. Thus, the teacher is more or less left on her own, uncertain of what she is asked to do.

5. has not designed its cards for the Greek curriculum, indeed they have been produced to respond to a completely different educational philosophy and serve needs other than those advocated by the Greek system. Some of the cards introduced topics which could have been omitted from the corresponding Greek syllabus, a fact which recommended the exclusion of these cards from the

Greek version of SMP. The same problem applies in the test papers which include exercises referring to the cards that are inapplicable in the the Greek version. These exercises could be replaced.

Also there exist cards which cause numerous difficulties due either to the formulation of their subject matter or to the terminology, symbolism and mathematical concepts introduced.⁴⁴ These cards, in the course of the present study, impeded the child not only in understanding what they required but also in realizing the technique in its operation. The length of the text and the general lay-out of the cards proved an obstacle especially for the weaker pupils.

6. encourages children to work individually. Despite the proclamation made by SMP that it promotes pair or group work little of both is in evidence. Thus, unless the teacher intervenes, the children do not exchange ideas, express their thoughts, get accustomed to hearing and voicing mathematical propositions, using mathematical terminology, in a word, interacting. Children are certainly encouraged to be active and inquisitive but they also " . . . need assistance to translate actions and this comes about by communication and interpretation through language from teachers. Teachers must judge when to take an active role in any learning situations, when to stand back, when to interact, when to advise and when to interpret. . . "45

In addition, by allowing children to work on their own, on the topics of their preference, according to their ability and at their own pace, the recording of their progress becomes quite difficult. The teacher has no definite way of telling whether a child's progress is in accordance with his capacity or whether he wastes valuable time chatting about irrelevant subjects, wandering around in class or daydreaming. As Ernest Choat points out "in large classes with each child working at his own pace it was sometimes easy for a boy or girl to 'get stuck' or pick up

the wrong idea from a workchart without the teacher being aware immediately of this."⁴⁶

It might be argued, therefore, that SMP benefits the able pupils who can proceed at a fast rate, while the less able pupils in a class may be liberated by their anxiety and sense of failure but, on the other hand, are not necessarily assisted to tackle their difficulties, catch up with their able peers and expand their potential. In fact, "to be guarded against is a tendency for pupils to do some low-level thing they were expert at years ago."⁴⁷

In the present study we were confronted with the case of a child who, without facing particular difficulties, at the end of the school year, had covered a small portion of the first section cards only. Certainly in this particular case the child had covered the prescribed syllabus through the Greek teaching method, nevertheless the question remains open what would happen if a child were taught only through the SMP system? Should a child be allowed to proceed at such a slow pace since this seems to suit him? Then it is possible, or rather certain that this child will have accomplished too little by the end of the year and will definitely encounter problems the following year. It could, of course be argued that he could be allowed to work at that slow rate throughout his primary schooling. Would not this then create for him serious problems in his interacting relationships with his classmates and, moreover, when he enters secondary school? How could his class teacher help him tackle his weaknesses, kindle his interest in Mathematics, find out his needs and furnish him with the appropriate activities when she has a whole class of twenty five children? Since no pressure is exerted on the child and the time allocated by the teacher to each child is rather limited, the low attainers always run the risk of being left far behind, unless a scheme is devised to arouse their interests and stimulate their learning (see appendix A, pp. liii-lv).

7. another difficulty innate in the SMP teaching method is its way of presenting a new concept, symbol or technique. Since children are allowed to proceed at their own speed, it is sometimes difficult to form a group of children who are more or less at the same point in order to introduce them to a new topic. Even when the initial issue is resolved the teacher is still obliged to repeat the same instruction and explanations several times which is definitely a waste of valuable time. Certainly the teacher-pupil interaction is expanded to the benefit of less able, shy children, but all at the expense of the syllabus to be covered.

In conclusion the whole group of difficulties in direct or indirect relation to SMP should be considered carefully. Certain changes of materials or techniques should be adapted and a rearrangement of the classroom should be attempted so that SMP is made applicable to the Greek educational system where it stands good chances for success.

Suggestions for alterations of the teaching materials and method of SMP 7-13.

After the relative discussion in chapters III and IV, it becomes obvious that in order to apply SMP in the Greek school it would be necessary to undergo certain changes, improvements or adaptations in both its subject-matter and teaching system. Thus:

1. The introductory text, the explanations and instructions of exercises would be better kept to a brief, simple and precise form. Such a scheme would favour both low and high attainers. The former would put less effort in reading and would encounter fewer difficulties in grasping the meaning and fulfilling the demands of a card. Therefore, their confidence would increase and satisfaction would be achieved. Similarly, the latter would be given the chance to progress at a faster pace avoiding mistakes resulting from the misinterpretation of the text and could make up examples of their own to extend their knowledge. Fi-

nally, the whole class could benefit by securing their teacher's essential assistance on Mathematics and not on reading alone.

It should be indicated, however, that not all cards require a high standard of reading ability, so SMP has to some extent provided for low attainment pupils who are not very fluent at reading. But even in these cards the text could become simpler or be completely omitted. For example, from the cards which instruct: "Copy these exercises" or "Write your answers in the boxes" the text could be erased. Instead the teacher, at the very beginning, could point out to all her pupils that all exercises should be copied in their exercise books - nothing to be written on the cards - and that the blank boxes are furnished so that they can insert their answers-symbols, digits, short words. Besides, very often the requisite is so obvious that children do not stop to read the instructions but proceed straight to the solution of the exercises. At times, perfectionism in designing the lay-out of a scheme of work may result in hindering children's understanding.

2. The meaning of the explanations supplied by the card should be clear and concise. A common characteristic of all individualized schemes is that oral speech cannot be easily replaced by the written form. The teacher, on introducing a new concept, can modulate her voice in order to make her point, to explain, advise and guide her pupils. This cannot be substituted by the colourless, flat, limited surface of a card or worksheet. The written word, especially a mathematical text addressed to young children, can seldom be vivid, comprehensible, pleasant and succeed in gaining or even exciting them. In an effort to make up for this weakness, SMP uses attractive, familiar figures which make the card lively, less "mathematical" in appearance. These figures, appealing to the children, succeed in attracting them into the purpose of the card. The excitement of narration, the potential of expression, the pleasure of communication offered by the word is balanced by the liveliness of the picture, the vivacity of the graphic representation which has a similarity of format to comics.

Even in this case, however, the picture like the text, dominates over the exercise or the activity to be tackled. Thus both pictures and texts often miss their target, which is to facilitate understanding and exist in their own right. These cards are few and can easily be sorted out and adapted so as to serve the purposes of the particular section to which they belong.⁴⁸

3. The excessive copying of texts and shapes should be limited. It is not unusual to practise writing and drawing accurate shapes but not at the expense of the children's progress in mathematical understanding. The amount of time involved in reading the instructions and copying the texts and exercises is a common problem of all schemes employing individualized instruction. This SMP characteristic becomes an impediment for slow learners who are not competent at reading and writing; preferably then, copying should be minimized. Photocopies could be provided and attached to the children's exercise books whenever tables or graphs are required. Furthermore, fewer exercises could be allocated to each card so that children do not get exhausted by copying them out, but they are able to complete more tasks, thus deriving satisfaction from their work and progress. This decrease of copying demands should be pursued for an additional reason. The primary school curriculum recently introduced in the Greek school makes very few demands for writing and copying. Children simply fill in the blanks in their books - Mathematics and Language - simply with words, short sentences, mathematical symbols. Regardless of the criticism that may be exercised on this work process, it has not only disqualified children from writing but it has created a dislike for copying as well. Consequently, SMP might not be accepted in the Greek system if too much copying was demanded.

4. A teacher's manual should be published, in which the theoretical framework of the project should be explored and its objectives and teaching strategies analysed. The manual could indicate the reasons which dictated the design of the project, connect the subject-matter, philosophy and methods of the pro-

gramme to a specific educational and cognitive theory, describe the content of the syllabus, explain the teaching approach followed, and justify the choice of the particular scheme. The main purpose of this manual would be to assist the teacher to realize the scope and aims of the project and to familiarize herself with the mathematical concepts, skills and attitudes promoted.

Furthermore, the guidelines should convince her of the advantages of the project and alert her to possible disadvantages. Before deciding to use SMP the teacher should be well informed of its advantages, the purposes and needs it serves, she should be aware of the differences between various mathematical schemes and the amount of work required in order to maintain a high standard of competence among the children. The teacher's guide would be an indispensable tool if the application of SMP in Greece were seriously considered.

Teachers hitherto, in Greece have gone through a strict, authoritarian, uniform educational system, a milder form of which they have adopted in their teaching. In the course of their training they were introduced to individualization as a theory but they have rarely been given the chance to witness it in operation nor, moreover, apply it themselves. Thus they might consider its application in the Greek educational system as a form of Utopia! It might take some time to persuade them of the necessity of applying individualized instruction and the teacher's handbook could certainly contribute to this greatly.

5. The content of certain cards would need revision as they were seen to be problematic for some children. Problems stemmed from either the mathematical concept introduced or the way of its presentation. Several of the concepts, then, should either be omitted or simplified (fewer concepts and/or different symbolisms on the same card).

Also the way that some topics are elaborated should be reconsidered. There are several topics which, although lengthy, are de-

veloped so as to follow a natural evolution of activities and concepts and provide graduated stages of content. On the other hand, certain topics cover their subject rather too hastily, and their cards are insufficiently challenging for the age to which they are addressed. These topics should be re-examined and enriched by additional material.

Finally, there are several topics - graphs, for example - which favour work in small groups, encourage collaboration and because of their modern, fresh theme are very interesting. It was noticed that the form of their presentation - a small booklet - being different from the ordinary lay-out of the single card, as well as the subject itself, fascinated almost every child. It might be suggested then that the idea of this presentation - the booklet - could be extended to several more points if possible.

6. If SMP were introduced to the Greek primary schools, the suggested implementation of the cards as well as the type of individualization would need adaptation. The Greek educational system does not accept, at least for the time being, children of the same class to proceed at varying rates, on the contrary it insists that all children should cover the same syllabus. SMP could serve this purpose if it were possible for the Greek manual to be adapted, so that children were expected to complete satisfactorily the same concept but not all of them in the same depth.

Apparently then SMP could not be adopted to the Greek school in its current form. The Teacher's Handbook provided by SMP (p. 3) reads: "SMP is an individualized course, allowing the children to progress at their own rate." And a little below it states: "children should work through the course section by section not going on to a new section until they have completed the one before." This means that:

a. In the course of a school year, a child can complete the cards of one section only or possibly not even a whole section but just a part of it.

b. A child who at the end of the year has managed to cover the cards of all three sections will have completed satisfactorily each one of the twelve topics included in every section three times.

c. At the same point in time it is possible that all twelve topics are being tackled simultaneously in the same classroom. Nevertheless it is highly unlikely to have all children who tackle the same topic, e.g., addition, to be working on the same card as well.

In order, therefore, to fulfil the demands of the Greek educational system, it would be necessary for all children to have covered the same topics by the end of the year. On the other hand, however, in order to comply with the SMP principles this should be attempted according to the children's individual abilities, needs and interests.

SMP could be applied to the Greek educational system, only after some mutual adjustments and compromises. Of course, care should be taken that changes will not cancel the principles and philosophy underlying both the Greek educational system and SMP.

As far as the Greek educational system is concerned, the same syllabus could be provided for all children, but the degree of difficulty and elaboration of the subject could be diversified for each child.

Now concerning SMP, a minimum and a maximum number of cards on each topic could be set for every child to complete. Thus low attainers would be expected to work to the best of their ability, while at the same time they would be able to cover the syllabus only through simpler tasks. On the other hand, the highly motivated intellectually able children could proceed at their individual pace on any subject they choose provided they have covered every topic of the syllabus and not their favourite ones only.

Another alteration that should be considered about SMP is the way in which children proceed from section to section covering the topics within the same section in any order they decide. Alternatively, the three sections could be incorporated into one which could include three stages for each topic graded according to the difficulty and complexity of their content. Thus the whole class could be brought together for the introduction of a new concept, skill or technique and individual teaching could be planned for children's practice. For example, the teacher explains the new concepts just once, thus avoiding tedious repetition and saving time to deal with individual pupils. After having introduced the concept she asks questions, gives answers and examples, proposes several applications and then leaves children to work on their own offering her assistance wherever necessary. The cards of each topic can be either colour or number coded and graduated into three stages. All the first stage cards should be tackled by everyone, except if the teacher judges differently. Then children can proceed to the second stage cards which they must finish before continuing to the third. Having elaborated a subject for some time (that the teacher regards adequate) and having calculated the time limits posed to her by the syllabus or the children's progress on the particular topic, the teacher introduces the next concept.

A problem likely to arise is a possible inadequacy of cards. As all children do Mathematics in the same teaching session, the teacher could "stagger" the children's work, at least on the first day of the introduction of a new topic. Alternatively, she has to produce a quite large number of the first stage cards - as many as the children - or, if this is impossible, separate children in small groups who can share the same card. The teacher could also distinguish certain cards of each topic to use as revision material. Furthermore, an additional booklet could be prepared for revision purposes only. Thus, from time to time she may briefly go back and confirm previously learned meanings and acquired techniques. Revision could apply to the whole class simultaneously, a number of children - and not the

same topics for all children - or individuals, if the teacher judges it necessary.

These changes may be considered as essential, if SMP is to be applied as a commercial scheme of work to the Greek elementary school. Certainly more points could be stressed and more specific suggestions made if a large research project with SMP modified to suit the Greek school reality could be conducted, using many schools, in various areas and by a group of researchers. It should be clarified here that the introduction of SMP does not necessitate the withdrawal of the Greek Mathematics manual. On the contrary, with the correct co-ordination both SMP and the Greek method could be used quite effectively; in fact, the proposal of such a scheme of work might be more readily accepted.

The potential of a parallel use of both schemes.

It has already been stressed that the weakest point of the Greek educational system is that it requires both able and less able pupils to work at a uniform rate, a policy that ignores the abilities of both groups. The introduction, therefore, of SMP and its parallel use to the Greek teaching method should be beneficial for all pupils by fully exploiting their capacities.

A tentative work programme for the teaching of Mathematics is described below:

At the beginning of the school year the teacher must distinguish between the areas of the curriculum, those which receive either inefficient and hasty or unreasonably long and detailed treatment. She must then pinpoint the pages of the book the content of which respond to all pupils' ability level and they could, therefore, be completed by everyone, as well as those which are too difficult. At the same time she should sort out the SMP cards that are highly attractive presenting concepts and skills in a simple and pleasant way and, on the other hand, the ones which employ a more sophisticated, complex mathematical language

and after the necessary adaptations introduce their subject and require the application of specific skills and concepts. In the course of the lessons she would not encourage all children to complete all the pages of the book.⁴⁹ She should allocate certain pages of the manual and/or several SMP cards to all children and then, according to their needs and capacities they could either continue their work from the book or work on the SMP cards. Weaker children, therefore, practise more on the material they need - and all within their abilities - while the more advanced pupils could pursue a topic at their heart's delight. Thus, as far as possible no one should feel repressed or disappointed.

Concerning the work process, the teacher could explain from the very beginning that after completing the prescribed work on a specific topic, pupils could work on either the SMP cards or their manuals for the rest of the time.

In this work scheme, of course, the SMP cards would be used as supplementary material to the Greek Mathematics manual and not as the main teaching system. Nevertheless, they would certainly affect the traditional teaching method to become more flexible, less authoritarian, adding at the same time a touch of individualization to it. However, in no circumstances should this proposal be considered as the ideal solution.

It could be surely claimed that the suggested scheme has nothing to do with the original English version of SMP, but it is an absolutely different system which adopts or keeps certain characteristics of the project. Nevertheless, SMP itself (Teacher's Handbook, unit 1, p. 4) states that its major advantage is its flexibility and that it could be applied in many different ways and forms of organization. Moreover, even in case SMP could be adopted as the main method in the Greek school it would need some modification, so that all conditions mentioned above would be observed.

The potential of SMP 7-13 in a class with a number of pupils with special educational needs.

In chapter III several special examples of children were encountered,⁵⁰ for which the efficiency of SMP failed to cater. In case, therefore, any individualized programme - SMP or another alternative scheme - were to be introduced in the Greek school the problem of slow learners in a class should be seriously considered.

The term "slow learners" is by no means used to describe the severely handicapped children but those pupils in a class who face learning problems resulting in educational failure, children, that is, who cannot cope with the school work assigned for their age, but deviate markedly in performance from their peers of average ability. The existence of slow learners in a class is an acute problem which needs studying not only in relation to SMP but also, or even more so, in the case of other mathematical schemes and indeed to many other areas of the curriculum.

The slow learners and their reactions as evidenced in the present study.

The background information concerning the five slow learners of the present study were derived from either their class teacher or the researcher's personal observations and offered an insight into those children's special problems. For instance:

1. All five children came from a problematic, underprivileged family background.
2. Three of the children exhibited highly aggressive behaviour. Even though there was some period of collaboration and understanding with their peers, suddenly, as if they were somehow threatened by something, their confidence would be shaken and they would resume their hostile attitude.

3. They usually were indifferent, almost non-existent in class but at times they would do anything in their power to disturb and irritate their peers, the very personification of objection and negation. In any case, they were very seldom satisfied or enthusiastic about school work.

4. Their behaviour was highly unpredictable. At times they did not want to be identified as different from their peers but there were occasions when they desired to stress their difference.

5. All five children faced reading difficulties. Four of them were in no position to recognize the letters, nor were they able to read or write.

Concerning their reactions to Mathematics from SMP it was noticed that the particular children invested a lot of hope in SMP. they envisaged it as a panacea for all their learning problems, as their only means to catch up, to be accepted by their peers. They clung to the use of SMP, were anxious to progress at all costs. Thus, during the whole of the first term they refused to tackle anything other than the cards. They insisted on the card work, even if the words and symbols of the cards meant nothing to them.

They showed a strong dislike for the cards which contained numbers and facts. They usually phrased their dislike with expressions like, "numbers again?", "you keep giving me the ones with the numbers, I want the ones with the clocks," etc.

They were fascinated by the simple apparatus of SMP. They never failed to use it for every problem they were asked to solve and at times their involvement in the apparatus distracted them from their main objective, namely the topic.

They favoured the cards containing cartoons, the clock stamps enthralled them. They insisted on taking coins, exhibited a re-

markable ability to colour and painted skillfully and imaginatively.

They obviously preferred cards which involved activities based on everyday, practical subjects, such as capacity, volume, weight, time, money, while on the contrary disliked cards with numbers and shapes.⁵¹

They particularly liked - beyond any expectation - the cards on division. Here again they were attracted by the lay-out of the card - the little counters, the absence of any facts/operations- and used apparatus excessively thus achieving correct answers.

They were lured to the addition and subtraction cards because of their handsome figures but the difficulty of the task soon disappointed them.

Their need for the teacher's assistance was constant. They could not work, unless she was by their side. They stumbled at every small step, needed support and advice. Since, however, the teacher could never satisfy their need sufficiently, they often experienced anxiety expressed with anger and aggression.

Often their choice of cards depended on the text accompanying them. Many a time they would insist on taking a card which represented pleasant pictures of houses and dolls, but as soon as they drew the card out and saw the text following the pictures they became disappointed and hurried to push the card back in its place.

The rest of the class recognized and accepted the fact that some of their classmates faced particular problems and needed extra help and support from the teacher, yet they had not reached that stage of maturity that would enable them to be patient and understanding towards their peers.

This brief report of the five examples of slow learners encountered in the course of the research indicates that SMP has these

qualities that may incite the interest or even enthusiasm of low attainers. If it eventually did not succeed in remedying their backwardness in Mathematics and in helping them make a really positive step towards progress, this should not be blamed on the project's planning or inefficient provision. SMP does include several cards with very simple mathematical text and content for the less able children but, at the same time, as it points out in the Teacher's Handbook, "the very slow or remedial child will need extra help." It is distinctly stated then, that while some SMP cards are suitable for backward children, remedial help will be positively necessary while using an alternative approach. However, it remains a fact that SMP helped these children where the Greek method had failed them. At least with the SMP cards they felt some sense of satisfaction and achievement, their inferiority towards their peers decreased and they formed a fairly positive attitude towards Mathematics.

The experience of the research suggests that the SMP material would not be sufficient for use with slow learners. Nevertheless, it is believed that the prevailing feature of SMP, that of individual instruction⁵², did affect positively even these children, as:

1. Children proceed at a varying pace, thus their rate of work as well as their progress is not easily detectable and for this reason markedly different. Comparison is not direct, therefore, slow children do not experience so deep a disappointment.
2. The teacher (with SMP) does not teach the material of the book page by page and, of course, she does not address the whole class every day but only those who face difficulties thus providing for their needs. Even these children can then understand, and, what is more, actively participate in the lesson.
3. If the teaching session is well organized and the children get used to working on their own, the teacher may save some time - not always as much as these children need - to devote to the

particular children and allot them work that serves their needs, weaknesses and interests.

Consequently, it is not only SMP as teaching material itself that can help the slow learners but rather its function and the circumstances it promotes which create chances for more care and assistance for these children.

Naturally, it will take an expert or the class teacher⁵³, or both to design an appropriate work programme for slow learners. Possibly every slow learner is an individual case but it is most probable that their problems originate from common sources.

Several conditions should be taken into account if a work programme for these children is to be designed:

1. Mathematics teaching should not confine these children to concentration, inactivity and silence. No such demands as elaborate written language or conformity to rules should be insisted on. On the contrary, any programme should encourage their creativity, imagination and development of their social and intellectual abilities.

2. The programme should not rely on reading or other academic skills as the major weakness of slow learners is their reading and writing inadequacy. Mathematics could be introduced in a natural way directly related to their experiences.

3. Mathematics does not merely consist of numbers and facts which do not make much sense to children, to slow learners, in particular. Mathematics is more than counting and computing, it is a language indispensable for everyday communication and activity, and it should be presented to these children as such.

4. The central notion of Mathematics is order but most of the slow learners come from homes generally less well organized. Thus, their cultural background does not provide them with the motivation, orientation and experiences relative to number. The

structured environment of school is often in contrast to what they have experienced at home and may be less than constructive when slow learners are required to deal with a highly directed Mathematics programme.

5. These children seldom seek knowledge for its own sake but only as a means of attaining practical gains.⁵⁴ SMP, then, could be applied in a class where a number of slow learners exist, but not in its present form. A special individualized programme should be designed for each of the particular children. For instance, it would be beneficial for many schools if a group of teachers specializing in the teaching of Mathematics could produce an appropriate system. This special approach should not be based on reading and writing as SMP does for the most part and, furthermore, it should take into consideration the children's cultural and social background, their needs and values and try to respond to them positively. The slow learner should not be made to feel inferior to his classmates but on the contrary learn to give credit to himself and draw satisfaction from his work.

There might be a problem deriving from these children's urgent need of the teacher's constant assistance. Nevertheless, SMP, or any similar individual programme, diminishes this problem. It offers such a variety of activities to each child that it somehow releases the teacher from the obligation to do all the talking, be consumed in instructing, guiding, explaining to the whole class all the time. Therefore, she may have more time to devote to the slow learners of the class.

Alternative possibilities for the teaching of Mathematics in the primary sector.

The possibilities of the application in the Greek elementary school of an individualized scheme -other than SMP - as well as the potential success of SMP as the only approach followed or as

supplementary material to the existing Greek method were explored at a previous point of the present chapter.

In both cases certain conditions must be observed: 1. The teaching materials now in effect and only recently introduced should be either withdrawn or partly used only. 2. An extremely large sum of money would be necessary in order to equip every school of the country with the new material. 3. An in-service programme for teachers should be introduced. 4. A different organization of classrooms and teaching material would be required. 5. A re-assessment of teaching strategies leading to changes within the educational provision in primary schools should be considered.

It might also be worth examining the potentialities of applying a type of individualized scheme with the lowest possible budget, moreover, one that would not disturb the feeling of security offered by the familiar, established status of the existing educational philosophy.

It is suggested that the simplest, most inexpensive, least disturbing and most directly applicable innovation which, moreover, will be hardly attacked or objected to⁵⁵ is to employ the available Mathematical book but in a different teaching method from what is now used.

Proposal for the teaching material.

As a first step towards the innovation to the teaching of Mathematics, it could be suggested that the Mathematics manual could assume the form of a card-based individualized scheme, after it has undergone the strictly basic changes to its content and layout. The manual currently in use could keep its present form, but its pages could be kept individual and printed on cardboard. Of course, the book leaves are printed on both sides, so it must be decided whether there should be produced as many cards as the book leaves (152, for example, in the case of the second class book) or as the book pages (304 in the same example).⁵⁶

This choice should depend on:

1. the possibility (from a purely technical point of view) to print, under the existing circumstances, the cardboard on both sides,
2. the most attractive appearance of the card and its most convenient use,
3. whether both pages of a leaf should be kept on the same card because the activity or concept to which they refer should be presented jointly,
4. whether two consecutive pages should face each other in a folder form.

In any case great care should be taken to secure an excellent cardboard quality (i.e. rounded corners, plasticised surface), so that the card may be protected from the constant use and be maintained in a reasonable condition for a few years, if possible.

Cards could be kept in open-topped boxes in the same order they are presented in the book or in any other order might prove convenient. Indeed, if a rearrangement of the book content is decided, the colour frame of every book page could be used to distinguish the different topics or the sections where the cards belong. Such a device would facilitate the child in either referring to or using the cards. The page numbers of the book could either be transferred to the cards even if the teacher decides to use them in an alternative order or change, if the card rearrangement into topics and sections we discussed above, is eventually determined.

The appropriate apparatus for each activity proposed by the card must be available in adequate quantities in each classroom.⁵⁷ It must be remembered that through the traditional teaching method and under the time pressure to cover the prescribed syllabus no apparatus is ever used. Simply looking at the pictures of the book, children are not actively involved but only imagine the procedures necessary to pass from the stage of concrete operations to the stage of abstract concepts.

The suggested apparatus is, as in the case of SMP, simple, cheap and easy to acquire or to make (by the teacher). A detailed record system must be used - the assessment tests (see appendix C for a sample) provided by the manual could serve this purpose, a profile of each child's progress must be kept and a record sheet must be attached to each child's book of Mathematics.

The teaching material - cards - as well as the apparatus should be exhibited on a bench at the child's height and be easily accessible to all children.

Since, however, the book has not been designed to serve the purposes of an individualized, card-based scheme of work, the ideal process would involve a considerable amount of re-writing, re-designing and re-arrangement. Properly planned individualized programmes present their topics in small units of work, with their own introduction and necessary explanations.

Nevertheless, considering the fact that only recently an innovation has been introduced in the teaching and content of Mathematics and being familiar with the reactions any attempt at innovation has aroused, we maintain that if the prospect of a radical reformation seems unrealistic, then the proposed change moderate as it might be, could prove a worthwhile venture.

Suggestions about the teaching method.

The teacher may rely on class or group teaching or individual tuition. The content of the syllabus could be covered by the same linear process. The length of time devoted to a subject, i.e. addition, will be the same for all children, topics will be tackled in a similar order, but the number of cards to be covered will not be the same for everyone. In this case the teacher will not be obliged to introduce the same concept many times, thus allowing herself more time to assist individual children and supervise the class's progress more effectively.

As an alternative, different groups could cover varying subjects, only the time and duration of the activities of every group will differ. The children within the same group, however, will work as described above. If the teacher decides, that is, to divide children into groups, according to their abilities, she may have to repeat the same lesson more than once, but she will be in a position to adjust the various subjects to the groups' abilities. This process might be more beneficial for the pupils, because the less able ones will be initiated to a new concept or technique more smoothly, with an easier use of language, through simple activities and perhaps more practical work. On the other hand, the "advanced" pupils might take up the challenge of discovering new relations, possibilities, techniques, proceeding fast to a more abstract stage. Also the demands for the same cards decrease - since only about half of the children will deal with the same subject - and thus the organization of the lesson becomes simple and the class atmosphere calmer with fewer disputes and tensions.

Suggestions for the lesson organization.

If the teacher decides to adopt the class teaching approach she may follow exactly the same process described for the SMP cards in p. 257 of the present chapter. However, if she chooses to divide children into groups according to rather distinct levels of ability - it will be easier for everyone, teacher and children alike and it will facilitate a smooth conduct of the lesson in general, if the introduction of a new concept or skill is staggered for the groups. Thus, when she has to introduce a lesson to one of the groups, the other groups, who are likely to be engaged in the work of the previous days, will not distract them.

The teacher may prefer to organize her cards by fostering a linear progression in covering the various topics of the Mathematics syllabus, dividing in this case the cards of each topic in stages of gradual difficulty. Alternatively, she may follow a

spiral programme of work - like the one SMP suggests. In the latter case, she would distribute the cards in sections in each of which a linear development of the syllabus will be followed. She will have, however, to be more careful in organizing the material as well as the time she will allocate for the completion of each section and every topic within the section. She will be obliged to revise the same topics with the same group two or three times depending on the sections into which she has allotted the cards. Of course, again she should indicate the minimum and maximum number of cards that both low and high attainers are expected to complete. Apparently, however, things would thus become more complicated and the teacher might find it more and more difficult to supervise the children's work, discovering the difficulties they face and help them efficiently. Nevertheless, this also constitutes a possibility even if it involves a very systematic approach on the teacher's part, and even if there might be few teachers who will support and even fewer teachers who will attempt it. However, when teachers have received sufficient in-service training, they are likely to feel more confident in introducing and maintaining the particular form of organization.

Considering the suggestions made above, it becomes obvious that even the valid Greek Mathematics manual, if used to its full capacity, may respond to the intentions and philosophy of an individualized programme.

If the book takes the form of individual cards it becomes much more flexible and enables the teacher to foster different approaches depending on the number of children, the ability level of her class, the type of school she is assigned to (one -, two -, six-class school) and the area where the school is situated (urban - rural).

Moreover, the proposed innovation would not require much additional expense. At present the government supplies one book of Mathematics to each pupil (an average of thirty books per class each year), whereas if the book was substituted by cards one box

of cards would suffice for a whole class. Furthermore, the innovation could be applied within a very short time, because only a minimum change in design or material production would be necessary.

Finally, the limitations imposed by the timetable could be respected, since the allocation of time for Mathematics would remain relatively unchanged, although the teacher might decide to extend the practical element into other areas of the timetable.

Not many reactions are likely to arise from all those interested, since it is a low-key and not in the least spectacular change. Besides, the book has already been introduced to schools and has passed the preliminary stage of strong attacks and criticism.

The use, therefore, of the book pages so as to serve the purposes and intentions of an individualized programme could be a workable solution for an immediately applicable innovation in Mathematics teaching. Of course, we do not wish to claim that the proposed scheme is the best or, even less, the only solution. We simply wanted to examine the possibility of employing a method, other than SMP, in an attempt at innovation, and this method could implement the book currently in use. The success of this limited change would depend largely upon the teachers' willingness and readiness to initiate the new approach.

Discussion of the results of the various tests given to the children during the study.

As mentioned in the foreword of this chapter, one of the purposes of the research was to study the attitudes towards the applied project, the attainment during the application and the achievement in the distributed tests of children with different home backgrounds, attending schools in three areas of the town inhabited by different social classes.

It was stated from the very beginning that very little information was collected about the children's families, i.e. parental occupation and educational background, time and attention devoted by mothers and/or fathers, to their children work and progress at school, access to books and other learning material as well as relations between parents and teachers and parental attitudes towards primary education and the upbringing of children.

The information collected was based mainly on teachers' comments, pupils' discussions in class and on a short questionnaire filled in by the pupils at school.

The lack of systematic and valid information was due, on the one hand, to the lack of official statistical facts about children's home and educational background and the inefficiency of the present study to collect facts, on the other. Special official permits had to be issued for the purpose, as well as carefully designed questionnaires. Similar procedures, however, were neither within the possibilities nor the purposes of the present study.

An effort is made to discuss the results of the tests (as they appear in the tables) in relation to the children's attainment and their home background, only this discussion is not based on specific statistical material. Another point to which attention should be drawn is the size of the sample. It has already been mentioned that the total number of children in the three classes was fifty-five. Forty nine⁵⁸ children completed the first section test, twenty-one of which were boys and twenty-eight girls. Only in one of the three schools (the Aghia Triada school) the number of boys equaled the number of girls while in the other two schools the number of girls surpassed the number of boys, thus any conclusions concerning the differences of achievement between boys and girls run the risk of being erroneous. A discussion is actually attempted about these topics in which boys/girls of each of the the three schools were successful in

an effort to pinpoint the interrelation between boys/girls achievement.

Finally, a discussion is attempted on the tables concerning the children's progress (as it is presented through the results of the three tests) in each one of the three schools separately and jointly.

Before starting the discussion of the findings several explanations appear to be in order:

1. Tables 1, 2 and 3 present the success rates of the children of the three schools - 41st, 9th, and Aghia Triada respectively - in the three general tests⁵⁹ given in the course of the research. Test 1 was a preliminary test given in October, 1985 before the SMP programme started. Test 2 was given to the children at the end of the second term (1986). It was based on the SMP material covered up to that time and it was designed by the researcher herself.

Finally, test 3⁶⁰, given in 1986, was the official SMP test based on section 1 and contained questions on the first section material. The researcher's participation and interference in the test was limited to the translation of the English text, the omission of certain exercises which were not included in the Greek Mathematics syllabus and the replacement of a number of mathematical facts with others that the children had covered through the Greek version of the SMP.

2. Test 3 was not completed by the four children of the 9th school of Phinikas for whom, as mentioned at another part of this thesis, a different teaching procedure was followed. Also, George of the 41st school, whose case is described in appendix A, p. xxxvii, did not complete the test; and finally Anna, whose rate of work with the cards was so slow that she managed to cover a small part of the first section material only, could not complete the test either.

3. The success rates of the 9th school children as they appear in the first test results do not represent a reliable source of information. The majority of the children faced reading backwardness and as a result they were not able to comprehend the exercises of the test. Their class teacher assisted them in completing the test, thus we assume that their actual ability level is much lower than it appears in the table.

4. The number of children in the 9th and Aghia Triada schools was very small, eleven and fifteen respectively. They were not, that is, representative of a primary school class which usually has twenty-five to twenty-eight children.

5. The proportion of boys/girls who completed the tests was not uniform in the three classes of the research. Thus, while in the 41st school the number of girls is almost three times bigger than the number of boys (seventeen girls - six boys), in the Aghia Triada school there is a balance (eight girls - seven boys) and finally in the 9th school, the number of boys is almost three times bigger than the number of girls (three girls - eight boys). On the whole, in all three schools the number of girls is greater than the number of boys (twenty-eight girls - twenty-one boys).

6. The second test was not common for all children. It was given at the end of the first term and while the children had covered different material from the cards. The children were divided into groups according to the topics they had covered and a separate test was prepared for each group.

7. The first two tests were given on the same day to all children of the same class while the third test was given on different days for each child. This arrangement was inevitable since the test could not have been completed unless the children had covered all cards of the first section and it was impossible for all children to finish simultaneously.

8. The teaching session was so limited, usually 40 minutes in duration, and moreover, it was usually at the last hour of the day that most of the children did not manage to complete the test in one teaching session. Thus, they were given the chance to continue and finish the test in the next teaching session. Therefore, the time of completion of the last test was neither fixed, nor uniform for all children. They were given as much time as they needed to complete all the questions of the test (usually one whole teaching session and almost half of a second).

9. The children were exposed to the SMP card work only twice a week, while they were taught through the Greek teaching programme for four times a week.

Column Diagrams

In an effort to clarify and depict the research findings, as they appeared in the pupils' attainment tests, bar charts were produced (all these charts are presented in chapter IV). In all diagrams, excepting P11, the horizontal axis presents the serial number of the SMP assessment test exercises on the first section, while the vertical, the success rate of children in the corresponding exercises. In diagram P11, the horizontal axis depicts the three tests, while the vertical one the success percentage of each one of the three schools in the corresponding tests.

Considering the limitations of the present research, the results depicted in the column diagrams do not offer a clear statistical picture of the childrens' progress, the difficulties they encountered and the reasons causing them. They simply suggest the topics the children grasped fully, partly or vaguely, the subjects that boys or girls appeared more competent at, and the general progress made by the children. The facts that the study of these figures yield offer implications that could prove helpful in case a large-scale research were ventured. This new re-

search, therefore, could be based on the findings of the present study and could be conducted only after the weak points of the project itself or the process of its application were corrected.

1. The sixteen most difficult questions experienced by boys/girls.

a. 41st school.

A parallel examination of P1 and P2, with reference to the topics covered by the sixteen questions, suggests that:

i. there were certain topics which both girls and boys found most difficult. These topics were: subtraction, money, fractions, and to a lesser degree time, problem solving and angles.

ii. the boys' mistakes presented more variety (they occurred in more topics), while girls seemed to "persist" in certain subjects excessively (e.g. subtraction, money).

iii. the girls succeeded a maximum score (100%) in two only of the sixteen most difficult exercises for boys, while the boys in the corresponding sixteen most difficult exercises for girls scored 100% in six of the sixteen exercises.

iv. even in these sixteen most difficult exercises for boys/girls the success percentage dropped lower than 50% in two of the sixteen exercises only, both in the case of boys and girls.

b. Aghia Triada school.

A comparative study of charts P3 and P4 suggests that here also the topics which presented most difficulties to boys/girls were common. The topics were: fractions, tens-units, subtraction and to a lesser degree, money and turn. Also, as was the case of the

41st school, the exercises on money and subtraction presented difficulties, only here a third topic emerged that of tens-units. In fact, a parallel study of the figures suggests that:

i. while on fractions and subtraction girls and boys experienced the same difficulties, the tens-units topic was twice as difficult for girls.

ii. the achievement level in the sixteen most difficult exercises for boys as well as girls was similarly low for boys and girls except for two exercises in P3 (numbers 19 and 10, where the success rate of boys was 50 and 57.1% respectively, while the corresponding scores of girls were 87.5% and 87.5%) and two in P4 (numbers 33 and 57, where girls scored 37.5 and 50% and boys 85.7 and 100% respectively).

iii. the success rate dropped below 50% in four exercises in the case of both boys and girls.

c. 9th school.

The figures in bar charts P5 and P6 indicate that boys and girls encountered common difficulties in fractions and subtraction and less often in money and division. From the charts it becomes obvious that:

i. boys made more frequent mistakes in the exercises on fractions while girls in the ones on subtraction.

ii. in most of the sixteen most difficult exercises for boys the success rates of girls were equally low - indeed in eight of the sixteen exercises they were lower - but in four they were not only higher but reached 100% success. In every one of the sixteen most difficult exercises for girls, boys scored very high (in fact, in three of the exercises they were 100% successful).

iii. in the case of boys only in one of the sixteen exercises the success rate dropped below 50%, while in the case of girls in all exercises, except for two, it was below 50%; furthermore, in two questions the rate dropped to 0%.

All six charts on the sixteen most difficult questions for boys/girls in the three schools of the research show certain trends:

i. Certain topics proved more difficult to the majority of the children. The most difficult of these were subtraction and fractions. Characteristically, the very same topics confused the children when they were completing the cards on them.⁶¹ It could be claimed, therefore, that the various terms used for subtraction - take away, subtract, the difference of, ...from... - as well as the different depictions of the operation - correspondence, verbal and numerical symbolisms - puzzled rather than helped the children.

ii. As far as the fractions were concerned, difficulties stemmed mostly when the fraction was given pictorially,

e.g.  and its numerical symbol was asked, $1/4$. Similarly, there were difficulties in the addition of common denominator fractions, where children added not only the nominators, but also the denominators.

iii. Money also caused several difficulties mainly due to the fact that coins had not yet been related to the value they represented, but were taken for separate objects. Thus, when asked to take two "equivalent" sets of coins they would take two sets which had the same number of coins regardless of the value they represented (e.g. two five drachma coins-two two-drachma coins).

iv. Finally, in the 9th school only, children experienced difficulties in comprehending and relating tens to units. Tens were treated exactly as units and not as sets of units. This

difficulty the children faced resulted in some consequent problems in number operations, measurements etc.

2. The common most difficult exercises experienced by boys/girls.

The figures of bar charts P7 and P8 show that from the seven most difficult exercises experienced by boys, three were on money (namely 43% of the total number of exercises), while four of the common most difficult ones for girls, one was on coins (25%) and two (50%) on subtraction. Also, in the particular exercises, the Aghia Triada boys scored the lowest rates except for two of the questions, while the 9th school boys achieved the highest rates in four of the seven questions. In the case of girls, the lowest rates can be observed in the 9th school, while in all questions the highest scores were achieved in the 41st school.

The charts do not supply facts that could lead to general conclusions on boys/girls' achievement levels. We could, however, claim with a fair chance to be accurate - considering the size of the sample - that:

a. the 9th school girls seemed to encounter - at least in the common most difficult topics - the most difficulties both in relation to the boys of the same school and to the girls of the other two schools.

b. the results of the charts do not offer specific conclusions as to the differences of mathematical performance between boys and girls. It could not be claimed that girls do better than boys in Mathematics. What could be definitely argued, though, is that certain broad social attitudes are directly linked to children's mathematical performance.

c. the difficulties that all children faced in certain sub-categories may have been due to the fact that the particular topics

were difficult anyway, demanding a more advanced level of development on the children's part. They might, however, have been the result of the teaching scheme through which the children were introduced to these subjects.

Based on the above facts a new evaluation of the syllabus of Mathematics and the SMP material could be attempted in future studies.

3. The common unanswered exercises by boys/girls.

The first characteristic a close examination of the figures of bar charts P9 and P10 yields is that girls left more questions unanswered than boys. No penalty was set for incorrect responses (i.e. subtraction of part of the mark), nevertheless, quite a few questions were not responded to. Especially girls seemed determined to omit a question instead of risking an erroneous response. The 41st school girls, however, left very few unanswered questions in contrast to the boys of the same school, who at times left more unanswered questions than the boys of the other two schools.

The common unanswered questions again referred mostly to fractions in the case of boys and subtraction and tens-units in the case of girls. Also among the common unanswered questions by boys and girls there was one on money. The facts furnished by diagrams P9 and P10, therefore, confirm the view formed by the data of the previous charts (P1-P8) that the particular topics definitely caused difficulties to both boys and girls of all three schools.

4. The pupils' progress over the year.

In chapter IV and before the presentation of the findings, some clarifications were offered concerning the size and peculiarities of the sample. Certain references to the time of completion and the content of the three tests (the results of which

appear in diagram P11), as well as the children's progress during the research were also made. Taking all the above into consideration as well as the presentation of the findings in chapter IV and before we discuss the data of the charts it might prove useful to point out.

a. The progress achieved by the 9th school children was more significant than the one presented on the charts, since their actual performance in the first test was lower than what the chart suggests.

b. If the children of the Aghia Triada and Phinikas schools were more, the usual number for any Greek class, that is, the results might have been different.

c. If the number of girls in the two schools (41st and 9th) did not deviate so markedly from the number of boys again results might have been different.

d. The high performance a child achieved in the second test (i.e., 90%) could have been the result of the limited material he had covered.

e. The children's performance in the third test might have been influenced by the fact that they were completing the test while their peers were working on the cards. This might have affected them either positively - they might have been assisted by their peers - or negatively - the class activity might have attracted their attention and delayed them.

f. If a time limit had been set for the completion of the tests and it had been continuous, with no disruptions, that is, then several of the children would definitely have had time to answer all the questions, but a number of children would not and thus, the success rate, due to the large number of unanswered questions would have dropped.

g. The second and third test questions were the same or similar to the card subjects as they had been covered and presented by

SMP. The syllabus they contained, however, was the same as the one covered by the Greek book of Mathematics and through the Greek teaching method. Of course, apart from the information indicated above, there were possibly additional factors affecting the children's performance that cannot be accounted for. Among these factors might be reported, for example, the teacher's efficiency and influence on pupils, the children's influence on one another, as well as the school environment and the periods of teachers' and pupils' absences.

Nevertheless, despite all the above as well as the very decisive factor of the particularly small sample (forty nine children in all), it is tempting to offer several brief comments on general trends witnessed in the test results. According to diagram P1:

a. The 41st school children, compared to the rest of the sample, exhibited at the beginning of the school year a much higher competence level. They retained the difference to the end of the research, only that it diminished.

b. From the beginning to the end of the school year the Aghia Triada school children showed the lowest performance in all three tests. This difference, however, gradually decreased and tended to reach, particularly in the third test, the 9th school children's performance.

c. The Aghia Triada school children exhibited the most pronounced progress, nevertheless their success rate in the final test was inferior to the rates achieved by the 41st school children in the first.

Points a. and b. above demonstrate that despite the definite progress the children of both the 9th and Aghia Triada schools achieved the original balance of the three schools was held stable to the end. Thus, the 41st school maintained their positive results followed by the 9th and the Aghia Triada schools. The potential association between the children's home background and their academic performance is hard not to be noticed.⁶²

From a., b. and c. above and considering the explanations about the sample and the conditions under which the research was conducted it becomes obvious that the pupils in all three schools profited from the application of SMP, the progress of the 9th and Aghia Triada pupils being the most striking. Naturally, it could not be claimed that this progress was the result of the application of SMP only, since the children were simultaneously taught through the Greek teaching method for four hours a week (as opposed to the two of SMP instruction). On the other hand, the Greek teaching system could not possibly claim the full credit for the children's progress, since the same method applied by different teachers during the children's first year at school had brought about the particular differences among the three area schools. At the beginning of the research the difference of attainment levels between the two schools - working and rural area - but mainly between these two schools and the urban area school were significant. Naturally, then, we might claim that even a small portion of the credit for the children's progress rightly goes to the application of SMP in the three schools.

The discussion so far has shown that the application of SMP, even in this small scale research, faced quite a number of problems. The Greek educational system, centralized as it is, does not allow for radical or even moderate changes. On the other hand, even if the application of an individualized programme, like SMP might enrich Mathematics teaching, it certainly does not solve such problems like syllabus development, teaching methods or work procedure in Mathematics. Moreover, in its present form SMP could not be applied in every school of the country.

In chapter V a number of problems were described, problems which emerged during the application of SMP and originated in the peculiarities of the Greek school as well as the system that defines and activates this field. The impressions and reactions of parents, teachers and children in relation to the application of the programme in their school for a year were reported. A

discussion on the findings of the research was made and it yielded several useful hints as to the necessity of a re-evaluation of the teaching material. A profile of the children's progress in the course of the research was formed and several views regarding the tentative method of the application of an individualized project like SMP in the different schools of Greece were shaped and expressed.

Chapter VI which follows will contain a brief account of the field work, the analysis of the results, a discussion of problems associated with SMP and suggestions for further research.

NOTES

1. There are only meagre possibilities for a child to repeat a class, when a. his attendance has been most insufficient, b. his competence level is extremely low, so that he faces great difficulties in keeping up with the rest of the class and his parents and teacher agree that the child should repeat the class.
2. The aim of the present study is not to suggest a change of the valid educational system, but rather to propose a change inside the existing system. As far as the building facilities are concerned, they are taken for granted as they are not likely to change for many years to come, so as to suit the needs of an individualized teaching approach.
3. By the term individualized programme we refer to only one area of the school curriculum, namely Mathematics. The rest of the school programme, therefore, would continue undistracted, based as it is on a teacher-directed, class instruction.
4. See Geoffrey Howson, Cristine Katee, and Jeremy Kilpatrick, *Curriculum Development in Mathematics*, (Cambridge Univ. Press, 1981), p. 11.
5. See chapter II, p.20-28.
6. See chapter II, p.62.
7. Norman Kirby, *Personal Values in Primary Education* (London, Harper and Row), p. 90-94.
8. For a description of the school building and classroom, see appendix A.
9. The school buildings under construction now are totally different, pleasant-looking and so designed as to respond to a new logic. Nevertheless, the demands for school accommodation are so urgent and the old school buildings in the urban centres so numerous, that the existing conditions are not likely to change in the near future.
10. We might claim that the new Mathematics syllabus is still at an experimental stage.
11. By new scheme we mean teaching material other than the Mathematics books in use at present.

12. See Geoffrey Howson et al., p. 7.
13. Paul Hurst, "Some Issues in Improving the Quality of Education," *Comparative Education*, 17, No. 2, (June 1981), pp.183-185.
14. Educated parents might react from fear that through this method their children are not likely to attain the high standards required for their entrance to the University. On the other hand, parents belonging to the working class might react thinking that the proposed method would broaden the gap between classes and their children, at a disadvantage to begin with, will be given fewer chances to surpass their learning difficulties.
15. For relative suggestions see ch. V, pp.252-270.
16. See Maurice Gibbons, *Individualized Instructions : A Descriptive Analysis* (New York, Teachers' College Press, Columbia Univ., 1971), p. 16.
17. See ch. II, p.31-42.
18. See Maurice Gibbons, p. 23.
19. Colin Richards, *Curriculum Consistency: New Directions in Primary Education* (Sussex, The Falmer Press, 1984), p. 48.
20. Teaching material is not available, at present anyway, in the Greek market. This does not imply that there are no people who are interested and willing to design such material, nevertheless, there is no demand for such a thing, since the educational system has always obliged all schools to employ the same manual which is supplied free by the Ministry of Education. The design and writing of the book is the work of groups of experts who are chosen and appointed by the Ministry after certain formal procedures.
21. Integrated day is a school day organized in such a way that it allows for a number of different activities going on at the same time in the classroom.
22. Curriculum is totally consistent, that is all pupils of the same age attend the same class, are introduced to exactly the same curriculum elements. There is a uniform curriculum, a uniform syllabus and, more or less, a uniform teaching approach.

23. The political situation in Greece is usually unstable, thus, it is common practice of the political party governing to enforce the laws and changes it wishes to introduce, so that its successor party could not cancel a decision already adopted by the whole country.
24. See in T.E.S., 20 May 1988, "The Glue of Schools: Geoff Southworth on the 'Whole' Primary School," a review of the book *Understanding the Primary School as an Organization*, soon to be published by Cassell. In the article, the new trends and the new vocabulary created since 1980 are discussed. "the primary school curriculum should be *continuous* and teachers should strive for *consistency* so that work work of the children and the school's curriculum become coherent. . ."
25. See Schools Council, *Mixed Ability Teaching in Mathematics*, (London, Evans/Mathuen Educational, 1977), p. 81.
26. Education in Greece is free at all stages. This means that the Ministry of Education, at the beginning of the school year distributes to each pupil and student the books of all subjects. These books are not borrowed but given to the pupils and students to keep for their own. Enormous amounts of money, therefore, are spent by the Ministry each year in order to provide all students of the country with the appropriate teaching material.
27. At times, if a teacher has not had enough time to wind up a subject in one teaching hour or judges that a newly introduced concept requires further practice on the children's part, she may decide to continue with the same subject at the expense of part or the whole next teaching session, disregarding the timetable. Children, however, are never permitted to continue, if so need or wish, an activity they have started on the previous hour's topic.
28. Today, with the emergence of the various means of communication, of television in particular, and with the sincere effort made (new bus, plane or ship lines, telecommunication, easy access to the nearest urban centres) these differences tend to disappear.

29. For an account of the development of education in England and in Greece, see ch. II.
30. The word "foreign" refers to any innovation, not necessarily to SMP.
31. Norman Kirby, *Personal Values in Primary Education* (London, Harper & Row, 1981), p. 36.
32. For a more detailed description of the structure of the curriculum and the school day, see pp.206-211 in the same chapter and ch. III, p.81.
33. For relevant research, see Olive Banks, *The Sociology of Education* (London, B.T. Batsford, 1976).
34. Of course, it is always possible that low attainers being allowed by the teaching system to progress at their own time may rest on a very slow pace of work.
35. For more details on the function of these schools, see app. A, pp.xiii-xv.
36. Two or three teachers are usually allocated to these schools.
37. Olive Banks, *The Sociology of Education*, p. 75.
38. See ch. IV, the children's questionnaires and the bar charts on their progress.
39. We do not refer to the group of slow learners in the class who, anyway, did not use the cards. Suggestions for these children are offered in the appendix A, pp.liii-lv.
40. See Martyn Denscombe, "Keeping 'em Quiet: The Significance of Noise for the Practical Activity of Teaching," in Peter Woods (ed.), *Teacher Strategies* (London, Croom Helm, 1980), p. 63.
41. See Sidney Tiedt, *Teaching the Disadvantaged Child* (London, Oxford Univ. Press, 1968), p. 181.
42. See Neville Bennett, Charles Desforges, Ann Cockburn, and Betty Wilkinson, *The Quality of Pupils Learning Experience* (London, Lawrence Erlbaum Associates, 1984), p. 51.
43. Nuffield Primary Mathematics, for example, have not produced any pupils' materials at primary level, but they have only prepared teachers' guides, where the stress is on how to learn, not what to teach.
44. See ch. IV, pp. 147-159.

45. Ernest Choat, *Mathematics and the Primary School Curriculum* (Winston-NFER, 1980), p. 54.
46. Ibid.
47. Schools Council, *Mixed Ability Teaching in Mathematics*, p. 93.
48. For the particular cards, see appendix C.
49. Provided, of course, that the ones they complete cover the prescribed curriculum.
50. See appendix A, pp. xxxvii-xxxviii, xlvi-li.
51. In the worksheets, however, which they worked during the third term, they simply adored the cards that asked them to colour shapes.
52. Not only SMP 7-13 for that matter, but any individualized programme.
53. The teacher is normally informed of the children's family and social background and the specialist should possess the knowledge of learning processes.
54. It is characteristic, for example, what one of the five slow learners replied to our efforts to persuade him to work on the cards on money: "I know how to count money. My father takes me with him and we sell the goods together and it's me who does the counting. So, I don't need your cards!"
55. Naturally, the application of this particular suggestion should be conducted at three stages (pre-pilot, pilot, main study) before deciding its final and uniform application.
56. The second class Mathematics Book, for example, consists of two volumes, the first of which contains 152 pages and the second 150, so the total number of pages for each child is 304.
57. The book, like the SMP cards, depicts very simple apparatus - unifix, flat and solid shapes, cups, jugs, brushes, pencils - in such a vivid way that the text can often be avoided. The pictures make the page simple, pleasant, more "light" concerning the mathematical content and at the same time they avoid the long, explanatory text which can cause difficulties in reading and understanding.

58. Four pupils of the 9th school and a boy and a girl from the 41st school had not taken the test for reasons explained at another point in this thesis.
59. General were the tests that were common for all children. In the course of the research children were given supplementary tests based on the material that each child had covered up to the particular moment and thus were not the same for all children.
60. For samples of the three tests, see appendix C.
61. The cards in question are 2-5, 2-6, and 2-9 for subtraction and 6-2 and 6-6 for coins.
62. M.L. Cornelius and D. Cockburn, "Influences on Pupil Performance," *Educational Research* , 21, No. 1 (1978), pp. 48-53.

CHAPTER VI

Conclusion

The present research was focused upon an exploration of applying in the Greek primary school and under the existing functional and building conditions, an individualized scheme of work, namely SMP 7-13, which at the time the research was decided upon (1982) was possibly one of the most popular Mathematics teaching programmes in use in English primary and middle schools. It was hoped that the investigation would reveal the children's academic, social and personal gains from their participation in the research, the reactions of parents and teachers from the attempted innovation and the difficulties the research programme would entail.

In chapter II, a parallel examination of the evolution of primary education in the last few years in both England and Greece as well as the development of the Mathematics curriculum and of Mathematics teaching in primary education was explained and commented upon. This brief report exposed the differences in the evolution of primary education between the two countries. Thus, in England, after the Second World War, a continuously increasing interest in primary education matters appeared originating from the influence exerted by Developmental Psychology and expressed through the appearance of child-centred philosophies. The interest in primary education reached its peak after the Plowden Report (1967), when radical changes were advocated in the primary sector.

On the contrary in Greece, at the corresponding time, things remained almost stagnant. The lack of political stability directly affected education. Every attempt at innovation resulted in reactions that annihilated any positive results. Every move forward attempted by the progressive forces of the country was bound to trigger a direct, firm step backwards on the part of conservatism. It could be argued, therefore, that up till 1981 no actual change had taken place and primary education had hardly been affected by the modern, progressive theories. Mathematics teaching and the content of Mathematics syllabuses

had both remained the same for many years. The same concepts, skills, rules, alien to the children's experiences and irrelevant to their interests, were presented in a pedantic way, demanding sterile, rote-learning rather than real comprehension. The teaching method relied heavily on class-instruction. No attempt was made to introduce group or individualized teaching whatsoever, no reference to the children's personal experiences or connection to everyday activities or resources.

Only in the very recent years, from 1981 onwards, a definite move has been observed towards a more modern, progressive primary education. This innovative tendency led to the publication of new books of Mathematics, the content of which was based on "new Mathematics" and which professed to help children understand the various mathematical concepts and acquire the appropriate skills through everyday activities. Despite the good intentions, however, the teaching method of Mathematics has not changed, perhaps because teachers had not been adequately trained or even had not been convinced of the necessity of the change that had occurred. Thus, class teaching still prevails in Greek classes and all children are obliged to proceed at the same pace, regardless of their abilities. Group or individualized teaching remains a mere exhortation, a wish stultified in the teacher's manual.

This study, started in 1982, was dictated by the following:

1. the realization that the Greek primary education had remained static, attached to the traditional, knowledge-centred educational philosophy, while other countries, England in particular, had already passed from the stage of evolution, of testing the proposed changes, to a period of assessing and analysing results with a tendency to achieve certain "general", nationally accepted approaches in primary education.
2. a personal interest in Mathematics, its content and teaching in the primary school along with a wish to contribute to the modernization of the Greek Mathematics curriculum, so badly needed in the field of the Greek primary school. This attempt at introducing a progressive scheme of work in Mathematics in

the primary sector took into consideration two factors: a. the particularities of the field in which the innovation was going to be introduced, as well as its history and the prospects for innovation it allowed. b. the data offered by the literature on the specific subject: The procedure having been followed in a similar attempt at innovation in a foreign country or in the country where the research was being conducted; the reactions, criticism and/or oppositions it received by its opponents; the practical difficulties it encountered; the adjustments on the original idea suggested and finally, the new tendencies created after the application of the change and the evaluation of its results. The above data marked the process of the present study and are also being considered in the suggestions made for further research or for the introduction of a specific innovation.

In chapter III, the procedure followed during the application of the study and the reasons influencing or even dictating the particular procedure were described and discussed.

Official permission had to be granted by the Ministry of Education, which to some degree dictated what was acceptable and how the research could be carried out in a number of schools.

The study was conducted in three stages: pre-pilot, pilot and main study with a gradual increase from stage to stage of both the number of children that participated in a number of schools and the duration of the research. The graduation of the research in three stages was deemed necessary, so that the smooth and unproblematic conduct of the main study could be secured.

The two preliminary studies offered an insight into the possible mistakes or oversights in the organization of the research as well as several problems or reactions that might emerge during its application. An opportunity was provided for the necessary changes and adaptations before proceeding to the final main stage of the research.

The children's progress was assessed through the completion of attainment tests and the attitudes of children, parents and teachers towards the innovative programme of work were explored through discussions during meetings, as well as through the completion of questionnaires.

The sample was by necessity limited to one geographical area of the country only. The main study was applied for a complete school year in three schools of the city of Thessaloniki. The choice of the three schools was made so that the population from which they accepted their pupils represented the middle, rural and working class. The three schools of the main study were appointed by the L.E.A. of Thessaloniki and the total number of children of the three schools was fifty four.

Several of the first unit SMP cards (orange box) were not used at all, since their content related to syllabus not included in the Greek curriculum. The conditions under which the research was conducted rendered the content of one box inadequate, thus, four copies were prepared for each one of the schools (the process of their preparation is described in chapter III).

In the course of the main study three tests were taken by the pupils of the three schools. The first one, the pre-test, derived its material from the Greek Mathematics manual of the first class. The second test was distributed after the end of the first term and it was based on the material each pupil covered from the SMP cards up to that moment. Finally, the third test, the post-test, was given at different times for each one of the pupils, immediately after they had completed the first section cards. The first two tests were designed by the researcher herself. The third test was a translation and adaptation of the test designed for the needs of SMP itself to the Greek Mathematics syllabus.

During the school year, the children, parents and teachers involved in the research were encouraged to attend meetings where they expressed their opinions concerning the approach and method

of teaching, as well as their impressions of the children's reactions towards the programme and finally, the extent to which it influenced the children's attitudes towards Mathematics.

Finally, at the end of the school year questionnaires were completed by the children, parents and teachers, so that:

1. these topics of SMP which the children found easy and comprehensible, as well as the ones that caused them difficulties and problems were explored. Also the children expressed their preferences on additional material which they felt might be included.
2. parents and teachers expressed their impressions, reservations or even objections to the content of the cards and the teaching method used. Furthermore, they were required to offer their suggestions for changes in the hope for the researcher to discern, if possible, the way that teachers and parents think about the content and teaching of Mathematics and also how they might co-operate.

In chapter IV the problems that emerged during the research and the difficulties the children encountered were described and analysed. The problems stemmed from the peculiarities innate in the Greek educational system, but also from certain specific characteristics of SMP itself. If SMP, or a similar individualized programme was adopted, the conditions outlined in chapter IV would demand careful consideration. The problems related to the Greek educational field were mainly due to:

- a. the building facilities and consequently the classroom, which had been constructed to serve educational needs and objectives different from those required by a progressive, child-centred primary education.
- b. the curriculum which is strictly prescribed for all subjects and is uniformly applied to all children of the same class in every area of the country.
- c. the system of provision of the teaching material which is centralized, thus not offering any choice.

- d. the teacher's basic training which had been inadequate and old-fashioned and the scarce opportunities offered for in-service education and training.
- e. a general conservative attitude and reservation towards any attempt at innovation, more freedom and decentralization in education.
- f. the pupils themselves, who being used to work under the teacher's constant direction cannot make relevant use of the freedom and the opportunities an individualized teaching scheme offers them.
- g. several special circumstances, the fact, for instance that the programme was not applied by the class-teacher and moreover, its application was parallel to the teaching from the Greek Mathematics manual.
- h. the total lack of supporting staff, i.e., assistant teachers or/and remedial workers, so that children with learning or psychological problems cannot expect the support they need.

Nevertheless, the above problems which were identified could be overcome and certain changes could be implemented, so that the possibilities for a successful application of a large-scale research or for the introduction of an innovation in Mathematics teaching would be feasible.

It would be impracticable and anyway beyond the scope of the present study to suggest alterations to the school building. School buildings are designed so as to serve certain needs and fulfil certain objectives and the Greek ones are typical of a traditional, authoritative, knowledge-centred education. School accommodation could not possibly change, unless the philosophy underlying the Greek primary education was challenged with subsequent changes.

The first cautious suggestions towards a more progressive education scheme are:

- a. A more flexible "core curriculum." The term "core curriculum" implies that instead of relying on a curriculum demanding total consistency, all children of the same age, that is , are

introduced to exactly the same curriculum content, we could turn to a curriculum that secures a degree of consistency. There will exist, that is, a sort of national curriculum which will secure that all children will have undertaken a number of common experiences and will have been introduced to certain basic skills and concepts. This relative curriculum consistency complies with the demand for curriculum continuity, as well. Thus, based on the minimum common experiences, skills and concepts a continuity is achieved throughout the primary school years, facilitating the children's transition to the next educational sector. This national curriculum framework should allow L.E.A.s but also individual teachers certain extensions or adaptations to its original form, so they could best provide for the needs and demands of their schools. Therefore, it is suggested that the present uniform curriculum will be superseded by a common, basic curriculum, which will secure quality and consistency in primary education. It is envisaged that this proposal concerning the curriculum will not raise too much opposition, since, in a sense, the curriculum remains centralized, directly connected to the traditional curriculum policies. It is further presumed that it will be favourably accepted by both the L.E.A. and the Teachers' Union, since it offers them the chance to take up responsibilities and develop local and school policies.

Furthermore, this suggestion, apart from being suitable for the reality of the Greek educational system, it is also in harmony with the latest trends observed in countries such as England, which, after having tested the idea of a school-based curriculum, they have begun to formulate new trends for the development of a national curriculum framework. The Greek curriculum currently in use, therefore, should not change in favour of a school-based curriculum, but rather develop into a more flexible, less instruction-based curriculum framework, which would allow interventions by and co-operation with L.E.A.s, schools and teachers.

b. The abolition of the unique manual, at least for Mathematics and Language at the beginning, with the prospect of gradu-

ally extending the innovation to the other subjects of the curriculum, should be attempted. According to this proposal, the teacher is offered a variety of teaching programmes (i.e., like Nuffield, Fletcher, Alpha-Beta Mathematics, etc., in England) for each subject-area, but particularly pertaining to Mathematics and Language. The teacher, therefore, will not be obliged to use the one and only manual prescribed by the Ministry of Education and follow the teaching approach it recommends, ignoring her pupils' stage of development and abilities. Given the choice of many alternative schemes of work, she is likely to find what will best suit her class' needs, also complying with the possible particularities of the region in which the school is situated. The teacher may also choose more than one scheme, and use them in combination, in order to introduce the various topics of the syllabus, since it so happens that certain topics are better introduced through one scheme rather than another. Alternatively, the teacher may choose one scheme to introduce a particular subject, but she may further enrich it with elements of another or even other projects. Through the alternatives offered by different schemes, the teacher is given the opportunity to plan and prepare a variety of resources applicable to the individual group or class. By so doing the full ability range is recognized and the relevant provision is made.

c. There should be a relationship between the primary teacher training curriculum and the school curriculum. As HMI (1978)¹ claimed, there should be a "match" between what teachers need in order to be effective and confident in the classroom and what colleges provide as theory mostly. Of course, it is not possible to provide prospective primary teachers with such education that could only cover their future practical needs, totally ignoring their aspiration for theoretical knowledge. It so happens, however, that in some countries the staff at Teachers' Colleges are not always concerned with practical experience in schools, as some tutors have not taught in schools themselves for a number of years. Teachers' training in the particular countries should take into account the nature of teaching, the

procedures of learning and the current primary curriculum. If the philosophy prevailing in colleges remains stationary, then colleges not only fail to promote changes in primary education, but also obstruct any move towards innovatory practice.

d. As Perry² (1981) argues, "change does not just 'happen.' It requires considerable advance planning and continuing support from the moment of inception onwards." It is obvious that teachers and parents should be very well informed about the philosophy, objectives and necessity of the proposed change. Indications abound that a change will cause objections on the part of a great number of people involved in educational matters, since to them, any innovative move constitutes a threat to the established forms. Communication of the attempted reformation must be so well organized, as to make teachers and parents realize its necessity and convince them to take part in it. The arguments in support of the innovation have to be powerful and carefully formulated. In-service seminars should be organized, which should be attended by all teachers, so that they can be familiarized with the content and objectives of the change. The innovation should win people over rather than be enforced.

e. Children, with their teachers' vigorous assistance, should learn how to work quietly in an environment which offers them freedom of movement, invites collaboration with their peers and encourages learning through various activities and through their active involvement with everyday material. Children should get used to collaborating quietly, to circulating carefully in the classroom, to respecting their peers' work. In short, they should get accustomed to the new learning conditions, classroom organization and teaching methods. Most probably, if children learnt to work in this environment throughout the day and not for a fraction of the school day only, then the commotion and the waste of time in non-productive activities would be limited.

Above all, however, teachers should be trained in order to accept purposeful noise in the classroom. In Greece, as well as in other countries till now, quiet, disciplined children denoted

a well-organized class, achievement of an efficient teacher who knows her job well and can control her class. "Closed" classrooms were not accessible to teachers of adjoining classes, thus, they protected the teacher's reputation of absolute control over her class, promoting her image of competence within the staff. Having been trained to consider noise as an unnecessary intrusion, as an implication of an incompetent teacher, teachers dreaded it and went out of their way to fight it. Absolute quiet has been considered the ideal working environment in a society where noise is continuous, annoying but inevitable. As Martyn Denscombe (1980)³ notes "in a society, where noise is easily associated with aggression, we should not be surprised if quiet classrooms are valued in their own right - as pleasant setting for teaching rather than a necessary prerequisite for the learning process. And attempts to control noise might also stem from the desire to avoid the fatiguing effect of working with constant high levels of noise."

In the course of the study it was also found that individualization as a teaching approach, but also the way that SMP itself handles and presents the various subjects creates a number of problems in practice. Some of these problems were of an organizational nature. An essential requisite of SMP was a provision of sufficient cards to allow all children access to them whenever they needed them. Furthermore, it was noticed that the weaker pupils wasted a lot of time waiting for the teacher to assist them. They would "invest" this time in discussions irrelevant to the lesson or even arguments and quarrels, which, of course, increased the noise in class. Perhaps some of these problems would never occur or would be minimized, if the school curriculum was more flexible and allowed for different areas of the curriculum to be in progress simultaneously. At present, however, no integration of different subjects is permitted, each lesson occupies its own fixed hour in the timetable. As this inflexibility of the programme is not likely to alter soon, any attempt at applying an individualized approach in the teaching of Mathematics should take into consideration both the rigidity in the teaching of the

various subjects and the inability or unwillingness of teachers to introduce an integrated approach in their teaching.

Keeping all the above and the experience of the research in mind, it appears highly demanding for the teacher, no matter how well organized her lesson is and even if she is lucky enough to work in comparatively better conditions, to meet the needs of every child in her class. The time available for each child is very limited and the teacher-pupil interaction insufficient. If the teacher is not cautious enough, one of the basic advantages of individualization, that of providing more efficiently for weaker pupils, can become a serious weakness. The almost continuous need for help children with learning difficulties have, on the one hand and the imprudent allocation of the teacher's time, on the other, might disappoint these children, instead of helping them overcome their problems. Moreover, the high reading standards an individualized programme of work always requires constitutes an extra impediment in the progress of weak pupils. When the conditions of organization and function of the individualized programme of work are ideal, slower learners should benefit more than in a traditional approach, drawing at the same time satisfaction from the lesson tackling tasks within their capacities. There are indications, however, which point to the fact that even an individualized approach - very much like any other method - cannot cater adequately for low attainers, except, perhaps, for relieving them from their anxiety and pressure. It does not guarantee, though, that they do not feel inferior to their peers. It could be argued - even if this might be misinterpreted as a suggestion for a return to streaming - that the particular pupils need special attention and more essential help through a programme specially designed for them, after their learning difficulties and the reasons causing them have been located and remedied.

Another problem observed during the present study was the teacher's difficulty to assess the pupil's practical work. Children may measure distance in feet or palms, volume in peas or cubes and write their answers in their exercise books, but

the teacher cannot always tell how accurate these calculations are. Children sometimes produce "highly improbable," "contradictory" answers and the teacher very rarely gets the chance to ask the child to repeat the measurement or do the operation again in her presence, so that she can check whether his answer is based on logical thinking.

It was also noticed that very often children were reluctant to repeat certain cards. As soon as they had completed a card - correctly or wrongly they did not seem to care - they considered the task definitely finished. At times, even parents resented this procedure, unwilling to accept their children's weaknesses.

The use of SMP 7-13⁴ in the present research, apart from these difficulties that anyway seem to characterize every individualized programme, brought to light certain characteristics of the programme itself that may tend to cause problems to the children. These problems become even more acute for pupils who are not fluent readers. The usually long, introductory text, the explanations it volunteers, the examples it suggests requires competent reading skills and it consequently causes difficulties in understanding. The lengthy text, however, discourages even children who are fairly competent at reading. Children, therefore, proceed to the solution of the proposed exercises without having read the explanations or after having spent all their energy on reading per se and not on understanding the mathematical concepts or rules. Moreover, certain concepts that the cards introduce and several symbolisms that are employed to denote relations are either too advanced for the age they are addressed to or appear in isolated cases, which makes their consolidation almost impossible.

Among the weaknesses of the programme could be listed the lack of a teacher's manual which could introduce the philosophy of the system, justify the choice of the particular approach, supply the necessary theoretical information and offer directives for the best organization of the lesson or the multiple possibilities that might be hidden in the cards. Thus, the teacher,

who is rarely a Mathematics specialist, is left to her own resources to discover the logic of the project and find the best means of applying it.

The questionnaires completed by the parents indicated their reactions towards the innovation, in general and the specific project and teaching method, in particular. Most of the parents were positive towards the new approach; they all agreed that the way new concepts were presented by the cards was interesting and pleasant. They found the approach fresh, suitable for almost every competence level and able to motivate children into action. However, parents' opinions differed between the various schools, parents of the middle school area being more sceptical than parents of the other schools.

Concerning the teachers' attitudes, it became apparent that at the beginning they were reserved and even suspicious, but towards the end of the project, their attitudes became favourable. Again the middle class school teacher was less convinced of the value of such an individualized approach. All three teachers found the new approach much more demanding, offering little chance for teacher-class communication. However, all three of them conceded that their classes enjoyed the SMP session, since the project appealed to them as play. They admitted that in most cases it helped children understand and enjoy Mathematics teaching and that under certain conditions SMP or any other individualized project could be introduced to the Greek primary school.

The teachers' comments show that the reservations they held, the difficulties they pointed out, the weaknesses they located, and the doubts they expressed about the efficiency of the system did not differ much from the reality or the expressed views in other countries where similar approaches had been applied.

The pupils' views concerning their work with the cards were interesting and in some cases illuminating, but were interpreted with caution as at times they were contradictory, offering no

safe grounds for comparisons and discussion. Again the middle class school's answers were indicative of a "sense of duty," austerity and a clear influence by their parents attitudes, whereas the replies of the children of the other schools were spontaneous, although less well expressed.

When we turn to the tests that were used it should be taken into account that the sample was small, the schools pre-selected and confined to one area of the country and were, therefore, unrepresentative of the general population. The results of the tests indicate some likeness between schools, but they do not take into account areas of progress, nor do they seek to compare results with those tests devised in conjunction with the Greek manual.

Nevertheless, the results of the tests indicate that the children of all three schools achieved significant progress in the course of the year decreasing the differences existing between them at the beginning of the school year. The initial success order, however, was maintained to the end (41st, 9th, Aghia Triada). Naturally, SMP cannot claim the full credit for the children's progress. The marked differences, however, in the success rate which can be noticed in the pre-test and their significant reduction, according to the results of the post-test, imply the positive effect of SMP on the children's progress.

A year's application of the project revealed that:

1. the children enjoyed working with SMP. It could be claimed, of course, that this was a natural response to a novelty and their enthusiasm was bound to fade when the novelty turned to routine. It is true that SMP does have attractive characteristics, such as the high quality, colours, figures of the cards, the variety of apparatus, the way of presentation of the various subject areas and the activities it suggests that attract and appeal to children. Actually, we could claim that our proposal for a parallel use of the cards with the Greek programme could prolong their period of "freshness" and originality.

2. regardless of the possible gains the children derived from the application of SMP, they undoubtedly succeeded in overcoming their dislike and fear of Mathematics, they even started to enjoy tackling mathematical tasks that were within their abilities, familiar and tangible, a game rather than a school subject.

3. even if the children of all three schools enjoyed working with the cards, the response of the children of the labour area school was really surprising. In this school an acute problem emerged in relation to a number of illiterate pupils. SMP was proved inadequate for this category of children, thus we were obliged to improvise a scheme of work to face the problem. Assuming that the particular school is not an exception to the schools of its category, it becomes obvious that the existing educational system, totally inflexible, with a tendency to generalize everything, cannot come up with solutions to these problems.

Indeed any programme of work, the Greek system in use, SMP 7-13, or any other individualized programme cannot cater for the particular group of children, who obviously need special attention and consideration. Solutions that propose a radical change of the curriculum and a reversal of the spirit prevailing in the Greek educational system are rather inapplicable. Several suggestions, however, which might be considered as emergency outlets rather than results of extensive researches, are offered in the appendix to this chapter. Far from ideal as they might be, nevertheless, they could probably ameliorate the situation.

Having mentioned some of the difficulties likely to be encountered during the application of either SMP or any other individualized approach and taking into consideration the existing educational system in Greece, it could be said that some pupils may be at a disadvantage when they reach their secondary level of education. Finally, it could be recognized that in England, according to teachers' unofficial comments, it seems that SMP

which has been applied for about ten years in primary schools, after a period of wide popularity, when it was applied as the main teaching scheme, it finally reached an anti-climax and a certain decline in its use followed with the advent of alternative approaches, such as Nuffield, Scottish or others. It appears that SMP 7-13 is more likely to be used as a supplementary scheme rather than a core approach.

The data accumulated by the small scale research and the experience gained by its application indicate that an innovation in the Greek primary Mathematics curriculum - in its approach and method of teaching rather than its syllabus - is not only practicable but also imperative. The history of the evolution of the Greek primary education, as well as the current situation of the Greek educational system (the primary education, in particular) should be taken into consideration; moreover, the recent international developments concerning the particular proposal should be carefully examined.

The proposals arising from the present study for the successful application of an individualized programme of work in the Greek primary school are the following:

1. It would be ideal if a second, more extensive and carefully organized research project could be carried out, as a continuation of the present one. Educators from various fields of education should collaborate for the particular project, plus a number of experts from the Ministry of Education. The design and organization of the research - based on the data of the present study and a further systematic exploration of the field - should be thus arranged, that this new research will offer conclusions rather than tentative suggestions, which will lead to an innovation and the method by which it will be applied. This new research should be carried out by the class teacher herself, after she has been familiarized, that is, about the philosophy, the objectives, the advantages and disadvantages of the suggested scheme of work and the regular, close supervision of the researchers involved in it.

It might be expedient for several of the schools to be permitted to apply only SMP 7-13 (or any other individualized programme they may choose), while another number of schools should be appointed to employ a combination of SMP with the Greek teaching programme of Mathematics. Before, as well as after the application of the investigation the children involved in it should complete tests. These will facilitate the comparison and discussion of the results that will follow the application of the Greek educational system, with the results of the schools which will have used only SMP and those that will have relied on a combination of the two programmes of work. This comparison might yield definite results regarding the progress and attainment levels achieved by the children of all categories of schools that will have participated in the research and may also point out the system that will have benefitted the children most.

2. In the event of a second research project being regarded impracticable, then bearing in mind the facts and observations the present study yielded, the situation currently existing - and perhaps is likely to exist in the near future - in the Greek primary education and, finally, the insight gained by reports on relevant researches on individualization, an individualized instructional programme could be suggested, specially modified to suit the needs and abilities of each individual pupil and, maybe, periodically relying on class teaching.

A national curriculum framework should be created which may guarantee that all pupils at a particular stage of their school lives will be introduced to a similar set of curriculum elements. Class and/or group teaching could be alternatively used. After having been introduced to a certain concept or mathematical skill, pupils may proceed at their own pace, themselves choosing the level of difficulty that best suits them. Concerning the teaching material, the teacher should be given the chance to choose from a variety of projects - which may have

been approved by the Ministry of Education, if the latter were to secure the project's optimum quality.

This suggestion is by no means revolutionary, nevertheless, it is certainly innovative, even if it does not totally reject certain qualities of the traditional class teaching, since it takes into consideration the individual differences existing in a class. It surely constitutes a moderate proposal for individualization and as such it is subject to certain limitations: it does not allow children, for example, to choose the task of their preference and it does not offer them opportunities to discover Mathematics in other curriculum subjects. It rather favours mathematical efficiency over the pupils' intellectual and social development. Nevertheless, this suggestion includes several qualities, as well: it does not demand absolute conformity but, at the same time, it secures some common knowledge, skills and experiences for all pupils. Above all, however, under the circumstances, it is believed that this is the simplest, easiest proposal to be implemented, an applicable and readily acceptable solution. At least, if accepted and applied successfully, it could serve as a preliminary stage of a more radical change in the field of primary education.

Concerning the application of SMP 7-13 as an individualized programme in the Greek primary school, it appears that it would be preferable if it were applied not as the main and only programme of work, but as a supplementary scheme. We have come to this conclusion relying on the experience gained by the present study as well as the relative information about its current use in England, since, to the best of our knowledge, no official information about the project's efficiency exists today.

The present study started from the belief that Greek primary education has to reconsider the values and theories it is based on, it has to attempt a move from its abstract, austere, uniform character to a more progressive, flexible and experience-based aspect.

The implications of the present research show that an innovation to the teaching of Mathematics is both necessary and possible, even under the currently existing peculiarities in the primary sector, provided, however, certain conditions are observed. The innovation proposed in the present study is the adoption of SMP, which, however, will be simply supporting the main Mathematics teaching scheme.

The present small scale research study has asserted the well-known fact that there is always a gap between a person's vision of the ideal and actual reality. Nevertheless, if the findings of the present investigation have contributed even slightly to the prospects for innovation of primary education in Greece, then it could be claimed that it has achieved a considerable accomplishment, fulfilling the most important of the visions it had envisaged.

NOTES

1. HMI, *Primary Education in England* (London, HMSO, 1978)
2. Euan S. Henderson and George W. Perry, *Change and Development in Schools* (London, McGraw-Hill Book Company, 1981), p. 17.
3. Martyn Denscombe, "Keeping them Quiet: The Significance of the noise for the Practical Activity of Teaching," in Peter Woods (ed.), *Teacher Strategies* (London, Croom Helm, 1980), p. 64.
4. We refer to those cards that were used for the Greek version of SMP.

BIBLIOGRAPHY

BIBLIOGRAPHY

- AITKIN, M., BENNETT, S.N. and HESKETH, JANE (1981) "Teaching Styles and Pupil Progress: A Re-analysis." *British Journal of Educational Psychology*, 51, 170-186.
- ANDERSON, H., HIPKIN, J. and PLASKOW, M. (eds) (1970) *Education for the Seventies*. London, Heinemann Educational.
- ANDRIOPOULOS, K. (1985) "Ta Nea Analytika Programata ke Vivlia tou Demotikou Scholiou." (The New Curricula and Manuals of the Primary School). *Epistemoniko Vema tou Daskalou*, (Teacher's Scientific Stand), 60, 41-44.
- ANTHOULIAS, TASSOS (1979) *Eliniki Ekpedefsi: Foria sto Agnosto*, (Greek Education: A Journey to the Unknown). Athens, Helidoni.
- ARCHAMBAULT, R.D. (ed) (1965) *Philosophical Analysis and Education*. London, Routledge and Kegan Paul.
- ASHTON, PATRICIA, KNEED, PAT and DAVIES FRANCES (1979, 3rd imp.) *Aims into Practice in the Primary School*. Kent, Hadder and Stoughton Educational.
- ASSOCIATION of TEACHERS of MATHEMATICS (1977) *Notes on Mathematics for Children*. Cambridge, Cambridge Univ. Press.
- AUSUBEL, P. DAVID (1967) "Learning Theory and Classroom Practice." *Bulletin*, No. 1, U.S.A., The Ontario Institute for Studies in Education.
- BADGER, M.E. (1981) "Why Aren't Girls Better in Maths?" *Educational Research*, 24, 1, 11-23.

BALDWIN, L. ALFRED (1967) *Theories of Child Development*. New York, John Wiley and Sons.

BANKS, OLIVE (1976, 3rd ed.) *The Sociology of Education*. London, B.T. Batsford.

BARRON, ROBIN (1975) *Moral Philosophy for Education*. London, George Allen and Unwin.

BASSETT, G.W. (1970) *Innovation in Primary Education: A Study of Recent Developments in Primary Education in England and the U.S.A.* London, Wiley & Sons.

BELL, A.W., COSTELLO, J. and KUCHEMAN, D. (1983) "Research on Learning and Teaching." *A Review of Research in Mathematical Education. Part A*, Windsor, NFER-NELSON

BENNETT, NEVILLE (1976) *Teaching Styles and Pupil Progress*. London, Open Books.

BENNETT, NEVILLE and McNAMARA, DAVID (1979) *Focus on Teaching. Readings in the Observation and Conceptualization of Teaching*. London, Longman Group.

BENNETT, NEVILLE, DESFORGES, CHARLES, COCKBURN, ANN and WILKINSON, BETTY (1984) *The Quality of Pupil Learning Experiences*. London, Lawrence Erlbaum Associates.

BERNARD, JOHN (1983) "An Essay on Perception and Understanding of Mathematical Symbolism." *International Journal of Mathematics Education Science and Technology*, 14, 4, 489-496.

BIGGS, J.B. (1962) *Anxiety, Motivation and Primary School Mathematics*. U.K., NFER.

BIGGS, EDITH and McLEAN, R. JAMES (1969) *Freedom to Learn. An Active Learning Approach to Mathematics*. Canada, Addison and Wesley.

BIGGS, EDITH (1983) *Confident Mathematics Teaching*. Windsor, NFER.

BIGGS, EDITH (1985) *Teaching Mathematics 7-13. Slow learning and Able Pupils*. Windsor, NFER-NELSON.

BISHOP, A.J. and NICKSON, MARILYN (1983) *Research on the social Context of Mathematics Education*. Windsor, NFER-NELSON.

BLANE, DUDLEY (1985) "A Longitudinal Study of Children's School Mobility and Attainment in Mathematics." *Educational Studies in Mathematics*, 16, 2, 127-142.

BLENKIN, G. and KELLY, A. (1981) *The Primary Curriculum*. London, Harper and Row.

BOARD of EDUCATION (1931) *Report of the Consultative Committee on the Primary School* (Hadow Report). London, Heinemann Educational.

BOLTON, ERIC (1985) "Curriculum 5-16," *Educational Review*, 37, 3, 199-215.

BOWEN, JONES and HOBSON, PETER (1974) *Theories of Education. Studies of Significant Innovation in Western Educational Thought*. Australia, John Wiley and Sons.

BRENNAN, W.K. (1974) *Shaping the Education of Slow Learners*. London, Routledge and Kegan Paul.

BRENT, ALLEN (1978) *Philosophical Foundation for the Curriculum*. London, George Alley and Unwin.

BRIGHOUSE, ALAN (1977) "SMP 7-13. The Primary School Background." *Mathematics in School*, September, 35-36.

BROWN, GEOFFREY (1977) *Child Development*. Somerset, Open Books.

BRUNER, JEROME S. *Diadikasia tis Pedias*. (The Process of Education. President and Fellows of Harvard College, 1960). Trans. Ch. Klerides. Athens, Karavia.

BRUNER, JEROME S. (1967) *Toward a Theory of Instruction*. The Belknap Press of Harvard Univ. Press, Cambridge, Massachusetts.

BURTON, LEONE (1986) *Girls into Mathematics*. Cambridge, The Press Syndicate of the University.

BURTON, LEONE (1986) *Girls into Mathematics Can Go*. Eastbourne, Holt, Rinehart and Winston.

BUTCHER, H. J. (ed) (1968) *Educational Research in Britain*. London, Univ. of London Press.

BUTCHER, H. J. and PONT, H. B. (eds) (1970) *Educational Research in Britain 2*. London, Univ. of London Press.

BYERS, VICTOR and ERLWANGER, STANLEY (1985) "Memory in Mathematical Understanding." *Educational Studies in Mathematics*, 16, 259-281.

CENTRE for Information and Advice on EDUCATIONAL DISADVANTAGE (1980) *Educational Disadvantage in Rural Areas*. Manchester, CED.

CHAZAN, MAURICE (ed) (1972) *Aspects of Primary Education*. Cardiff, Univ. of Wales Press.

CHILD, DENNIS (1981) *Psychology and the Teacher*. Eastbourne, Holt, Rinehart and Winston.

CHOAT, ERNEST (1980) *Mathematics and the Primary School Curriculum*. Windsor, NFER.

CLARKE, MICHAEL (1981) "Class Size and Standards." *Forum*, 23, 3, 64-65.

CLEAVE, SHIRLEY (1985) "NFER Evidence to the Select Committee on Education Science and Art for its Inquiry into Achievement in Primary Schools." *Educational Research*, 27, 2, 117-126.

CLEMENTS, KEN (1984) "The Origins of Conceptual Difficulties that Young Learners Experience in Mathematics." Robert Morris, ed. *Studies in Mathematics Education*, UNESCO, 3, 107-127.

COPELAND, RICHARD (1985) *How Children Learn Mathematics*. New York, McMillan Co.

COPPLE, CAROL, SIGEL, IRVING and SAUNDERS, RUTH (1979) *Educating the Young Thinker: Classroom Strategies for Cognitive Growth*. New York, Litton Educational.

CORNELIUS, M.L. and COCKBURN, D. (1978) "Influences on Pupil Performance." *Educational Research*, 21, 1, 48-61.

CORNELIUS, MICHAEL (1985) "From Jeffery Syllabus to Cockcroft Report," Part 2. *Mathematics in School*, 14, 5, 28-30.

CRAWFORD, H. DOUGLAS (1975) *The Fife Mathematics Project: An Experiment in Individualized Learning*. London, Oxford Univ. Press.

CROLL, PAUL (1985) "Teacher Interaction with Individual Male and Female Pupils in Junior-Age Classrooms." *Educational Research*, 27, 3, 220-223.

COUNCIL OF EUROPE (1985) "United Kingdom: Assessment of Teachers and Pupils." *News-Letter 5/85*. Documentation Centre for Education in Europe, Strasbourg.

COUNCIL OF EUROPE (1987) *Educational Developments in the United Kingdom 1982-1987*. Documentation Centre for Education in Europe, Strasbourg.

COUNCIL OF EUROPE (1987) "United Kingdom: Political Parties and Educational Policy." *News-Letter* 2/87. 37-42. Documentation Centre for Education in Europe, Strasbourg.

CONSEIL DE L' EUROPE (1987) *Projet no 8 du CDCC: L' innovation dans l' enseignement primaire*. Conseil de la cooperation culturelle, Strasbourg.

DAVIS, B. ROBERT (1984) *Learning Mathematics. The Cognitive Science Approach to Mathematics Education*. London, Croom Helm.

DEARDEN, R. F. (1968) *The Philosophy of Primary Education: An Introduction*. London, Routledge and Keagan Paul.

DEARDEN, R. F. (1976) *Problems in Primary Education*. London, Routledge and Kegan Paul.

DEARDEN, R.F., HIRST, P.H. and PETERS, R.S. (eds.) (1972) *Education and the Development of Reason*. London, Routledge and Kegan Paul.

DEPARTMENT OF EDUCATION AND SCIENCE (1967) *Children and their Primary Schools: A Report of the Central Advisory Council For Education*. (Plowden Report) 1. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1975) *Curriculum Differences for Boys and Girls*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1975) *A Language for Life: Report of the Committee of Inquiry Appointed by the Secretary of State for Education and Science under the Chairmanship of Sir Alan Bullock F.B.A.* (Bullock Report) London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1977) *Education in Schools. A Consultative Document*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1978) *Primary Education in England. A Survey by H.M. Inspectors of Schools*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1980) *Mathematical Development: Primary Survey Report. 1*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1982) *Education 5 to 9: An Illustrative Survey of 80 First Schools in England*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1985) *Education 8 to 12 in Combined and Middle Schools: An HMI Survey*. London, HMSO.

DEPARTMENT OF EDUCATION AND SCIENCE (1985) *Mathematics from 5 to 16: Curriculum Matters 3: An HMI Survey*. London, HMSO.

DESFORGES, ANNE and DESFORGES, CHARLES (1980) "Number-based Strategies of Sharing in Young Children." *Educational Studies*, 6, 2, 97-104.

DEWEY, JOHN (1916) *Democracy and Education*. New York, Macmillan.

DICKSON, LINDA, MARGARET BROWN AND OWEN GIBSON (1984) *Children Learning Mathematics*. Eastbourne, Holt Educational.

DIDASKALIKO VEMA (TEACHERS' STAND) (1979) "Apo ti Dialexi gia ta Anagnostika Vivlia tou Dimotikou." (Extracts from a Speech on the Primary School Manuals) 842, 3.

DIDASKALIKO VEMA (1980) "D.O.E. gia ta Didaktika Vivlia tou Dimotikou." (The Confederation of Greek Teachers on the Primary School Manuals) 862, 2-4.

DIDASKALIKO VEMA (1980) "Ethniki Ipothesi e Morphossi ton Daskalon sta Panepistimia." (The University Education of Teachers: A National Matter) 867, 1-3.

DIDASKALIKO VEMA (1980) "Exodiki Prosklissi tou Kathigiti Mega ke Apendissi tis D.O.E.." (The Extrajudicial Invitation Pressed By Pr. Megas and the Response of the Confederation of Greek Teachers.) 868, 2-3.

DIDASKALIKO VEMA (1980) "Possi Demokratia Echoun ta Vivlia tou Dimotikou?" (How much Progressive are Primary School Manuals?) 877, 6-7.

DIMARAS, ALEXIS (1974) *E Metarithmissi pou den Egine, Tomos B, 1895-1967.* (The Reform that Never Happened, Vol. B, 1895-1967) Athens, Hermes.

DOBINSON, C. H (1969) *Jean Jacques Rousseau.* Suffolk, Richard Clay.

DONALDSON, MARGARET (1978) *Children's Minds.* Glasgow, William Collins.

DONALDSON, MARGARET, GRIEVES ROBERT AND PRATT, CHRIS (eds.) (1983) *Early Childhood Development and Education.* Oxford, Basil Blackwell.

EDDOWES, MURIEL (1983) *Humble pi: The Mathematics Education of Girls.* York, Longman for Schools Council.

EGGLESTON, JOHN (1980) *School-Based Curriculum Development in Britain.* London, Routledge and Keagan Paul.

ERIKSON, ERIK (1951) *Childhood and Society.* Suffolk, Richard Clay.

ERNEST, PAUL (1980) "Integration in Mathematics and Assessment of Integrative Skills in Mathematics." *International Journal*

of Mathematics Education. Science and Technology, 17, 1, 103-113.

ERNEST, PAUL (1985) "Philosophy of Mathematics and Mathematics Education." *International Journal of Mathematics Education. Science and Technology*, 16, 5, 603-612.

EVANS, DOROTHY (1977, 4th ed.) *Mathematics: Friend or Foe? A Review of Some Ideas about Learning and Teaching Mathematics in the Primary School*. London, George Allen and Unwin.

FÉLIX, LUCIENNE (1966) *Modern Mathematics and the Teacher*. Cambridge, Cambridge Univ. Press.

FENNEMA, ELIZABETH (ed) (1985) "Explaining Sex-Related Differences in Mathematics: Theoretical Models." *Educational Studies in Mathematics*, 16, 3, 303-320.

FIDELMAN, URI (1985) "Hemispheric Basis for Schools in Mathematics." *Educational Studies in Mathematics*, 16, 59-74.]

FISCHER, JEAN-PAUL (1982) *L'Enfant et le Comptage*. Montigny, École Normale d'Instituteurs.

FRAGOUDAKI, ANNA (1977) *Ekpedefitiki Metarithmissi ke Filelefteri Dianooumeni*. (Educational Reform and Liberal Intellectuals) Athens, Kedros.

FRAGOUDAKI, ANNA and KONDILI, MARIANNA (1982) "'E Ekpedefitiki Metarithmissi' os Politiki Ideologia: E Thesi ton Komaton gia tin Ekpedefisi." (The Educational Reform as a Political Ideology: The Political Parties' Standpoint on Education) *Politiki* (Politics), Athens, 3, 104-117.

FREUDENTHAL, HANS (1973) *Mathematics as an Educational Task*. Dordrecht-Holland, D. REIDEL.

GALTON, MAURICE and BRIAN, SIMON (eds.) (1980) *Progress and Performance in the Primary Classroom*. London, Routledge and Kegan Paul.

GALTON, M.J., SIMON, B. and CROLL, P. (1980) *Inside the Primary Classroom*. London, Routledge and Kegan Paul.

GARDNER, K.L., GLENN, J.A. and RENTON, A.I.G. (eds.) (1980) *Children Using Mathematics*. London, Oxford Univ. Press.

GERMANOS, D. (1984) "To Pedi ke o Choros tou sto Eliniko Dimotiko Scholio." (The Child and his Space in the Greek Primary School.) *Technika Chronika A.* (Technical Chronicles A.), Athens, Greece, 4, 1-2.

GIBBONS, MAURICE (1971) *Individualized Instruction. A Descriptive Analysis*. New York, Teachers' College Press, Columbia Univ.

GIBSON, REX (1984) *Structuralism and Education*. London, Hodder and Soughton.

GINSBURG, HERBERT (1977) *Children's Arithmetic: The Learning Process*. New York, D. Van Nostrand.

GLENN, J.A. (ed.) (1980) *Children Learn to Measure*. London, Harper and Row.

GORDON, PETER and LAWTON DENIS (1978) *The Curriculum Change in the Nineteenth and Twentieth Centuries*. Kent, Hodder and Stoughton.

GRAY, J. and D. SATTERLY. (1981) "Formal or Informal? A Re-assessment of the British Evidence." *British Journal of Educational Psychology*, 51, 187-196.

GRIFFITHS, B. H. (1983) "Simplification and Complexity in Mathematics Education." *Educational Studies in Mathematics*, 14, 297-317.

GULLIFORD, RONALD and WIDLAK, PAUL (1975) *Teaching Mathematics for Disadvantaged Children*. London, Evans/Methuen Educational.

HARGEAVES, A and TICKLE, L (eds.) (1980) *Middle Schools: Origins, Ideology and Practice*. London, Harper and Row.

HARRIS, ALAN, LAWN, MARTIN and PRESCOTT, WILLIAM (eds.) (1975) *Curriculum Innovation*. London, The open University.

HAYDEN, W. ROBERT and RUDOLPH, B. WILLIAM (1984) "Will there Be a New 'New Math'?" *Journal of Curriculum Studies*, 16, 3.

HAYLOCK, W. DEREK (1987) "A Framework for Assessing Mathematical Creativity in School Children." *Educational Studies in Mathematics*, 18, 1, 59-74.

HENDERSON, S. EVAN and PERRY, W. GEORGE (1981) *Change and Development in Schools*. London, McGraw-Hill.

HIRST, P. H. and PETERS, R. S. (1970) *The Logic of Education*. London, Routledge and Kegan Paul.

HOLLOWAY, G. E. T. (1967) *An Introduction to the Child's Conception of Geometry*. London, Routledge and Keagan Paul.

HOWES, M. VIRGIL (1970) *Individualizing Instruction in Science and Mathematics: Selected Readings on Programs, Practices and Uses of Technology*. London, Collier-McMillan.

HOWSON, G. A. (ed.) (1973) *Developments in Mathematical Education. Proceedings of the Second International Congress on Mathematical Education*. London, Cambridge Univ. Press.

HOWSON, G. A. (1982) *A History of Mathematics Education in England*. Cambridge, Cambridge Univ. Press.

HOWSON, G. A. (1983) *Curriculum Development and Curriculum Research, Part C*. Windsor, NFER-NELSON.

HOWSON, GEOFFREY, KEITEL CHRISTINE and KILPATRICK JEREMY (1981) *Curriculum Development in Mathematics*. Cambridge, Cambridge Univ. Press.

HOWSON, GEOFFREY (ed.) (1987) *Challenges and Responses in Mathematics*. Cambridge, Cambridge Univ. Press.

HOYLES, CELIA (1985) "What Is the Point of Group Discussion in Mathematics?" *Educational studies in Mathematics*, 16, 2, 205-214.

HUEBNER, DWAYNE (1964) *A Research of the Curriculum*. New York, Bureau of Publication.

HURST, PAUL (1981) "Some Issues in Improving the Quality of Education." *Comparative Education*, 17, 2, 185-193.

HYDE, D.M. (1970) *Piaget and Conceptual Development*. London, Holt, Rinehart and Winston.

HYNDMAN, MICHAEL (1978) *Schools and Schooling in England and Wales: A Documentary History*. London, Harper and Row.

INHELDED, BARBEL and CHIPMAN, HAROLD (1976) *Piaget and his School: A Reader in Developmental Psychology*. New York, Springer-Verlag.

ISAACS, NATHAN (1965) *Piaget: Some Answers to Teacher's Questions*. London, National Froebel Foundation.

ISAACS, NATHAN (1966, 6th ed.) *The Growth of Understanding in the Young Child*. London, Ward Lock Educational.

ISAACS, NATHAN (1972, 9th ed.) *New Light on Children's Ideas of Number. The Work of Professor Piaget*. London, Ward Lock Educational.

ISAACS, SUSAN (1966, 9th ed.) *Intellectual Growth in Young Children*. London, Routledge and Kegan Paul.

JESSON, JOHN D.S. (1983) "The Development of Place Value Skills in Primary and Middle School Children." *Research Education*, 29, 69-79.

JONCICH, H.C. (ed.) (1962) *Psychology and the Science of Education: Selected Writings of E.L. Thorndike*. U.S.A., Teachers' College, Columbia University.

KAPLAN, BARBARA J. and PLAKE BARBARA S. (1982) "Sex Differences in Mathematics: Differences in Basic Logical Skills." *Educational Studies*, 8, 1, 31-36.

KAZAMIAS, ANDREAS (1983) "I Ekpedefitiki Krisi Stin Ellada ke ta Paradoxa tis: Mia Istoriki Sigritiki Theorisi." (The Educational Crisis in Greece and its Paradox: A Historical, Comparative Outlook). *Praktika tis Akadimias Athinon* (Archives of the Academy of Athens), Athens.

KELLY, V.A. (1981) "Research and the Primary Curriculum." *Journal of Curriculum Studies*, 13, 3, 215-225.

KINGMA, J. and KOOPS W. (1983) "Piagetian Tasks, Traditional Intelligence and Achievement Tests." *British Journal of Psychology*, 53, 278-290.

- KIRBY, NORMAN (1981) *Personal Values in Primary Education*. London, Harper and Row.
- KLINE, MORRIS (1973) *Why Johnny Can't Add: The Failure of the New Math*. London, St. James Press.
- KRUTESKII, A.V. (1976) *The Psychology of Mathematical Abilities in School Children*. U.S.A. Univ. of Chicago.
- LAND, FRANK (1970) The Teaching of Mathematics. Butcher, J.H. and Pont, B.H. (eds.) *Educational Research in Britain*, 2, London, Univ. of London Press.
- LANGFORD, PETER E. (1986) "Arithmetical Word Problems: Thinking in the Head versus Thinking on the Table." *Educational Studies in Mathematics*, 17, 193-199.
- LEDER, GILAH C. (1987) "Teacher Student Interaction: A Case Study." *Educational Studies in Mathematics*, 18, 255-271.
- LESH, RICHARD and LANDAN, MARSHA (eds.) (1983) *Acquisition of Mathematics Concepts and Processes*. London, Academic Press.
- LIVINGSTONE, DAVID V. (1983) *Class Ideologies and Educational Futures*. Sussex, Falmer Press.
- LOVELL, K. (1966, 5th ed.) *The Growth of Basic Mathematical and Scientific Concepts in Children*. London, Univ. of London Press.
- LUMP, D. (1980) "Mathematics and the Less Gifted Child in the Middle Years." *Mathematics in School*, 9, 3, 2-10.
- McMILLAN, BRIAN and HENRYLL, JANZEN (1984) "Peter Pawot: Evaluation of a Classroom Self-Instructional Training Programme to Increase Reflectivity in Children." *School Psychology International*, 5, 71-76.

MANSFIELD, D.E. (ed.) (1966) *Mathematical Forum*. London, John Murray.

MATHEMATICS COUNTS (1982) *Report of the Committee Inquiry into the Teaching of Mathematics in Schools under the Chairmanship of Dr. W.H. Cockcroft (The Cockcroft Report)*. London, HMSO.

MATTHEWS, GEOFFREY (ed.) (1973) *Mathematics through School*. London, John Murray.

MILLAR, CLIVE (1984) "Curriculum Improvement or Social Innovation? A Case Study in Teacher Education at a Black South African University." *Journal of Curriculum Studies*, 16, 3, 297-310.

MILLMAN, VAL (1983) Reducing Sex Role Differentiation in Schools. *Primary Education Review*, 17, 7-9.

MODGILL, SOHAN (1974) *Piagetian Research. A Handbook of Recent Studies*. Windsor, NFER.

MORRIS, ROBERT (ed.) (1981) *Studies in Mathematics Education*. Paris, UNESCO.

MORRIS, ROBERT (ed.) (1984) *Studies in Mathematics Education. The Mathematics Education for Primary School Teachers*. Paris, UNESCO.

MURPHY, F. (1973) The Paradox of Freedom in P.S. Peters' Analysis of Education as Initiation. *British Journal of Educational Studies*, XXI, 1.

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (1970) *Piagetian Cognitive Development Research and Mathematics Education*. Eds. Roszkopf, Myron F., Steffe, Leslie, and Taback, Stanley, Virginia, U.S.A..

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS (1980) *An Agenda for Action*. Virginia, U.S.A..

NEWSON, JOHN and ELIZABETH (1977) *Perspectives on School at Seven Years Old*. London, George Allen and Unwin.

NICHOLAS, E. J. (1983) *Issues in Education: Comparative Analysis*. London, Harper and Row.

NIMIER, JACQUES (1976) *Mathématique et Affectivité. Une Explication des Échecs et des Réussites*. France, Stock.

NORTHAM, JEAN (1982) "Girls and Boys in Primary Mathematics Books." *Education 3-13*, 10, 1, 11-14.

O'HAGAN, FRANK J. and ROBERTSON JANE C. (1984) "Primary School Children's Preferences Concerning Teachers and Teaching Methods." *School Psychology International*, 5, 97-102.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (1961) *New Thinking in School Mathematics*. France

ORMELL, C. P. (1979) "The Problem of Analysing Understanding." *Educational Research*, 22, 1, 32-38.

ORMELL, CHRIS (1983) "Maths with a Bite." *Education 3-13*, 11, 2, 22-26.

OXFORD REVIEW OF EDUCATION (1987) *Special Issue: Plowden Twenty Years on*. Eds. Halsey, A. H. and Sylva, K. D., 13, 1.

PEAKER, G. F. (1971) *The Plowden Children Four Years Later*. Windsor, NFER.

PIAGET, JEAN (1950; 1964 4th imp.) *The Psychology of Intelligence*. London, Routledge and Kegan Paul.

PIAGET, JEAN (1952; 1964 3rd imp.) *The Child's Conception of Number*. London, Routledge and Kegan Paul.

PIAGET, JEAN and INHELDER, BARBEL. (1956; 1963 2nd imp.) *The Child's Conception of Space*. London, Routledge and Kegan Paul.

PIAGET, JEAN (1960) *The Child's Conception of Geometry*. London, Routledge and Kegan Paul.

PIAGET, JEAN (1969) *The Child's Conception of Time*. London, Routledge and Kegan Paul.

PIAGET, JEAN (1978) *The Development of the Thought*. Oxford, Blackwell.

PIAGET, JEAN (1979) *Psychologia ke Pedagogiki*. (a translation of Psychologie et Pedagogie, Paris, 1969) Trans. Ververidis, A., Athens, Livanis.

PIDGEON, DOUGLAS A. (1972) *Evaluation of Achievement*. London, Macmillan Education.

PLAN EUROPE 2000 PROJECT 1: EDUCATING MAN FOR THE 21ST CENTURY *Perspectives in Primary Education*, 7, France, UNESCO.

PLUNKETT, STUART (1983) "Mathematics in the Mind." *Education 3-13*, 11, 1, 28-32.

POLYCHRONOPOULOS, PANOS (1980) *Politiki ke Pedagogiki stin Ellada: Kritiki Analsi ke Axiologisi Ton Ideologikon ke Gnostikon Litourghion tou Elinikou Scholikou Systimatos, 1950-1975. Tomos A.* (Politics and Pedagogy in Greece: A Critical Analysis and Evaluation of The Ideological and the Knowledge Functions of the Greek School System, 1950-1975, Vol. A.). Athens, Kastaniotis.

PRESTON, MICHAEL (1987) *Mathematics in Primary Education*. London, The Falmer Press.

PROCTOR, NIGEL (1985) "Educational Psychology and Curriculum Design: A Child-Centred Approach." *Educational Studies*, 11, 2, 151-158.

PROCTOR, NIGEL (1986) "Rethinking your Primary Curriculum Statement." *Education 3-13*, 14, 1, 9-13.

PURPEL, D. and BELANGER, M. (1972) *Curriculum and the Cultural Revolution*. U.S.A., McCutchan.

REID, I. MARGARET, CLUNIES-ROSS, L. LOUISE, COACHER, BRIAN and VILE, CAROL (1981) "Mixed Ability Teaching: Problem and Possibilities." *Educational Research*, 24, 1, 3-10.

RICHARDS, COLIN (1982) *New Directions in Primary Education*. Sussex, The Falmer Press.

RICHARDS, COLIN (1984) *The Study of Primary Education: A Source Book*. Vol 1, Sussex, The Falmer Press.

RICHARDS, COLIN (1986) "The Curriculum from 5 to 16." *Education 3-13*, 14, 13-18.

RICHARDS, P. N. and BOLTON, N. (1971) "Divergent Thinking, Mathematical Ability and Type of Mathematics Teaching in Junior School Children." *British Journal of Educational Psychology*.

RICHMOND, G. R. *Isagogi ston Piaget*. (Introduction to Piaget, 1970). Trans. Kantas, A., Athens, Ipodomi.

RIDING, R. J. (1977) *School Learning: Mechanisms and Processes*. London, Open Books.

RIESMAN, FRANK (1962) *The Culturally Deprived Child*. London, Harper and Row.

ROBERTS, ALASDAIR (1984) "Group Methods? Primary Teachers' Differentiation Policies in Mathematics." *Educational Review*, 36, 3, 239-248.

RODGER, I. A. and RICHARDSON, J. A. S (1985) *Self-Evaluation for Primary Schools*. Kent, Hodder and Stoughton Educational.

POGERS, P. J. and MILLER, J. VALERIE (1984) "Playway Mathematics: Theory, Practice and Some Results." *Educational Research*, 26, 3, 200-207.

ROGERSON, ALAN (1975) "SMP 7-13." *Mathematics in School*, 4, 1.

ROGERSON, ALAN (1978) "SMP 7-13." *Mathematics in School*, 7, 5, 4-6.

RUBINSTEIN, DAVID and STONEMAN, COLIN (eds.) (1972) *Education in Democracy*. Middlesex, Penguin Books.

SCHOOL MATHEMATICS PROJECT (1972) *Mathematics in the Middle Years of School*. A Report of the Conference Held in Birmingham.

SCHOOLS COUNCIL (1977) *Mixed Ability Teaching in Mathematics*. London, Evans Brothers.

SCOTT, CHARLES (1982) "The Small Rural Primary School: An Appraisal." *Education 3-13*, 10, 1, 43-48.

SHARP, R and GREEN, A (1975) *Education and Social Control: A Study in Progressive Primary Education*. London, Routledge and Kegan Paul.

SHERWOOD, PHILIP (1982) "The Cockcroft Report: A Primary School Perspective." *Education 3-13*, 10, 1, 4-7.

SHUARO, HILARY (1982) "The Sex Factor." *Journal of Education*, 6, 11, 9-10.

SIGEL, I and HOOPER, F (eds.) (1968) *Logical Thinking in Children*. USA, Holt, Rinehart and Winston.

SIMON, BRIAN and WILLCOCKS, JOHN (eds.) (1968) *Research and Practice in the Primary Classroom*. London, Routledge and Kegan Paul.

SKAALVIK, E. M. (1983) "Academic Achievement, Self-Esteem and Valuing of the School: Some Sex Differences." *British Journal of Educational Psychology*, 53, 299-306.

SKEMP, R. RICHARD (1971) *The Psychology of Learning Mathematics*. Harmondsworth, Penguin.

SKEMP, R. RICHARD (1979) *Intelligence, Learning and Action*. London, John Wiley and Sons.

SOCKETT, HUGH (ed.) (1980) *Accountability in the English Educational System*. London, Hodder and Stoughton.

SPEARMAN, C (1927) *The Abilities of Man*. London, MacMillan.

SUTHERLAND, MARGARET (1981, 6th ed.) *Sex Bias in Education*. Oxford, Blackwell.

SUTTON, ANDREW (1980) "Measures and Models in Developmental Psychology," *Educational Studies*, 6, 2, 111-126.

THOMAS, MURRAY and THOMAS, SHIRLEY (1965) *Individual Differences in the Classroom*. USA, McKay Co.

TIEDT, W. SIDNEY (1968) *Teaching the Disadvantaged Child*. London, Oxford Univ. Press.

TAYLOR, JOY (1983) *Organizing and Integrating the First School Day*. London, George Allen and Unwin.

VAUGHAN, B. W. (1978) *Planning in Education*. Cambridge, Cambridge Univ. Press.

- WADE, BARBARA E. (1981) "Highly Anxious Pupils in Formal and Informal Primary Classrooms: the Relationship between Inferred Coping Strategies and: I-Cognitive Attainment." *British Journal of Educational Psychology*, 51, 39-49.
- WALDEN, ROSIE and WALKERDINE, VALERIE (1983) "A for Effort, E for Ability: The Case of Girls and Maths." *Primary Education Review*, 17, 2-4
- WALDEN, ROSIE and WALKERDINE, VALERIE (1985, 3rd ed.) *Girls and Mathematics: The Early Years*. London, Institute of Education, Univ. of London.
- WALDEN, ROSIE and WALKERDINE, VALERIE (1985) *Girls and Mathematics: From Primary to Secondary Schooling*. London, Institute of Education, Univ. of London.
- WALLACE, J.G. (1966, 2nd ed.) *Concept Growth and the Education of the Child*. Slough, NFER.
- WALLACE, J.G. (1972) *Stages and Transition in Conceptual Development*. London, NFER.
- WARDLE, DAVID (1970) *English Popular Education 1780-1975*. Cambridge, Cambridge Univ. Press.
- WATSON, F.R. (1976) *Developments in Mathematics Teaching*. London, Open Books.
- WHITEHEAD, A.N. (1962, 5th imp.) *The Aims of Education*. London, Ernest Benn.
- WHITEHEAD, DAVID (1980) *The Dissemination of Educational Innovations in Britain*. Kent, Hadder and Stoughton Educational.
- WHITNEY, HASSLER (1987) "Coming Alive in School Math and Beyond." *Educational Studies in Mathematics*, 18, 3, 229-242.

- WHYTE, JUDITH (1983) "How Girls Learn to Be Losers." *Primary Education Review*, 17, 5-7.
- WILLIAMS, D.J. (1967) *Mathematics Reform in the Primary School: A Report of a Meeting of Experts Held in Hamburg during January, 1966*. UNESCO.
- WILSON, BRYAN (ed.) (1981) *Anglo-Soviet Seminar: Mathematics Education*. London, The British Council.
- WILSON, BRYAN (ed.) (1981) *Cultural Contexts of Science and Mathematics Education*. Centre for Studies in Science Education, Univ. of Leeds.
- WILSON, BRYAN (ed.) (1983) *Second Anglo-Soviet Seminar: Mathematics Education*. London, The British Council.
- WITTMAN, ERICH (1984) "Teaching Units as the Integrating Core of Mathematics Education." *Educational Studies in Mathematics*, 15, 25-36.
- WOODROW, DEREK (1984) "Cultural Impacts on Children Learning Mathematics." *Mathematics in School*, Nov., 5-7.
- WOODS, PETER (ed.) (1980) *Pupil Strategies: Explorations in the Sociology of the School*. London, Croom Helm.
- WOODS, PETER (ed.) (1980) *Teacher Strategies: Explorations in the Sociology of the School*. London, Croom Helm.
- WOODS, R.G. and BARROW, R.ST.C. (1975) *An Introduction to Philosophy of Education*. London, Methuen.

APPENDIX A

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THE EXPERIMENTAL SCHOOL (PRE-PILOT STUDY).

THE ONE CLASS EXPERIMENTAL SCHOOL OF THESSALONIKI.

The area around the school.



1. There are blocks of flats on both sides of the street that lead to and stop at the school gate.



2. The area facing the main entrance of the school.

The school playground.



3. The Teachers' College. The school building stands opposite it on the same playground.



4. One of the Experimental school buildings is adjacent to the Teachers' College.

The school building.



5. The one class school building.



6. Part of the school building. It borders on the Teachers' College Laboratory. The Archaeological Museum and some other buildings of the area complete the background.

Inside the classroom.



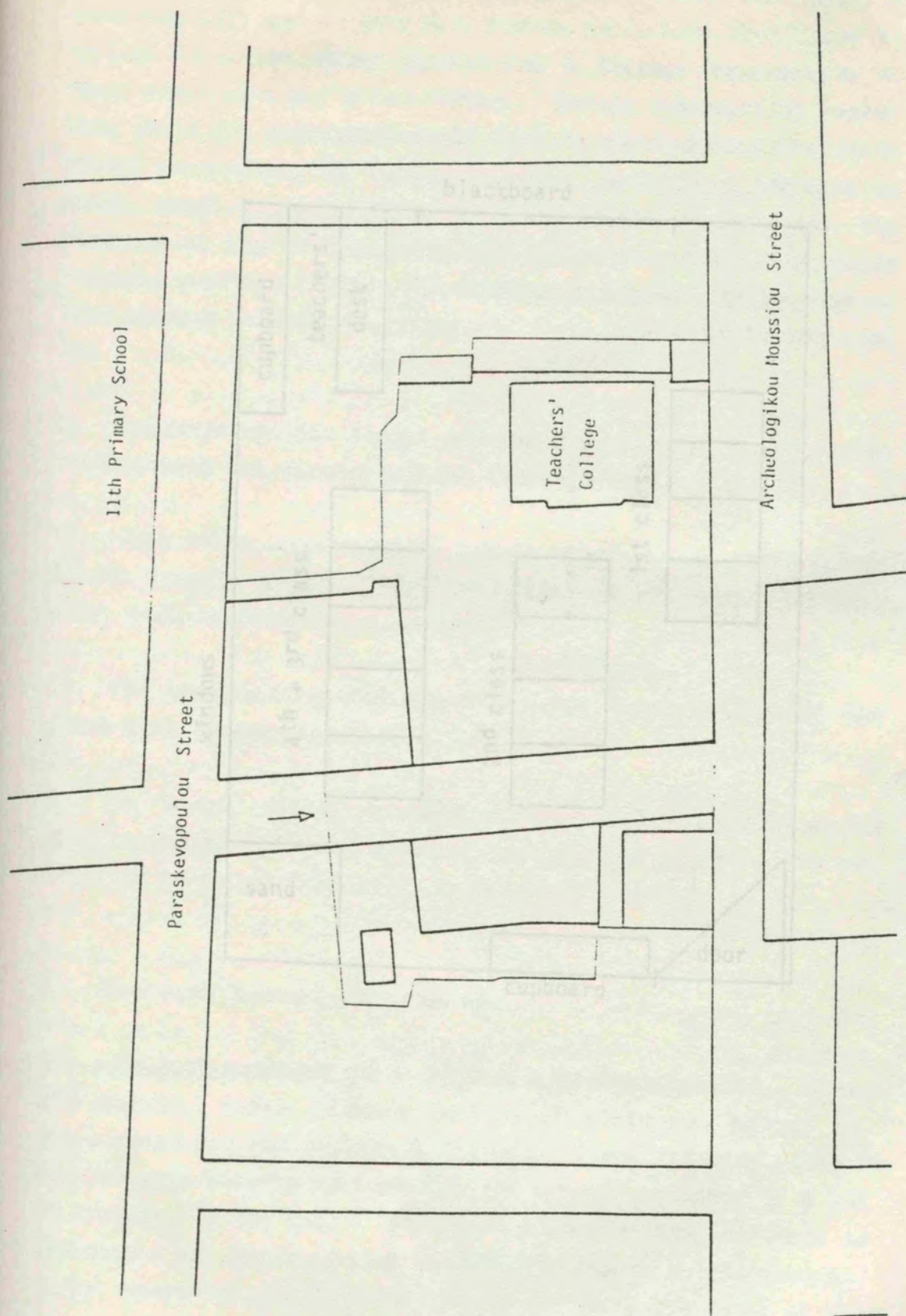
7. The desk arrangement.



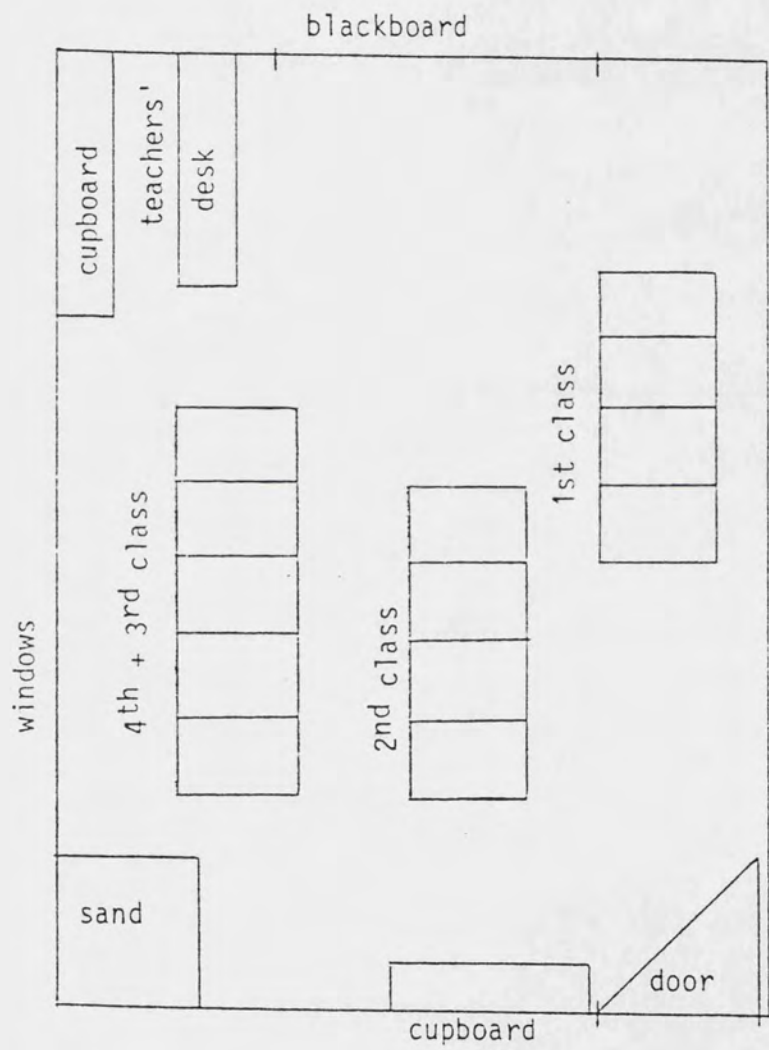
8. Part of the classroom where the blackboard and wall display can be seen.

Note: The photos were taken a year after the application of the research, so the children shown here are not the ones who participated in the study.

The experimental school



The classroom



The name of the school indicates the aims of its foundation some years ago. That is, it was supposed that at this school new projects and teaching approaches could be applied experimentally and if they were proven successful they could be applied to a few other schools for a further examination of their advantages and effectiveness. Having successfully passed this stage the experiment could then be adopted into the state school curriculum. At this school also, methods of teaching in small rural schools might be experimented upon, and the students of the Teachers' College could have a part of their teaching practice there. The experimental school is made up of five primary schools accepting children from 6 to 12 years of age.

1. The first and the second experimental schools that is, two schools with six classes and six teachers each.

2. The third experimental school which is a three class school, namely a school with six classes but three teachers only, each teaching two classes.

3. The one class school which has one teacher teaching the first four classes together.

4. The "mixed" school which is made up by third grade pupils who, having been found redundant in the other schools, are put together to form a completely independent school.¹

1. The area around the school.

The school is situated in a typical middle-class area. There are schools, shops, cinemas, blocks of flats all around it. The streets are narrow, the buildings old and ordinary. There are two main streets very near to the school, so there is a lot of traffic all day long. At a five-minute walking distance is the city's sea front covered through its length by playgrounds, parks, where children can be trained to learn the rules of the

4. The teacher and the teaching method followed.

The teacher devoted most of her time to the younger pupils. At the beginning of a teaching session she usually started with the older children, introduced them to a new task and after she had explained what they had to do, left them to work on their own. Then she turned to the younger ones and worked along with them, introducing and explaining new concepts, asking and answering questions. Sometimes she chose to start with the young children and finish the teaching session with the older ones. In this case, as soon as she entered the class she explained to the children of the 3rd and 4th grades what they had to do and then she went straight to the young ones. It should be noted here that it is very difficult for a teacher to deal with twenty five children who are at different ages at the same time. The situation was quite similar to that of group teaching but in that case you deal with a group of children of the same age who work on different subjects. In the case of the one class school there existed the additional difficulty of the very young children of the first grade who were often at a loss and in great need of the teacher's continuous attention and help. Thus, they could be very noisy when they were left with no particular task to accomplish. No matter how well organized the teacher might be or how carefully she planned her lesson, it so happened that there always appeared a problem which led to commotion. In order to make the lesson more effective and to avoid disruptive behaviour the teacher adopted a kind of mutual teaching method as much as possible. So whilst she worked with the young pupils, the old ones had a co-operative teaching, that is, they appointed for each discussion a co-ordinator among themselves.

The co-ordinator pointed out two or three pupils who asked the other pupils questions on the lesson of the day. It could be claimed that this teaching system worked satisfactorily even if it had its disadvantages. The children learned to respect each

others' opinions and to accept readily the others' points of view and arguments. They got used to a kind of mutual support and they often proved to be good organizers. They were usually strict both as co-ordinators and as participants. They made comments and passed judgements, they developed a remarkable attitude towards self-discipline. They demanded that their classmates supported the opinions they expressed and they protested vigorously when they thought that they were treated in an unfair way. Certainly there always appeared problems like disputes and contradictions, and aggressiveness was not unknown among them. They quite often mistrusted the others, they felt that the co-ordinator was partial and they fought dynamically in order to demand their rights. In general, however, the mutual-teaching method was rather successful and in many ways beneficial to the children.

5. The sample of the pre-pilot study.

The selection of the six second grade children of the one class school was considered most appropriate as these children were randomly selected and therefore of mixed ability, and furthermore, the fact that only six children formed the whole class simplified both the teacher's work and the researcher's aim. The six children could be divided into three groups according to their ability in Mathematics. Two of them were of a very good academic ability, another two were of an average ability and the remaining two of quite low ability. The children's age range extended between 7 and 7 $\frac{8}{12}$, the youngest child being the weakest in Mathematics. This child found it very difficult to concentrate on a task for a length of time, she could hardly work silently, and she interrupted the others quite often. Another child, a boy of 7 $\frac{3}{12}$, was very weak at Mathematics too, but the difficulties he met resulted from his inability to read fluently. Since, therefore, he used most of the time for reading and trying to understand what was asked of him he could hardly catch up with the rest of the class. Concerning the other three children, one of them was academically able but very absent-minded and an

attention seeker, and the two others, both girls, were very systematic and careful with their work. The best of the class was a boy aged 7 7/12 who could understand nearly every concept as soon as the teacher introduced it, and he had almost always the right answer to the question asked.

6. The reasons for the continuance of the one class school.

The main concern of the school is to develop methods of teaching suitable for mixed ability classes. This type of school is met in very small isolated villages or islands.³ In these villages with the very small and usually poor population there are often very few primary pupils, usually twelve or fifteen children only, of a different age range. Thus the state is faced with a dramatic problem. On one hand, primary education is compulsory for all children in the country, on the other hand, however, to establish and maintain such a small rural school becomes apparently very expensive. Providing full coverage of an expanding curriculum, appropriate teaching staff and requisite apparatus is a very difficult and costly task. So the desire and persistence of the state along with its obligation to run the rural schools created the specific type of the one class school.⁴

7. Advantages and disadvantages of the one class school.

There are, obviously, some academic, social and educational advantages and disadvantages in this type of school.

Advantages

a. The younger children in the classroom feel safe due to the presence of the older pupils. They know that the latter could support them if need be. They also become more mature and self-confident as they are very often treated by their teacher in the same way as the older ones. Sometimes the teacher

introduces a topic for all the children in the classroom and she lets them all take part in the discussion or in the various activities.

b. The young pupils develop a sense of their rights and duties much earlier than other pupils of their age who belong to "ordinary" classes (classes, that is, where pupils are of the same chronological age). Their class is a model of the society in which they find themselves some years later. From such a position in the classroom the most able children learn to coexist happily with the less able children, thus, they get used to behaving in a thoroughly acceptable way. The classroom is, therefore, a microcosm of the society in which they live.

c. The young children are given the opportunity to be introduced to certain concepts earlier than their school age while their teacher presents them to the older children. Thus, when the time comes for them to encounter these same notions again, they will already be familiar to them and possibly more readily comprehended. The older pupils, on the other hand, by listening to subjects already taught to them yet partly, or mostly forgotten, are given the chance to reinforce the concepts already presented at an earlier stage.

Disadvantages

a. The older children could very easily be turned from assistants of the young ones to patronizers, from co-workers to oppressors, from a help in a danger to a danger itself. At the same time the young pupils could change from peaceful playmates to destroyers of the play. Besides their coexistence with older children might be more of a hindrance to their normal maturity than a factor to prematurity. The young children might seek support and protection much too easily and so become pathetic and over-dependent upon others.

b. The teacher always finds it difficult to allocate her time fairly among her pupils. She always appears unfair to the

older pupils since she takes it for granted that they need her less than the young ones, so she usually devotes more of her time to the latter. It could be argued that this is not good enough for beginners who should enjoy most of their teacher's attention and care.

c. Finally, some of the children, for example, those of the third grade who attend the lessons of the fourth grade, face some difficulties because they are asked to assimilate concepts ahead of their school age and academic ability.

A brief description of the procedure followed during the Pre-Pilot study.

At the beginning of the lesson, a discussion on the new concept to be introduced took place, and the children answered various questions using at the same time the appropriate apparatus. In the course of the study the concepts taught were:

1. *The half ($1/2$)* making use of the square, the circle and their parts. While the children were engaged in becoming acquainted with the apparatus they were also introduced to the corresponding terminology⁵ only in order to become familiar with the particular vocabulary and not to memorize it.

At some time during the lessons, definitions of some mathematical notions emerged, such as: fraction, numerator and denominator of a fraction.

Practising these mathematical notions the children were able to describe some fractions given in either written or oral form to them.⁶ After this theoretical briefing and having answered questions like:

"How should I share six unifix between 2 children?"

"How should I share 14 chestnuts between Maria and Helen?"

the children were asked to complete the appropriate worksheets.

2. The notion of *one fourth, two and three fourths*.

The children discovered some relationships between these fractions without writing anything in their books or the blackboard, but simply by discussing or using the apparatus. For instance, covering half of the circle with the two fourths of the same circle they realized that:

$\frac{1}{4} + \frac{1}{4}$, that is $\frac{2}{4}$ equals $\frac{1}{2}$ thus alerting them the same time at the idea of equivalent fractions. Also, by covering the circle completely with the four $\frac{1}{4}$ pieces they noticed that $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4}$, that is $\frac{4}{4}$ make the whole, thus getting an idea about the addition of common denominator fractions and noticing that when the two terms of the fraction are the same then the fraction equals the unit. While puzzling out the pieces-parts of the circle and the square they encountered the fractions $\frac{2}{4}$ and $\frac{3}{4}$ and formed additions and subtractions of common

denominator fractions of the kind:

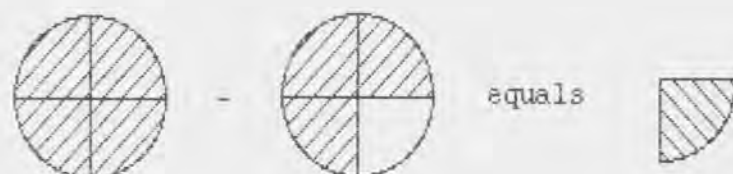
$$\frac{3}{4} + \frac{1}{4} = \frac{4}{4}$$



or

$$1 - \frac{3}{4} = \frac{1}{4}$$

or



Naturally, they did not write the facts but designed them in drawings. Finally, they filled in the corresponding worksheets.

3. The notions of *one third* and *two thirds*

The procedure followed for the fractions $\frac{1}{2}$ & $\frac{1}{4}$ was also followed for the fraction $\frac{1}{3}$. Apparatus for the introduction and comprehension of the concept was employed and the children formed additions ($\frac{1}{3} + \frac{2}{3} = 1$) & subtractions ($1 - \frac{2}{3} = \frac{1}{3}$) and found equivalences ($\frac{2}{3} = \frac{4}{6}$) by simply using the shapes and their parts.

During the second week in which fractions were taught a further development of the subject was attempted. The concepts of the continuous partition of the whole and the mixed numbers were presented in a way and some comparisons between whole and rational numbers were made. The fractions were associated with everyday life and finally the children's attention was drawn to the use of the vocabulary and they played games with fractions.

Therefore, in more detail, during the next three sessions the children engaged themselves with:

a. Continuous partition of the whole

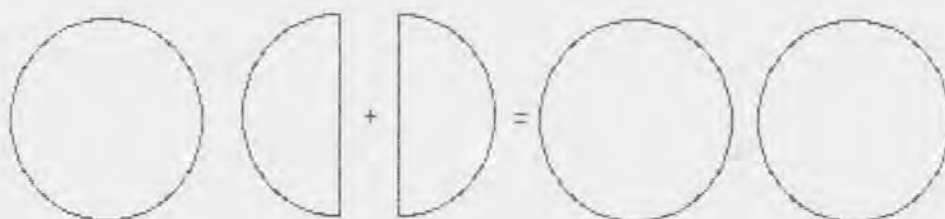
To consolidate the relationships existing between the different fractions of the same whole the pupils were asked to partition continuously the same thing into smaller and smaller equal parts. All the children were given the same number of paper strips for this purpose. Then a child was asked to take one paper strip and share it between two pupils, then among four and lastly among eight pupils. At the same time another pupil was demonstrating with his strips what his schoolmate was doing. So by the end of the activity the children were able to see the arrangement below:



and perceive the relationships among the various parts of the same whole (e.g., $\frac{1}{4}$ of the whole represents the $\frac{1}{2}$ of the half of the whole etc.).

b. Mixed Numbers

Employing the apparatus, the children were required to depict operations given to them orally or to express in words operations given to them in shapes, e.g.: "Using the circles and their parts, can you show me how many are one and a half plus a half circles?" or: "Can you tell me what the arrangement below denotes?"



c. Comparing the order in the number line of two whole numbers and their corresponding fractional numbers.

There was an effort, always with the assistance of apparatus, to point out the "paradox" of the formulas $a > b$ but $\frac{1}{a} < \frac{1}{b}$ when a, b are whole numbers.

Thus the children were asked to answer successively to the questions:

"Are twenty pieces of orange more or less than two pieces?"

"What do the fractions $\frac{1}{20}$ and $\frac{1}{2}$ of an orange mean?"

"Which of the two fractions, $\frac{1}{20}$ and $\frac{1}{2}$, is the biggest?"

There was no attempt to deepen the subject because it was considered extremely difficult for second class children to comprehend. The actual purpose of presenting it to the children was only to give them the opportunity to notice the difference between a whole and a rational number.

d. Fractions in everyday life.

Based on their everyday experience, the children were asked to name fractions representing things well known to them, e.g., what part (fraction) of the week/month is a day, or what part (fraction) of the 10p coin/10 dms⁷ coin represents a pence/dms. It was thus necessary for the children to recall what a fraction denoted and its written form (namely, what the numerator and what the denominator stood for).

e. The language

Given the opportunity during the lesson, the children were asked to give each other a fraction of something they possessed, thus practising the terminology. John, for example, was asked to give Dimitris $\frac{1}{2}$ of his square and Anthi $\frac{3}{4}$ of her circle, or Anthi was given a piece of Evdokia's circle and was then asked to name that particular piece. Or, the children were asked to fold a square into two, four, eight equal parts and so on.

Games used in the teaching of fractions.

1. Crosswords.

A crossword was made and given to the children to compose so that they could practise the terminology of the fraction.

2. Dominoes

A set of dominoes was made to help the children relate the visual form of the fraction to its corresponding symbol and vice versa. Each part of the domino consisted of two equal pieces of cardboard covered with plastic transparent foil. A shape was drawn on one of the halves and a fraction was written on the other, so that the children had to match the right fraction with its corresponding shaded shape on another domino.

Learning to tell the time.

During the third and last week of the study the children were introduced to the subject of time and particularly in how to tell the time from the analogue clock. This subject was considered as an extension of the previous mathematical topic. With the circle and its division into two or four parts as a starting point we moved to the clock face. The clock was treated as a circle. At the beginning a paper clock was used divided into four equal parts, with two diameters at the points of which the numbers twelve, six, three and nine were written.



After a very brief reference to the name of the hands (hour hand, minute hand)⁸ we proceeded to the way these hands operated. The fact that we always start from the moment the minute hand points to twelve was properly stressed. When the minute hand moves from twelve and by the time it has reached three it has covered one fourth of the circle so we say it is a quarter past. When it continues and reaches six it has run exactly half of the circle so we say it is half past. When it reaches nine it has already covered $\frac{3}{4}$ of the circle so we could say it is three quarters past or since there is only one quarter left to complete the circle we usually say it is a quarter to. The children were given identical clocks and they used them

either in order to show a time asked (e.g., A quarter past three) or to tell the time according to some schoolmate's clock (e.g., three o'clock). Then, they were required to fill in the worksheets.

Next, an analogue clock (divided however with two diameters into four equal parts) was employed so that the children could discern the concept of "minutes".

After referring to the fact that one hour equals sixty minutes (namely that the circle can be shared into sixty equal parts), again by putting the fractions to use (division of a countable whole to equal parts) the children managed to find out by themselves that half an hour (half the circle) contains thirty minutes and that the quarter of the hour ($1/4$ of the circle) has fifteen minutes. Then, and after the children had used both ways of dividing the clock into four equal parts as a circle, on one hand and as a period of time on the other, we proceeded to tell the time when the minute hand moves from twelve to six and then from six to twelve in both possible ways.⁹ Lastly, a brief account of the various ways of writing the time was given and the corresponding worksheets were completed.

THE 11TH PRIMARY SCHOOL.

The area around the school.



1. The main street passing in front of the school. The entrance to the playground which can be seen here is out of use.



2. The school yard. Opposite it, across the street one of the buildings belonging to the Experimental school can be seen.

The school building



3. The school building and part of the yard.



4. An interior view. The first floor: the open door belongs to the classroom where the research was conducted.

Inside the classroom



5-6. The classroom where the research was conducted.



Note: The photos were taken a year after the pilot study was conducted and the present desk arrangement is different from that of the pilot study. During the pilot study the desks were arranged in three rows, one behind the other and all faced the blackboard.

1. **The area around the school.** The school is situated in the same area as the Pre-pilot study school,¹⁰ and the description of the area is given in appendix A, p.ix.¹¹

2. **The school building.**

The school was built in 1981 and has fourteen classrooms. Twelve of these classrooms are used by the primary school, two for each one of its classes, and two by the nursery school. It is a two-storey building and it consists of two parts adjacent to each other. The main corridor consists of windows along one of its sides and classrooms on the other side. The same pattern is repeated on every floor. A cemented yard occupies the front of the building. Part of the yard is roofed over by one of the wings of the building, so that it offers protection to a number of children on rainy days.¹² The school operates in two cycles, one in the morning and another in the afternoon, and accommodates two schools, the 11th and 7th plus two Nursery Schools. The morning cycle operates from 8:30 to 13:00 and the afternoon cycle from 14:00 to 18:00. The research was carried out in the 11th school which had 300 children shared between twelve classes, two for each one of the age groups.

3. **The classroom.**

The second classroom was on the first floor of the school building. The wall opposite the door was occupied by windows. Several shelves stood against the wall, and a cupboard where books or apparatus could be locked against the third wall. The desks (see p. 16) were arranged in three rows, one behind the other, all facing the blackboard and the teacher's desk which took up the fourth wall. It could be said that it was a rather interesting classroom environment. No drawings or children's art exhibits hung on the wall. Nothing, that is, that could add some colour or some vividness to the place.¹³

4. The teaching staff and the class teacher.

The school consisted of twelve classes.¹⁴ Most of the staff had taught for a number of years, in fact some of them were soon due to retire. There were only two younger teachers who had come as substitute teachers to the school for one year.¹⁵ Many teachers had attended the in-service training courses offered on a yearly basis at the Teachers' In-Service Training Colleges (S.E.L.D.E.)¹⁶ They appeared rather conservative and cautious towards any kind of innovation whether it had to do with manuals and teaching methods or rearrangements inside the classroom. Their attitude was partly justified considering the fact that their work was continuously interrupted and criticized by the students of the Teachers' College who were admitted to do their teaching practice in the school.¹⁷ The second class teacher was young, very friendly and obliging and most importantly open to innovations. She was not afraid to expose her work with the children to a strange and perhaps critical eye. She was very interested in the research and the new teaching system and readily accepted the idea to get her class and herself involved in it. Both her bearing and way of teaching aimed at creating a pleasant, and warm atmosphere for the class. Hers was the only lively class, (the others being very quiet), since she permitted the children to move around freely and work together on the different subjects. The children liked her even if they often distressed her with their mischievous behaviour. She had passed satisfactorily an in-service training programme and she enjoyed very good relationships with all her colleagues at her school.

5. The children who participated in the research.

There were twenty six pupils in the second class, eighteen boys and eight girls aged between 6 3/12 and 7 8/12 at the time. They came from middle class families.¹⁸ Their parents seemed to care about their children's progress and were eager to help them with their lessons. Being very cooperative, they were

extremely interested in the research and almost all of them came to school when they were asked to do so. There were more boys than girls in the class, some of the boys were boisterous which made complete order and control almost impossible to maintain. The children were very sociable, talkative, impulsive and happy but very naughty, too. They never ceased to fight and quarrel during the breaks and even in class they would whisper or make gestures that indicated their intention to settle their accounts at all cost during the break.

Most of the pupils were around and below average ability, with very few exceptions. Several of the children needed their teacher's special attention and there was a maladjusted child who, nevertheless, was treated like the rest and with the combined assistance of her mother and teacher, was making remarkable progress. Generally more systematic than the boys, the girls of the class worked more quietly, efficiently and neatly. Obedient, well-behaved and usually shy they tried to survive in a "male-ruled" class. The boys were usually so naughty that they went almost beyond control. Throughout the lessons conducted by the class teacher and the researcher a buzz could be heard which was never productive nor due to the children's activity within the lesson. It was the result of teasing or rival fighting or talking, irrelevant to the lesson itself.

THE SCHOOLS OF THE MAIN STUDY

THE 41ST PRIMARY SCHOOL

The area around the school



1-2. The main school entrance and the pedestrian precinct outside the school.



The school building



3. The main entrance and the external view of the classroom where the study was conducted.



4. The playground and the blocks of flats surrounding the school.

Inside the classroom



5. The classroom windows overlooking the pedestrian precinct.



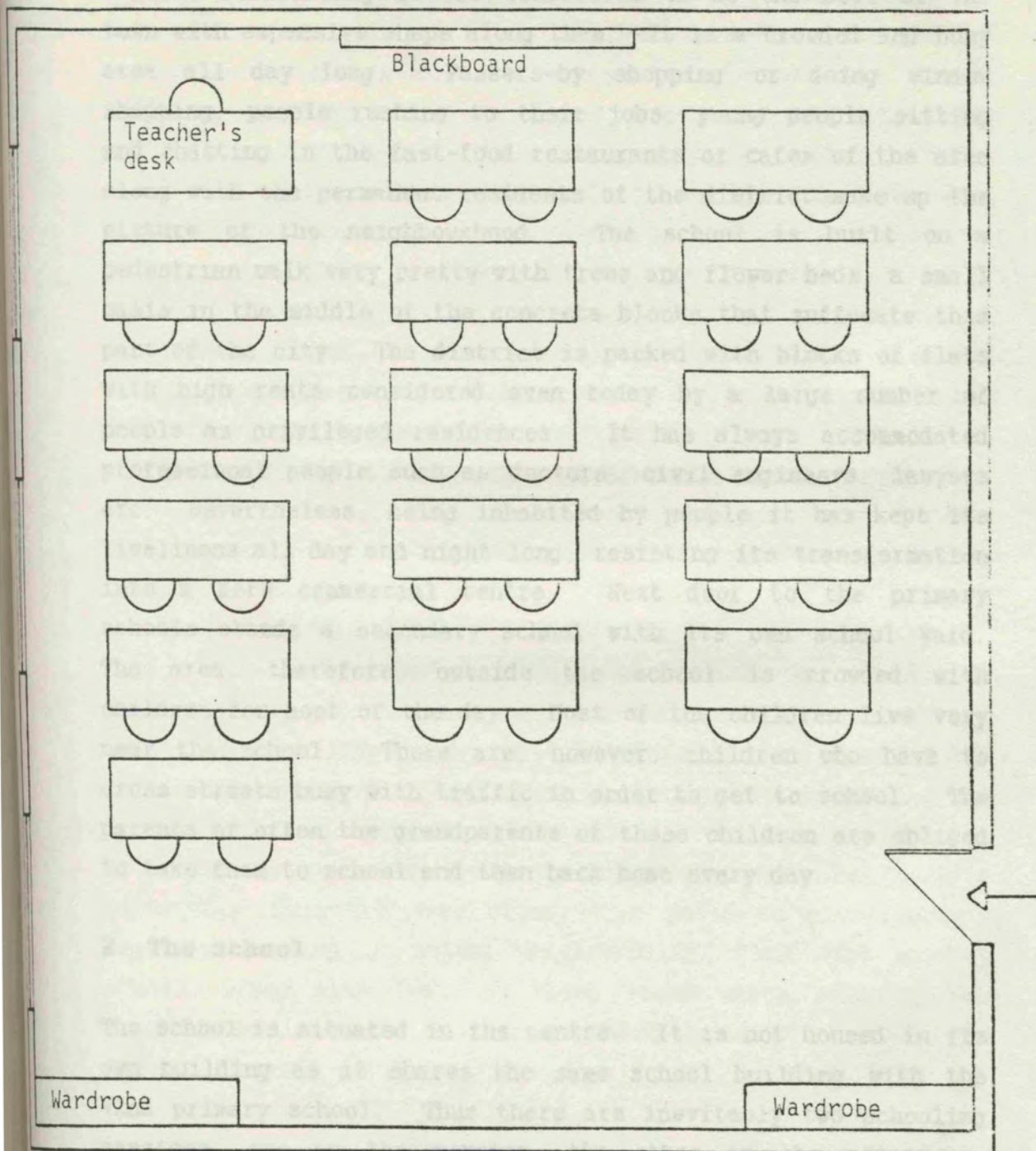
6. A general view of the classroom.



7-8. The pupils working on the SMP material.



A plan of the classroom



1. The area around the school.

The school is situated in the "heart" of the town centre. The streets surrounding it are considered to be the best of the town with expensive shops along them. It is a crowded and busy area all day long. Passers-by shopping or doing window shopping, people rushing to their jobs, young people sitting and chatting in the fast-food restaurants or cafes of the area along with the permanent residents of the district make up the picture of the neighbourhood. The school is built on a pedestrian walk very pretty with trees and flower beds, a small oasis in the middle of the concrete blocks that suffocate this part of the city. The district is packed with blocks of flats with high rents considered even today by a large number of people as privileged residences. It has always accommodated professional people such as doctors, civil engineers, lawyers etc. Nevertheless, being inhabited by people it has kept its liveliness all day and night long, resisting its transformation into a mere commercial centre. Next door to the primary schools stands a secondary school with its own school yard. The area, therefore, outside the school is crowded with children for most of the day. Most of the children live very near the school. There are, however, children who have to cross streets busy with traffic in order to get to school. The parents or often the grandparents of these children are obliged to take them to school and then back home every day.

2. The school.

The school is situated in the centre. It is not housed in its own building as it shares the same school building with the 42nd primary school. Thus there are inevitably two schooling sessions, one in the morning, the other in the afternoon, interchanging every week. The building, a two-storey structure, was built in 1932 and has eight classrooms. These stand, as in most school buildings in Greece, on one side of a long corridor, the other facing through a row of windows either the school yard or the street. Therefore, the only means of

communication among the rooms is the corridor. The eight classrooms were inadequate for the needs of the school. So they had to turn three other rooms, normally intended for staff offices or other uses, to classrooms. There is no open space, or a place for a library or a room for theatrical performances or other activities to take place. In short, the school building like most school buildings in Greece was designed and built to meet needs very different from those of today. The total number of pupils was 295 and the teachers employed were eleven. Most teachers, as is usually the case in most downtown schools, had been in the service from fifteen to thirty years.¹⁹ Several of the teachers had served in the same school for fifteen years. Most of them, however, had taught from one to five years in this particular school. The principal of the school had thirty years of teaching experience, he had a university degree and two years of graduate studies. Three of the teachers had attended a one-year programme of in-service training (S.E.L.D.E. = Seminars for Training Primary School Teachers).

Most of the rest of the teachers, given the chance, would have been willing to acquire some kind of special training and qualifications. The class that each teacher will teach in the following year is decided at the beginning of the school year during a general assembly of the staff. During the assembly every teacher expresses and justifies her wish to teach a particular class and very often, they yield to a colleague's wish in a spirit of mutual understanding. The 41st primary school, along with two or three other state schools, has always been considered one of the best in town. This is due to:

a. the fact that it has traditionally had very good teachers. This is only natural, since the teachers serving there have always had a long teaching experience. The majority of them work hard and make a point of keeping in touch with the new educational and teaching methods.

communication among the rooms is the corridor. The eight classrooms were inadequate for the needs of the school. So they had to turn three other rooms, normally intended for staff offices or other uses, to classrooms. There is no open space, or a place for a library or a room for theatrical performances or other activities to take place. In short, the school building like most school buildings in Greece was designed and built to meet needs very different from those of today. The total number of pupils was 295 and the teachers employed were eleven. Most teachers, as is usually the case in most downtown schools, had been in the service from fifteen to thirty years.¹⁹ Several of the teachers had served in the same school for fifteen years. Most of them, however, had taught from one to five years in this particular school. The principal of the school had thirty years of teaching experience, he had a university degree and two years of graduate studies. Three of the teachers had attended a one-year programme of in-service training (S.E.L.D.E. = Seminars for Training Primary School Teachers).

Most of the rest of the teachers, given the chance, would have been willing to acquire some kind of special training and qualifications. The class that each teacher will teach in the following year is decided at the beginning of the school year during a general assembly of the staff. During the assembly every teacher expresses and justifies her wish to teach a particular class and very often, they yield to a colleague's wish in a spirit of mutual understanding. The 41st primary school, along with two or three other state schools, has always been considered one of the best in town. This is due to:

a. the fact that it has traditionally had very good teachers. This is only natural, since the teachers serving there have always had a long teaching experience. The majority of them work hard and make a point of keeping in touch with the new educational and teaching methods.

b. the fact that most of the pupils attending this school come from upper middle class families, who have traditionally inhabited the centre of the city. There is a great demand for a place in the school by parents who wish to provide their children with the best of schooling and prepare them for further education. The fact that the majority of the parents are well educated themselves means that they are willing to cooperate with the school. However, many of the teachers were of the opinion that some parents interfered or even mistrusted what they were trying to accomplish with the children.²⁰

3. The classroom.

It was a spacious room with big windows along one of its sides overlooking the street. The windows began high above the floor so that even when standing, the pupils could not see outside. From the floor to half way up, the walls were painted in grey plastic colour and from half way up to the ceiling they were whitewashed. The door was the same colour as well as the two metal cupboards and the metal parts of the pupils' desks. The only decoration on the walls were some long forgotten paper doves. The big blackboard was fixed to one of the walls with a wooden stand of equal size below it for the children to stand when they wanted to write on it. Beside the blackboard, in one of the classroom corners, on a wooden stand was the teacher's desk. As in almost all state schools the children sat in desks all facing the blackboard. They did not form groups, nor were there corners of work inside the class. The teacher did almost all the teaching, and whenever a discussion arose, it was usually guided by the teacher, who asked the questions to which the pupils replied.

4. The teacher.

The second class teacher was a very experienced woman. She had established a warm relationship with the children and did her best working on and off the children's books of Mathematics. At her own expense she photocopied tests on Mathematics and

Language and gave them to her pupils quite often in order to check their weaknesses and consolidate the acquired knowledge. Very active and energetic, she was interested in her work. Her criticism for the new Greek Mathematics manuals was constructive. She found no difficulties in using them, but where she found them lacking, she would suggest other approaches. Also, when her experience dictated it, she would give them extra exercises to help them understand new concepts more easily.

5. The pupils.

Their social and family background.

The school had 295 pupils and the second class which participated in the research had 25 children. The majority of the children came from middle class families. The parents of two of the pupils were divorced ²¹. Often one or both parents had university education; in most of the families the mothers worked. According to information provided through the use of questionnaires:

- a. At least fifteen out of the twenty five fathers and the same percentage of mothers had university education. ²²
- b. Ten of the twenty five families had three children and fifteen had two children.
- c. All families had at least two children and in seventeen of them the child attending the second class was the youngest in the family.
- d. More boys than girls did not intend to pursue higher education. They appeared to be strongly influenced by the TV and did not seem to look up to their fathers as appropriate models. On the contrary, from the eighteen girls only three chose jobs for which university degrees were not necessary, and three others replied that they had not yet decided what they wanted to become when they left school.

One isolated case study in the 41st school

It was considered necessary to present this case study here in order to justify the special procedure followed for the particular child.

George:	Age: 7+	Sex: Male
	Class: B	School: 41st

George had acute psychological problems. His mood and consequently his behaviour would change rapidly, so at times he could be very pleasant and placid and the next moment extremely aggressive and restless. He was an attention-seeker. His family background along with the existing educational system caused his learning difficulties and subsequent behavioural problems. His failure in all school subjects along with his inability to make friends made him either disruptive and aggressive or pathetic and inattentive. Nevertheless, it is difficult to claim that his I.Q. level was low even though his competence level was far from satisfactory. Unfortunately, we did not possess standardized tests on children's mental development, nor some expert's report on the particular child so we are in no position to give a clear account of the boys' psychological and mental state. A close encounter with the boy, however, gave no reasons to believe he suffered any - at least serious - perception problems. It rather seemed that he suffered concentration and co-ordination deficiencies. From the very beginning it became clear that he would not work with the cards systematically. On the other hand, the researcher could not deal with him exclusively during the whole lesson. An attempt was made to occupy him with easier worksheets with much simpler texts, but in vain, since he would not accept specific differentiations from the others. After discussing the problem with both the boy's mother and his teacher it was decided to let him continue working with the cards. Moreover, his mother suggested that he should be allowed to take home several cards at a time. There, the tutor she hired to help him with his homework could help him with the

cards as well. At school he would work on the cards as much as he could be assisted by both the researcher and one of his schoolmates who was very nice and willing to read and explain the text to him. Certainly this was not the best arrangement. The particular child should have a person to teach and deal with him throughout the whole session but, of course, that was a luxury not permitted by the limitations and restrictions under which this research was being carried out.

THE 9TH PRIMARY SCHOOL OF PHINIKAS.

The area around the school.



1. The playground and the blocks of flats neighbouring upon the school's left.



2. The blocks of flats in parallel arrangement on the school's right.

The school building



3. The six classroom building.



4. The school playground and the staff room.

Inside the classroom.



5. The desk arrangement.



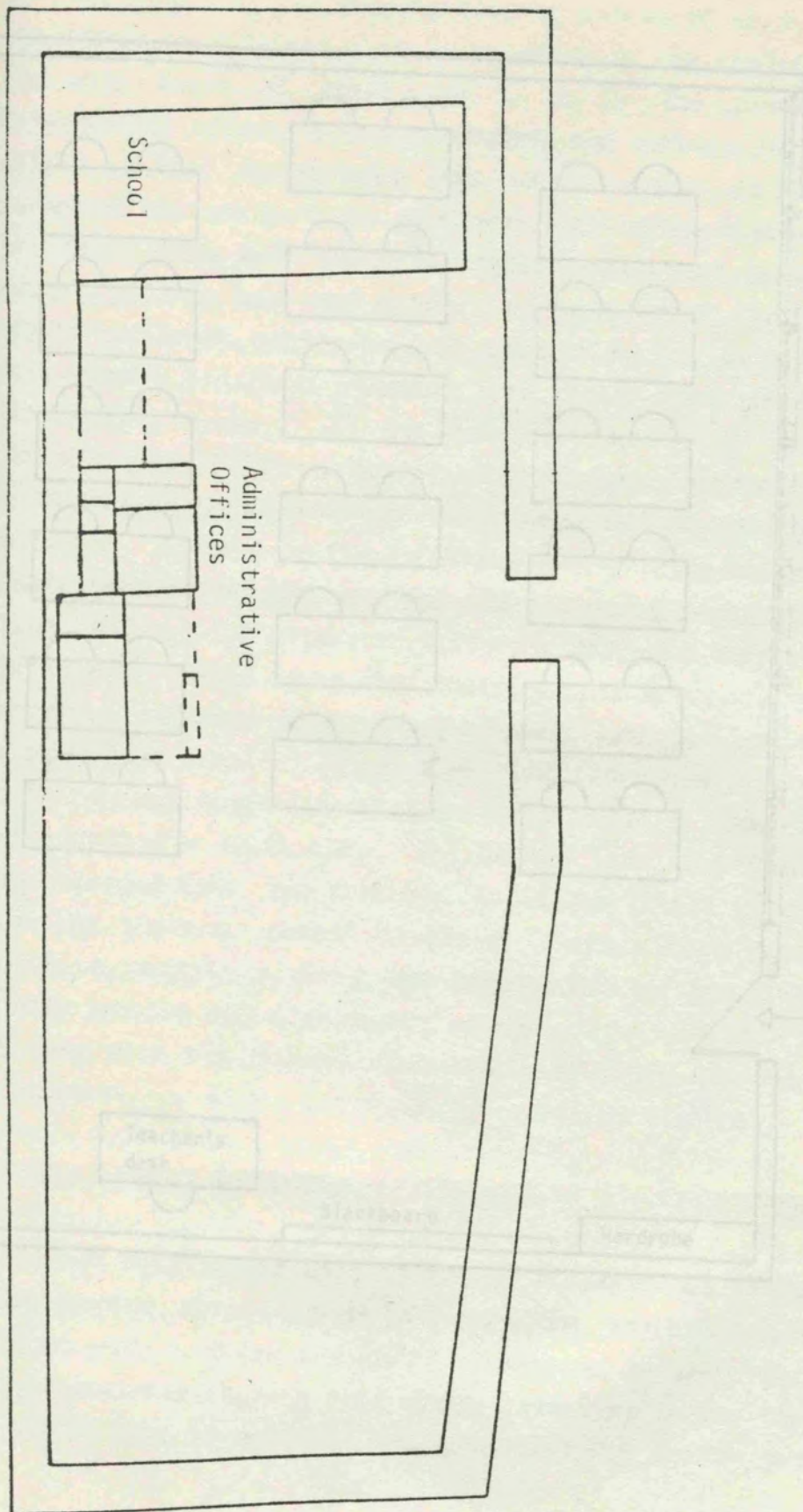
6. The classroom's entrance and the windows overlooking the playground.



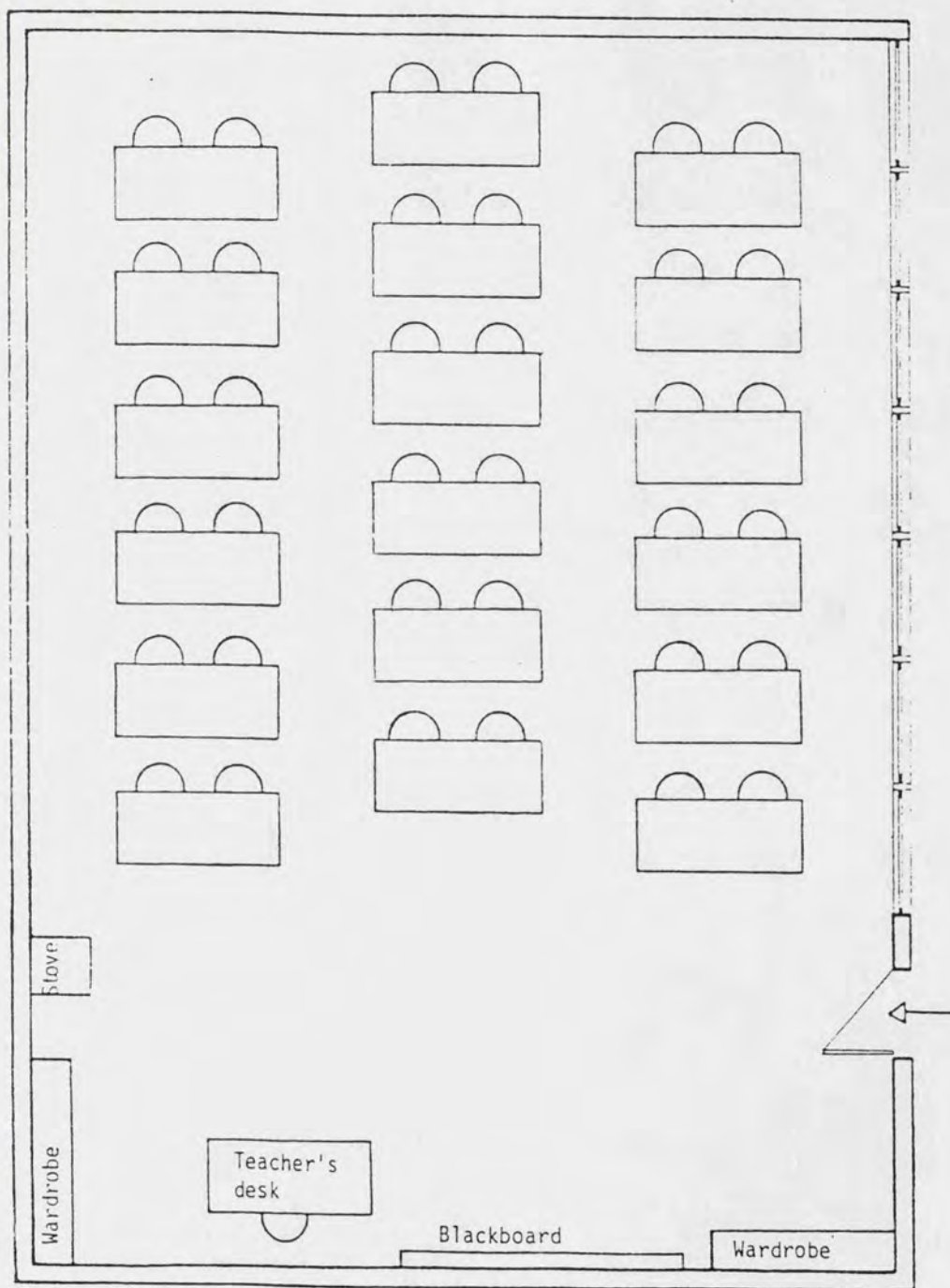
7-8. The children working on the SMP cards.



A plan of the school



A plan of the classroom.



1. The area around the school.

The 9th school of the Municipality of Kalamaria is situated in the suburb of Phinikas. It is a suburb in the eastern part of the city built 25 years ago. It is the product of a governmental effort to house refugees and workers in a housing estate. That arrangement was seen somehow to solve the perennial housing problems of a number of refugees who had come to Greece from Asia Minor in 1922, completely bankrupt and ruined, and who have had a housing problem ever since. These people had built cabins on land allowed by the government for this purpose and their personal care turned these roughly made houses into homes. It was natural that years later they demanded that the government yielded the ownership of the land up to them so that they could build permanent houses which they could own. Pressed by the situation, the government decided to create the housing estate. Thus, they built 3-storey blocks of flats, all looking alike, in different parts of the city. The flats were handed over to their rightful owners with an obligation on their part to pay a small symbolic sum of money in small instalments. It was thus that those homeless workers, unable through their financial position to buy a house of their own, acquired a small flat. And it was thus that Phinikas, a disadvantaged area, was created. Little by little in this area with the austere, cement blocks-of flats, there appeared a church, a market, a park, two playgrounds, a gymnasium, two primary schools and a secondary school. It is in this area of the city with its numerous peculiarities where the 9th school is situated.

2. The school building.

The school building is made up of two storeys. It is built in a rectangular shape and it occupies the whole width of the building site. There are three classrooms on each floor and they communicate through wide roofed balconies facing the yard. The staff room is opposite the main building in the yard. A

quite large yard of cemented surface, with no sign of green, stretches in front of the main building. Built twenty years ago, the building is similar to every old school, quite unimaginatively designed. Strict and colourless, all flat, without even a roofed yard, it lacks every element that would make it a pleasant, happy place for small children. Its only positive element is the open space around it. Situated on the limits of the suburb, one of its sides faces the mountain nearby. The other side opposite the school gate opens to a small play ground, where especially the smaller children usually play at the breaks. There are no buildings in the vicinity of the school so it does not seem to be overshadowed by the pressure of cement masses.

3. The classroom. The classroom²³ was characterized by a lack of style, imagination and colour. The blackboard was hanging on one of the walls, the teacher's desk stood next to it on a stand. Another wall with windows opened to the school yard. The pupils' desks, one behind the other, were set in three parallel rows and they all faced the teacher's desk. There were two grey metal cupboards in which various objects were stored. None of the walls was used to display current children's work.

4. The pupils.

The social and family background.

There were 216 children in the school and the second class which participated in the research had seventeen pupils. That was an exceptionally small number for an urban school, as the average number of children is between 24-28. The ministerial legislation, however, allows for thirty children in a class. Where they are more than thirty pupils in a class it is divided into two, thus giving a smaller number of children per class. This position was predominant in the 9th school. As there was no extra room to accommodate the newly formed class, one of the classes attended school in the morning and the other in the

afternoon, or vice versa. Concerning their social and family background, the majority of the children came from working class families, who faced both financial and social problems. The fathers were mostly inexperienced workers, with no permanent jobs, often unemployed and they lacked even elementary education. The majority of the mothers did not work. Very often the occupations of both mothers and fathers were seasonal, temporary ones. Some of the families had more than two children. Most of the parents were interested in their children's progress and eager to help them. Few of them were completely indifferent and unconcerned. According to information taken through the children's questionnaire it was assumed that:

- a. Only three or four of the parents finished secondary school. The rest must have barely finished primary school.
- b. In nine out of the seventeen families the child attending the second class was the youngest in the family.
- c. None of the parents had university education and none of the pupils expressed the wish to pursue further education after their initial schooling was completed.

A scrutiny of the children's life conditions in their family life as well as in their broader social setting would be out of the perspective and possibilities of the present research. Therefore the elements at our disposal are rather limited and have been drawn either from the questionnaire the children were asked to fill in or from the children's own spontaneous comments and talks in the course of a school hour.

5. The staff. The teachers of the first, second and third class taught in the 9th school for the first time. They were at a loss as to how to deal with the pupils' low competence. The first class teacher was quite experienced with that age of children. Nevertheless, she was anxious that some of her pupils might be unable to read and write or understand basic

mathematical concepts at the end of the school year. The teacher of the fifth class had been in the same school for many years, so that he was well aware of the children's family and social problems. He was thus able to evolve a programme for the children and he did his best for them.²⁴ Generally speaking, the staff were well aware of the peculiarities of the school and were prepared to face problems and tolerate the negative aggressive behaviour of the children. Most of the staff, even if they were aware of the inefficiency of the traditional teaching methods for certain pupils, were not prepared to offer alternatives, either because they were not imaginative enough or because they had experimented and been disappointed, or finally, because they did not dare to oppose ministerial legislations.

THE FOUR CHILDREN OF THE 9TH SCHOOL.

A discussion of four case studies is presented here in an effort to highlight the reasons why the particular children were treated as a special group throughout the research.

Vasso:	Age: 7+	Sex: Female.
	Class: B	School: 9th.

The smallest girl in class, she was always quiet, smiling and willing. Along with Vangelis they were the weakest pupils in their group. She was unable to recognize the numbers or letters. Her participation in class was nil. she could not even hold a pencil in the correct position. She made no progress at all. The only positive effect of school on her was that she associated with children of her own age and learnt the rules of behaviour and sociability.

To make an attempt she needed a person's constant help and support. Nevertheless, she could find this kind of special care neither at school - the educational system does not allow for

individual teaching - nor at home where they faced serious problems.²⁵

For a while she went to a Welfare Institution²⁶ but the people there claimed incapable of helping her. Vasso's brother, a first class pupil, also faced serious problems at school. The timetable at the Welfare Institution was different for the two children, so their mother had to take them there one at a time, which, she claimed, was not feasible with the baby she had to look after as well. Vasso, therefore, with both her school's and family's consent was left alone to push her way through the whole elementary school without having acquired not even the basic skills of reading, writing, etc. Her books were intact, she acted like a visitor, always aloof in any class activity. At times she expressed her wish to learn, to participate in some activity. That wish, however, was more of a gay whim rather than an eager intention to really learn, which distinctly characterized Maria's behaviour.

Vangelis:

Age: 7+

Sex: Male.

Class: B

School: 9th.

Vangelis was extremely quiet, shy and polite. He would be absent for most of the lessons. Therefore, even if he had made some progress by attending regularly for a few days, he would then be absent for one or even two weeks, so he would go far backwards and have to start all over again. He was unable to recognize even the numbers from one to ten or to symbolize the simplest mathematical facts. He always seemed eager to learn, even though that might be put down to his tendency to please his teacher. He became really happy when he made the slightest progress, thus inducing his teacher's encouraging word and reinforcement. Nevertheless, he could not complete even the simplest of the tasks without the continuous assistance and supervision of his teacher. At times, even that did not help, because despite his effort to listen he simply could not concen-

trate His father had died just before the school year started and Vangelis lived with his mother, brother and grandmother.

Spiros:	Age: 7+	Sex: Male
	Class: E	School: 9th

According to his teacher's opinion and my observations Spiros seemed unable to work efficiently in class. For a great deal of time he was unresponsive, naughty and in some cases he showed a cunning personality. Often he offered himself longer breaks, returning to the classroom after the lesson had started. He could not concentrate for very long in a presented task. He wandered around the room, sometimes daydreaming but in other cases he suddenly became interested and ready to volunteer his opinion.

Frequently he prevented the his classmates from working because of his unwanted interventions and even went so far as to fight with his peers or remove apparatus which other children needed.

Absences occurred during all three terms, many of which could not be accounted for. When present he seemed unconcerned, absent-minded, usually causing unnecessary difficulties in the classroom.

Maria:	Age: 7+	Sex: Female
	Class: B	School: 9th

She was too small for her age, but quite agile. When she was satisfied or aimed at something she would be sweet and polite; she would become very aggressive and hostile, though, when she felt threatened or ignored. To get along with her, one had to win her confidence. She did not trust people easily, but on the other hand she was not very trustworthy herself. She tried hard to progress because she felt embarrassed to differ from her peers. She knew how to get the assistance she needed. She

would start by pleading and if that failed to bring the desired effect she would end up grumbling and complaining. She was anxious to finish her work successfully. In case she did not understand an exercise or what was asked of her she would make someone help her one way or another. At worst she would copy the answer from a classmate's exercise book, even if she did not understand what it was all about. She lived with her parents - her father did not have a permanent job and her mother was a housewife - and her sister, who attended the fifth class of the same school, but was also almost illiterate.

Comments on the four children's work with the worksheets.

The worksheets were received positively by all four children. They all worked and somehow profited from using the particular material. The children's responses to certain worksheets (see app.C for a sample) present special interest because they are indicative of the way children regard and explain Mathematical concepts as well as their cognitive growth.

There are some examples of those answers:

1. In worksheet W1 Maria joined correctly the labels in the first two examples and in the third where something seemed to puzzle her she came up to me and said: "Miss, here I joined both (snakes) because they are equally long". Maria's answer implied that she had not acquired the notion of length preservation but was strongly affected by the visual perception of the objects. All she perceived was that the two snakes had the same beginning and end without following up the correct thinking process that could lead her to the logico-mathematical schema.

2. In W2 both Maria and Spiros in the frame allowed for a person taller than themselves drew a definitely male character. In Maria's sheet, in particular the figure was bigger rather than taller. Vangelis on the other hand, made his figure taller by

lengthening the legs out of all proportion to the body of the character.

3. In W3 Maria gives correct answers to all exercises except for the last one where she writes $8 - 2 = 9$. One could easily put this mistake down to Maria's inability to relate the whole to its parts or it may be attributed to a reading issue. I remembered, however, that Maria obtained this answer through the use of apparatus so I tried to figure out whether Maria's mistake was due to another reason. I recalled then that Maria asked me how 6 was written and as I was standing opposite her I wrote down 6 on a piece of paper. Quite absent-mindedly though, I made it a six to me and not to Maria who saw it as a nine from her seat.

4. In W4 none of the children noticed that the dots were distributed in such a way as to form very distinct rectangles. Thus they drew rectangles all standing upright like the example, and almost always more than six.²⁷ The children's drawings implied that they had realized some characteristic features of the particular shape (namely, that the opposite sides are parallel and equal and that the shape contains some symmetrical axes).

Vasso and Maria having joined the given points to form the two sides of the rectangles continue to draw the remaining two sides without the use of the points.²⁸ Vasso, in particular, put some dots where she believed that the distance between the given points was too long and found it difficult to draw the side of the shape. Vangelis was the only one who seemed to notice the intentional distribution of the dots. Therefore, some of his shapes looked as if they were symmetrical to an invisible axis and others as if they were derived from the transposition and the rotation of a given shape.

5. Finally, in W5 it is obvious that all four children succeeded in corresponding not only the place but also the number and sort of the shapes (there was only one omission in Maria's sheet). Vasso's drawing of the given pattern revealed the spe-

cial effort she made due to the great difficulties she encountered.

FOUR ALTERNATIVE APPROACHES FOR PUPILS WHO FACE SPECIAL LEARNING PROBLEMS.

1. Low attainers could be taught by their teacher in their classrooms: The teacher can thus organize her work so that three or four days a week she can "steal" an hour to devote to the children that need help on a certain topic. Naturally, for this teaching session she must take care to introduce the topic she has planned to the whole class, give them the necessary explanations for the task they are to tackle, so that they can work on their own for a comparatively long time. During this time, she can, without distraction, give her attention to those children of the class who face learning difficulties. After she has worked along, searched and explained various concepts to the small group of children, she may prescribe them tasks and return to the rest of the class.

Of course, the proposed scheme of work requires careful organization and planning of the material and it surely entails more work for the teacher who must combine two different tasks. Numerous difficulties are bound to arise due to the already acquired behaviours and existing rules of communication between teachers and children. The teacher must keep her promise to carry on this programme, despite the extra work it involves and the adverse circumstances under which it is carried out.

2. Two teachers may combine forces: This solution requires the collaboration of two teachers, preferably of successive classes (e.g., the first and second, the second and third, etc.), who jointly face their classes' problems. The two teachers must locate, each one for her class, the children who need special help, record the mathematical topics that have not been comprehended and require revision and finally, each individual child's needs. Co-operation between them is needed in order to

discover which teaching unit can be taught to the children of both classes, to the ones for the first time, to the others as a revision. They must allocate certain teaching sessions a week during which several "movements" and "interchanges" will take place. The teacher of one class will take the pupils of both classes who do not face problems to teach them, preferably the same subject, while her colleague will keep her own weak pupils along with the low attainers of the other. Naturally, this solution is impracticable in a class with an exceptionally big number of children, e.g., a class of forty children. It is exhausting for the teacher and perhaps without any tangible profit for the children. Actually, this kind of collaboration could be extended to the whole school.

3. A personal tuition scheme: In this proposal, the problem is confronted uniformly. Two or three times a week the school operates for six instead of the regular five hours. During those two or three additional hours every week, neither all children, nor all teachers will have to stay beyond the normal school day. Of the pupils, only the ones who need help will have to be detained, but they will not feel inferior, because they will share their problem with other children. A number of the teachers will alternatively offer their services to this "small, supporting school."

This solution will certainly create technical problems and is bound to evoke the teachers' reactions if it obliges them to extra teaching hours. Their working hours is a right they fought for and will be determined to maintain. In this case, therefore, the Greek Government will have to contribute the extra cost which will be rather extensive if the measure is imposed to every school of the country. Peripatetic teachers could also be appointed; of course, they will be used for the tuition hours only in more than one schools. Students in training could also be of assistance, since they would be involved with small groups of children in need of special individual attention.

4. **A national or a school-improvised special curriculum:** The Ministry could plan a different programme - concerning both its syllabus and the teaching method - to cater for children who face problems with a method that will be uniformly imposed.

However, the difficulties children face are not the same and do not originate from the same sources. Furthermore, it could be hardly claimed that another generally applied scheme could offer the ideal solution. Nevertheless, it provides an alternative, in case the prescribed book and teaching method are not profitable or even not applicable. Thus, in cases as the ones we were confronted with, where the children's Mathematics books remained intact to the end of the school year, where children were practically left to their own resources, to colour the pictures of their books or scribble meaningless numbers on the pages of their exercise-books, the possibility of another approach might provide an alternative solution. Maybe this other approach could use a book again, only smaller in volume, or even small booklets, simple and pleasant with fewer concepts and much less theory, so designed as to cover the elementary mathematical concepts a child of this age must acquire.

The class teacher could be allowed to decide, plan and apply the syllabus and teaching method of the above described approach, as she sees fit in each individual case, if she wishes to undertake such an endeavour. Finally, a national curriculum framework could be described - only different and much more limited than the regular one - and the class teacher could add material or follow teaching approaches according to her class' needs.

No matter what approach is followed, however, it is definitely necessary that certain measures are taken and some attention is paid to the children with special learning difficulties.

THE AGHIA TRIADA PRIMARY SCHOOL.

The area around the school.



1-2. The streets on the right and left of the school (with the sea at their far end).



The school building.



3-4. Different views of the school building.



Inside the classroom.



5. The entrance to the classroom and the arrangement of the pupils' desks.



6. The teacher's desk and the windows overlooking the playground.

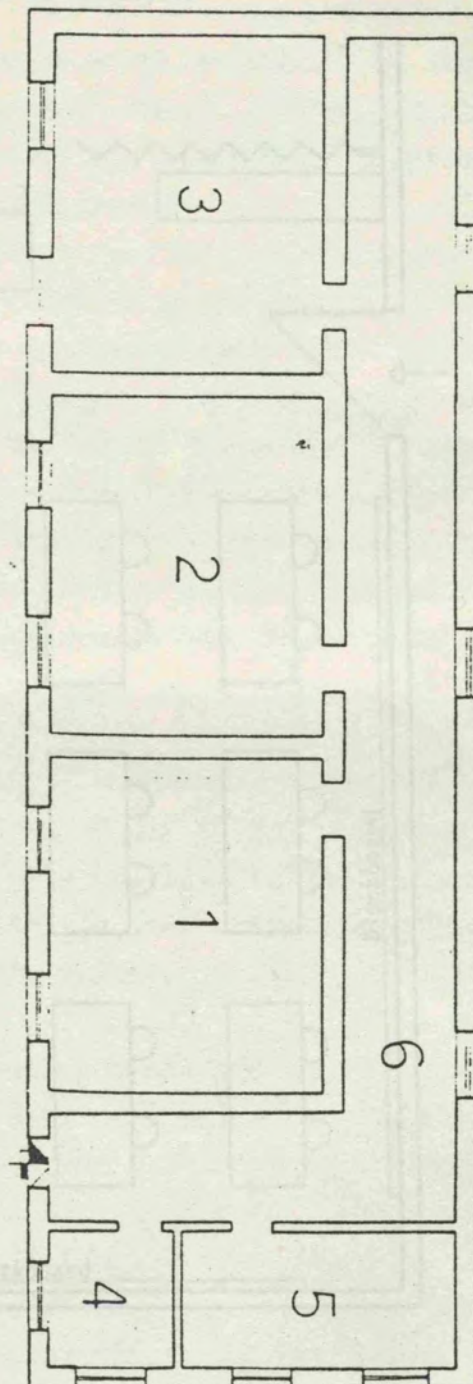


7-8. The pupils working on the SMP cards.



A plan of the classroom

A plan of the school building

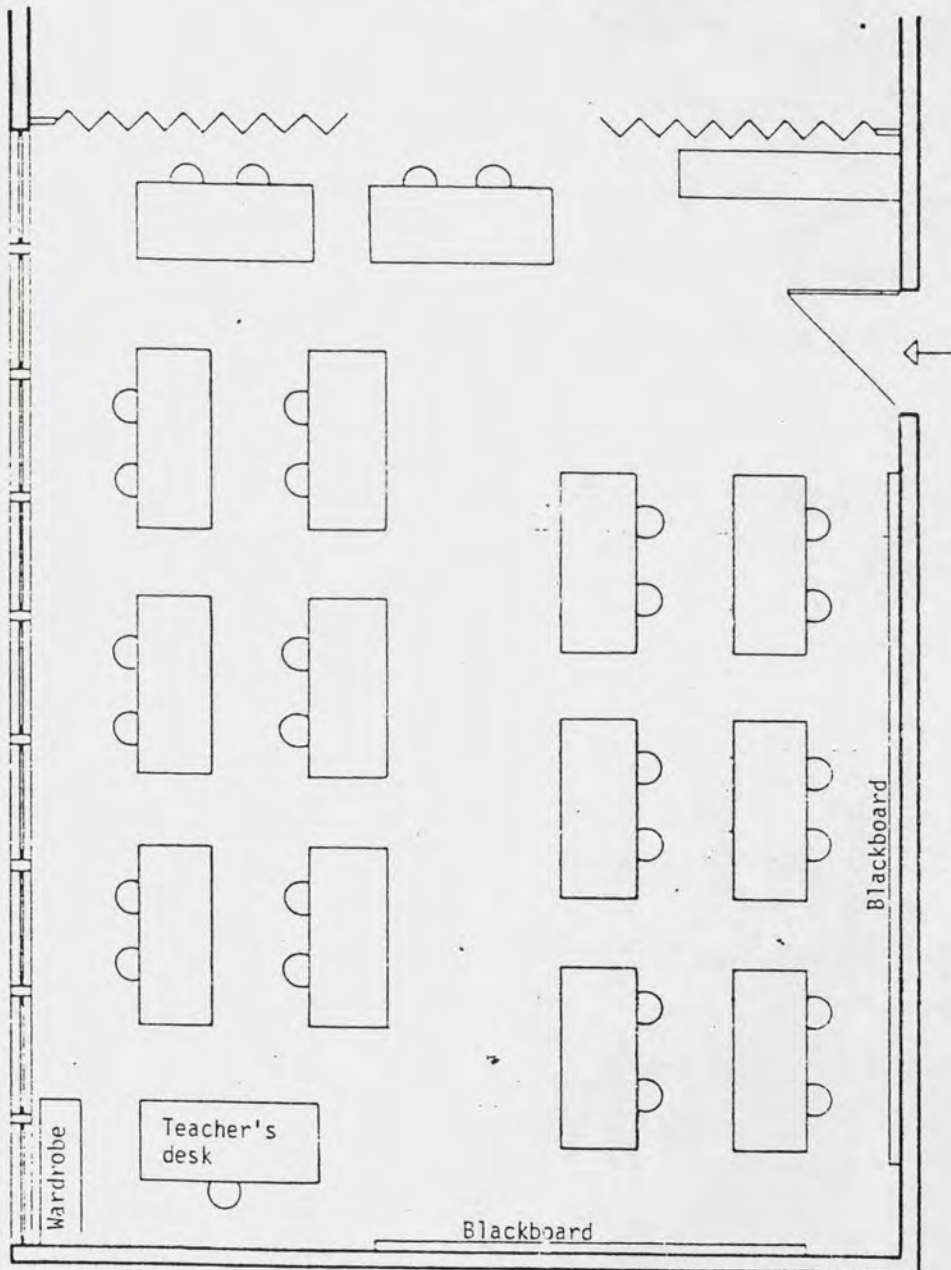


1:50

- 1 , 2 , 3 The three classrooms
 - 1 The classroom of the 1st and 2nd class where the research was conducted
 - 4 Pupils' canteen
 - 5 Staff room
 - 6 Corridor
- No separate head teacher's room

A plan of the classroom.

A plan of the classroom



1. The area around the school.

Aghia Triada is a village of about 800 inhabitants and is situated 26 km away from Thessaloniki. It was founded by Greek refugees from Asia Minor.

The villagers, farmers and fishermen until recently, in their majority, depend on tourism to make their living. In the summertime, the population of the village grows very large due to the great number of holiday makers.

Aghia Triada is nothing like the kind of poor, remote village one can find in the hinterland or insular Greece. The village houses are in the majority new ones, one or two-storey buildings with a tendency to be modern in appearance. Along the beautiful long beach there are many restaurants and gift-shops that are open during the summer holiday season. The village, almost a deserted place in the winter, presents a totally different picture from the summertime as then it is full of tourists and Greek holiday makers.

The village is connected with Thessaloniki with urban transportation, something that makes going to the city easy, and allows people to work in the city and live in the village, or the opposite, as is the case with the teachers of the school who live in the city and work in the village.

In this area there is only a three class public school.²⁹ There is no secondary school, therefore, in order to attend the respective school, high school children are obliged to travel daily to the nearest village.

The primary school is not far from the seaside and is near enough to the road that leads to the city. As the houses in the vicinity of the school are in their majority small or low buildings, and there are no buildings at all in the three sides of the school ground, the establishment does not give the sense

of being crowded. On the contrary, it looks like a beautiful house, built in a spacious site with its trees and playground. All the children, even those of the lower forms, come and go by themselves as the distance from home is short and there is almost no traffic in the streets.

2. The school.

The school building was founded in 1929 and in the beginning it had only two classrooms. Later on, in 1979, as the number of the pupils increased and there was a need for one more class, a classroom was added to the existing ones, so the school became a three class school.

The structure of the building was the same as that of all other schools. It provided three teaching rooms in a row, connected by a corridor which led to a spacious staff-room and the school canteen and eventually turned and opened to the school yard ³⁰

The latter with playground facilities was extended in front of the building. The yard, unlike the typical school yards that are covered with cement, was simply cinder-strewn, so that it did not get muddy in the winter. The apparatus of the playground had all been bought with the profits of the canteen run by the pupils themselves.

The same yard accommodated the Nursery School of the village which consisted of a small room in an independent small building, a sort of an extension of the school but separated from it.

The difference between the school from those of the city was obvious. Serving needs totally different from those of the city schools, the building was small, spread along the road, its yard being large with trees and no cement.

3. The classroom.

It was a roomy, well-lit, pleasant place. One of the walls, fully occupied by windows, opened to the yard. On the wall opposite to it hung a big, supplementary blackboard.³¹ There was no wooden stand below the main blackboard. There were two medal cupboards where apparatus³² was kept. The desks formed a semi-circle, so the centre of the classroom was free. Therefore circulation to and fro was made easy, the teacher could conveniently supervise the pupils' work and finally a friendly and warm atmosphere was created.

The classroom arrangement encouraged the children to form groups thus promoting cooperation among them. The children of the first class occupied one part of the semi-circle while the children of the second class occupied the other part. The two classes were distinctly separated and thus a very peaceful and clearly defined situation existed, where the children of one class did not disturb their peers in the other. Moreover, the children could attend the lesson addressed to them quite undistracted.

The classroom side opposite the blackboard was not a brick wall but a wooden division-door that could open completely and join the two neighbouring classrooms into one. Although that was convenient, and served some functional needs of the school it created a problem of sound insulation, which is a must for the Greek school and its type of teaching.

It is made clear from the description of the classroom that there was no space left for the children to exhibit their work. Even the space above the supplementary blackboard was covered by a colourful wallpaper on which drawings could not be well projected.

On the whole, however, the classroom was quite pleasant and certainly more appropriate for children than most other classrooms in the city schools.

4. The teaching staff.

The teaching staff consisted of three teachers. The teacher who had the most years of service was also the principal of the school. He had taught in that school for two years, but as he was a resident of the village he was naturally acquainted with everyone. Most of the parents regarded him as a friend and very often confided their problems in him. However, his combined duties as a principal and confidant made his teaching work difficult at times.

The second staff member had taught in the school for two consecutive years. He was strict but very good at his work. He often gave the pupils extra work, not prescribed by their books, on both Greek and Mathematics in his effort to observe the children's weaknesses and help them.

Finally, the only female teacher of the school was also the teacher of the class where the research was conducted. She had worked in that school for one year and had attended the in-service training courses (S.E.L.D.E.) for a year. Since she dealt with younger children she faced a lot of difficulties to help the children adjust to the class environment and school regulations at least at the beginning. She had arranged the desks of the class in a semi-circle in her effort to facilitate the children's attendance to the lesson, promote a spirit of collaboration among them and establish friendly relationships between the children and herself. Furthermore, in her attempt to achieve a regular communication with the parents she fixed a day of the week for them to come and discuss their children's problems with her.³³

All three teachers lived in Thessaloniki and travelled to the school daily. Generally speaking, they were pleased with the working conditions³⁴ and since their post in the particular school was permanent, they did not intend to move to another school, even if it were a city school.

5. **The pupils.** There were fifteen pupils in the class, eight girls and seven boys. According to the teacher's assessment of the children's ability, the level of the class was around the average with the exception of one or two children well above it. In addition, there were several children facing difficulties that required their teacher's continuous attention and care. They were very restless children, not yet completely adjusted to the school regulations. They often fought among themselves, especially the boys, in an effort to impose themselves on their peers. A very acute and not very "clean" competition was traceable among the children in every expression of their lives (such as their games, lessons and family status) 35

All the teachers remarked that the children's homework was rarely supervised at home. The parents took great care to meet children's needs and demands, strengthen their self-confidence and ego, but did not assist them with their work and did not display a special interest in their progress at school. For most of the day the children were free to play outdoors, a fact that made them particularly active and independent, but perhaps at the cost of their educational progress. In fact the majority of the children were unprepared to pursue further knowledge or to broaden their horizons.

There were a brother and sister in the class who were rather backward in Mathematics. They did not attend school regularly because of their father's profession and the necessity for the family to travel. These absences along with some home problems possibly badly affected their school competence.

Another pupil with acute speech problems faced serious difficulties in both reading and writing. In this class also, the girls were more systematic, neat and efficient than the boys, however equally noisy and with weak concentration.

Compared with the children of the other two schools who participated in the research the children of Aghia Triada

school were more spoilt and ill-mannered than those of the 9th school and certainly less hard working and less well organized than the pupils of the 41st school.

NOTES

1. All the schools mentioned above work only in the morning. The school buildings are also used by the pupils of a secondary school which works always in the afternoon.
2. That is for the academic year 1983-84, when the pre-pilot study was carried out, the pupils of the third grade were taught Geography, History, Religious Education, Environmental Studies and Grammar from the books written for the children of the fourth grade. It was only for Greek and Mathematics that they used the books written for their own age.
3. By the term isolated we mean those villages on the mountains or in the very small islands which in winter, and because of the very bad weather conditions remain blockaded from the rest of the country for a long time. But even in good weather their transport and communication is inadequate.
4. See C.E.D. (Centre of information and advice on educational disadvantage in rural areas) "Educational Disadvantage in rural area" (1980).
5. In order to get the children acquainted with the mathematical terminology and symbols there were cards where the fraction $\frac{1}{2}$ was written in both numbers and words, so that the children had the chance to experience all three forms (visual, symbolic, verbal) simultaneously.
6. They would, for instance, say after looking at the written fraction $\frac{3}{8}$ or hearing the fraction three eighths how many equal parts of the whole were taken.
7. dms (drachmas) is the Greek equivalent to the English pence.
8. In Greek the words for the hands are compound and if analysed etymologically they mean: hour - minute pointers. The etymology of the words was indicated to the children so that they would remember them more promptly. Moreover, the hour hand was described as a short, fat, lazy fellow who takes an hour to move, whereas the minute hand was depicted as his tall, slim and agile companion.

9. Both ways were introduced (e.g.: a) a quarter past... and fifteen minutes past... b) a quarter to ...and forty minutes to...) so that each child freely decided to use his/her favourite expression; all of them, however, were familiar with both versions.

10. The two schools, the 11th on the one hand and the Experimental school of the Teachers' College on the other, are opposite to each other on the two sides of the same street, a rather narrow street, yet busy with a bus service.

11. The 11th school admits children of the area, whereas the Experimental school's pupils come from different parts of the city.

12. The building, like most school buildings in the city centre, consists of a number of storeys. This is due to the urbanization and consequent immense growth of the city during the past years, a fact that renders the few building site extremely expensive. Furthermore, the children attending school are much more numerous than they used to be, thus one storey school buildings belong to the past.

13. As in all central schools that operate in two cycles daily, here too the same problem exists: the pupils of the school never leave things around the classroom because they might be destroyed by the children of the other school.

14. Twelve teachers were occupied for the six classes because each class was split into two.

15. One of these two teachers was the second class teacher involved in the research.

16. A three-year service is the prerequisite for the teachers who wish to attend the training seminars. Six hundred candidates are selected every year to attend the ten training centres of the country as a result of a draw. Therefore, it is possible for a teacher to apply for two or three times continuously and never be drawn, whereas some one who has just completed the required period of time can be lucky enough to be selected. Being a matter of mere chance the selection does not promote the best qualified teachers or those with many years of service.

17. The teachers objected to the students' presence in their classrooms once a week. They claimed that not only too many students were admitted but their conduct in the class was unacceptable. The classrooms became crowded and the students made a great commotion. The children became restless and excited and did their best to attract the students' attention, so the lesson was ruined. The teacher's potential was consumed in the effort to make both her class and the students behave. Moreover, always according to the teachers, the students, no matter if they attended or taught the class, disrupted the regular school programme and the classes were prevented from completing the syllabus. Thus, at the end of the school year the teachers struggled to cover the syllabus assigned by the Ministry of Education, only to fail at times.

18. In eight of the families at least, one of the parents had a university degree (in four of the eight families both parents were university graduates). Only six children's mothers worked.

19. If the Greek state teacher is to be transferred from one position to another (either from one city to another or from one school to another in the same city) the following standards are being considered: 1. Years of previous service. 2. Years of service in the same post. 3. Family status (whether she is married, no. of children etc.) 4. Co-service (namely, whether the teacher's husband or wife works in the same city). 5. Special reasons (serious illness, support or illness of some member of the family, children studying, etc.) It so happens, therefore, that a first placed teacher always goes to the most distant and difficult to reach areas, and of course not in urban centres. Thus, the staff of the urban schools usually have over fifteen years of service. Moreover, the central school teachers have more or less completed twenty or more years of service. Only in case of substitution a younger teacher can serve in a central school for a short period of time.

20. It so happens that people who have themselves been educated are interested in public matters and keep informed on educational matters, thus developing a critical attitude to the way

a teacher does his job. This criticism, if well-meant, could promote the collaboration between teacher/school and parent/family, so badly needed in schools today. It could be positive for both teachers and children alike but it could very easily fall to a meaningless critical attitude involving opposition and aggressiveness, nothing but harmful to the children.

21. One of these two children, a boy had serious adjustment problems to school life. His behaviour was difficult and his progress poor. The other child, a girl, was generally disorderly and disorganized in her writing and her way of thinking. She had little power of concentration but her conduct was normal.

22. The percentages might not be completely accurate as our only sources of information were the children's replies to our questions. Answers of the kind: works in an office, publisher, civil servant etc. made us - probably erroneously - assume that these parents had no university education.

23. Photographs of the classrooms are available in appendix A, pp xli, xlii.

24. Three years before, he had helped an illiterate girl of the fifth class to learn to read. He realized that the child found the reader boring. In his effort to supply her with the kind of book she would find interesting, he discovered that during the lessons, she secretly went through comics and magazines trying to guess the text by looking at the cartoons. He guessed that the girl would feel incompetent because of her inability to read, so he thought of turning that incompetence into an implement for learning. He did not hesitate to ignore the school's reading scheme in her case, and he let her keep the comics and magazines on top of her desk during the language lesson on the condition that she would not look only at the pictures but she would read the captions underneath as well. By the end of the school year she was able to read. In the case of Mathematics a similar innovatory approach might be considered i.e., the use of SMP cards.

25. There were two more children in the family, a seven-year-old boy and a seven-month baby. Her father was a builder, an

unsteady job, and her mother stayed at home, but was unable to help the children with their homework due to her very inadequate education.

26. The Welfare Institution is a state Institution which aims at tutoring weak or backward pupils with their lessons, while at the same time keeps them interested in various cultural and social subjects. The neighbourhood children can spend their free time there occupied creatively with such topics like literature, poetry, theatre, dancing. The staff of the centre are paid by the government and the inhabitants of the area are free to attend the lessons, seminars, lectures etc., offered. The teachers working at the centre at the time cooperated with the teachers of the schools of the area and knew all the children that were in need of help. They repeatedly tried jointly with the school to persuade those children's parents to take their children to the centre. The parents, however, even if they recognized their children's problems and were inadequate to help them, nevertheless, took no pains to send them to the care centre.

27. She drew the correct shape, rectangular, but she did not follow the pattern suggested by the intentional distribution of the dots which form six rectangles. Thus several dots were left out.

28. Maria drew more rectangles than required. Her shapes were correct but she made them all standing upright exactly like the example paying no attention to the intentional distribution of the dots. As a result some of the dots were left out. She came up to me and said "Miss I did it, but one of the dots is left out". She was concerned about the one, isolated "lonely" dot but she paid no attention to the row of the other three.

29. There are only three teachers who are responsible for the six classes.

30. Because the size of the school is limited no provision has been made for a separate headteacher's room nor for a space where parents can consult teachers in privacy.

31. It could be used in case the main blackboard was full. Also sometimes the teacher used it in order to highlight some-

thing for several days when she deemed it necessary and beneficial for the children.

32. Here the apparatus was nicely displayed and used by the pupils. There were no locks for fear of vandalism since the classroom was not shared with pupils of another school as is usually the case with the city schools.

33. To her disappointment, only few parents showed up on the appointed day. Most of them came whenever they found it convenient and often wanted the teacher to interrupt the lesson to give them information on their children's progress.

34. Contrary to the city schools, already described, this particular school operated only in the morning. It admitted far fewer children and the school environment was calm and peaceful. Differences and problems among the teachers appeared to be almost non-existent.

35. The closed, small community of the village may promote situations of this kind. The oppositions, antagonisms among the parents are usually projected on the children who, perpetuate, even kindle their parents' rivalry.

APPENDIX B

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THE INNOVATION INTRODUCED IN THE TEACHING OF MATHEMATICS IN THE GREEK PRIMARY SCHOOL.

The reactions of teachers, children and parents.

It has already been mentioned that in the past five years the elementary school Mathematics book has changed in an attempt to introduce the modern educational notions to the Greek Mathematics syllabus. Thus, the books which had taught several generations of children Mathematics were suddenly abolished and replaced by completely novel ones. This innovation, still at an experimental stage, has, naturally enough, surprised and caused various reactions from teachers, parents and everyone interested in the educational matters of the country.

It was deemed necessary to record here the confusion and various reactions the attempted educational innovation caused to teachers, parents and pupils. Through this brief personal estimation, we hope to show not only the perspectives of those involved in the educational matters of the country but their needs and concerns as well. Moreover, the insight gained by such a description will enable us to explore the reactions of the same groups of people to SMP.

1. The teachers' reactions.

a. Reactions to the attempted innovation.

The teachers' responses to the Governmental intention to reform the educational system originated from different reasons and could be classified in two categories: the ones who strongly objected to the attempted innovation and those who were open and positive to it. The first category included mostly older teachers who had taught for years with the traditional methods and wished to carry on this tradition with their classes. The main concern of the traditional class teaching method was to prepare children to become good and healthy members of the society. It relied heavily on strictness and hard work. It was natural,

therefore, for those teachers who had been brought up and educated in that spirit and were perhaps about to retire to consider the innovation as a threat.

The new books introduced by the Ministry of Education were quite unfamiliar to them. The concepts presented and the approaches recommended were either ignored by the teachers or caused confusion among them. Moreover, they felt their authority in the classroom to be at stake. A number of them refused to try to understand the philosophy and purposes of the educational change and to adjust their teaching methods to the new suggestions. Indeed a few teachers went so far as to abolish the new books and continue teaching from the old ones which, they claimed, were far better. Needless to say, their behaviour in class remained the same. Their inability to keep informed, to adjust themselves to the demands of our times led them to the rejection of the proposed change without giving it a chance.

The second category of teachers, despite the difficulties they faced or the objections they had concerning the new books and teaching methods, did their best to adjust themselves to the demands of this more progressive educational perspective. The majority of them were fairly progressive; mostly younger than the previous category of teachers, but not necessarily less experienced or established. Having been through the same formal and outmoded education, they also considered the social role of education more important than anything else.

Nevertheless, they accepted that a change in the educational system of the country was in order. They rejected the philosophy of the old system, yet they were not ready for the change when it came. They attempted to adjust their teaching style to the demands of the new system, though not always successfully. Thus, they followed an intermediate route between the two approaches. Quite a few of them attempted new classroom arrangements and encouraged pupil-pupil and pupil-teacher interaction reducing the time of formal instruction and facilitating children to participate and take the initiative more often. Of

course, they had encountered lots of difficulties, expressed several doubts as to the possibility of applying the innovation under the existing circumstances in the elementary school and they are still far from fulfilling the purpose of the educational reformation.

b. Reactions to the new book of Mathematics.

As mentioned before, there were teachers who, at least at the beginning, refused to use the new books. Another category of teachers, however, found that the new books of Mathematics were characterized by poor lay-out, inconsistency of presentation relating to the concepts and lack of continuity. The book made too many requests of the children without offering them the relative help. The same teachers, however, considered the new books much more attractive in appearance, functionally more appropriate to the understanding of the topics.

Now concerning the teacher's manual¹, it seems that not all teachers read it or, at least, read it carefully. Maybe it is still too early for the majority of them to wholly accept the requirements of the new Mathematics². Characteristically enough, most teachers had complained about the lack of a teacher's manual which, they hoped, would facilitate and enrich their work. Once they acquired it, however, several of them started complaining that it was too instructive, it limited their work and did not allow them to take the initiative. Nevertheless, there are certainly a lot of teachers who now consult it regularly. They find it a necessary and essential implement in their effort to make the best use of the new Mathematics manual.

2. The children's reactions.

The children's reactions to the introduction of the new Mathematics manual varied greatly: the younger children, who had little or no experience of the old manuals, accepted the new books quite naturally. To them, it was just another colourful, pleas-

ant book that invited them to take part in play-like activities from time to time. The older children, on the other hand, who had already been through the ordeal of using the old books and wasted time and energy in learning rules by heart and copying problems in their exercise-books, who, finally, had been stuck with an unattractive, colourless, thick book for years were really thrilled by the change. There was such a difference between the old and the new book that the children could hardly take it for a Mathematics book. For the majority of them, Mathematics became their favourite subject. Their eagerness to work on the new book proved quite fruitful, since their progress in Mathematics was remarkable. Several of them would rush to finish the prescribed exercises on a unit well before the teaching session was over. The rest of their time, they quite readily devoted to exercises on the following units. For quite a few of the children the new book offered the excitement of a treasure hunt. No one, of course, could anticipate how long this enthusiasm would last, when the novelty of the new book would wear off. Nevertheless, obliged by the teaching system, teachers restrained the children's zeal and prevented them proceeding beyond the prescribed syllabus. They knew that, unless they restrained those children from progressing at their own pace, they would not be able to cope satisfactorily with those children's ensuing demands.³

3. The parents' reactions.

a. The parents' reception to the innovation brought about in the educational system.

For years up to 1981, no essential reforms had taken place in the Greek educational system. The elementary school books were completely outmoded; not only were they inadequate to meet contemporary children's needs, but they were also too dull and unimaginative in their presentation. Compared with the variety of subjects and colours offered by the TV and books they read for pleasure their text books were most unappealing. The educational system, on the other hand, compelled children to learn

endless pages by heart, to copy long texts and do hard and time-consuming homework daily. The children's free time was very limited and school was like force labour to them. At times, some parents protested because of the hard work their children were compelled to do and also for the unquestioning obedience they owed their teachers. On the whole, however, they were rather satisfied that their children were obedient, continuously busy so that they had very few opportunities to establish unsatisfactory relationships with their peers or develop undesirable interests. They had been through the same syllabus themselves, so being familiar with it, they were able to tutor their children if needed and check their progress.

The reforms suggested by the Government, therefore, brought about a radical change to the existing status quo. To begin with, one of the basic objectives of the innovation was to release children from the intolerable burden of homework. Once free from it, children could either play or occupy themselves with activities that would stimulate them mentally and/or physically.

Moreover, this aspiration denoted the governmental wish to eliminate class differences. With the old system, most of the children's work was done at home. Naturally, children coming from low social strata did not expect any kind of help. Their parents could neither tutor nor offer them the "luxury" of books or audio-visual apparatus. On the other hand, children of middle class origin were offered a variety of stimuli at home, plus their parents' help when necessary. Finally, another basic purpose of the proposed innovation was to encourage individual and group work in class and to urge children to take the initiative and make decisions of their own.

As expected, this radical change of the philosophy of the Greek educational system produced various responses. At the beginning it surprised people, later it was disputed, eventually it was accepted with a lot of reservations by a number of people and with enthusiasm by others. There are still parents who are

sceptical about the efficiency of the suggested innovation. They argue that it is not very wise to move from one extremity to the other without a transitive period. Only then the reliability of the system could be tested. Some changes could take place and both teachers and pupils would be given the chance to become accustomed to the new working conditions and accept a balance between the old and the new approaches. At the same time, educational experts could observe the behaviour, consequences and results of the changes and suggest alterations before the educational innovations were actually introduced. They continue to say that they do not deny the advisability of the measure, i.e., all homework is to be done at school, but they hold their reservations as to whether this can be achieved in the four and a half to five hours of school programme. Furthermore, they believe it is neither too irrational nor too hard for the children to take some homework, even on an optional basis. Finally, they doubt the adequacy of the existing basic conditions, i.e., school buildings, trained staff, in-service provision.

The parents who welcomed the change in the educational system of the country might still be a little sceptical or reserved about certain aspects of the reformation but they were positive about one thing: it was an absolutely necessary move. They might have preferred a transitive period themselves, nevertheless, keeping in mind the reception that such attempts at liberalization had been given by the conservative and opportunist political tendencies in Greece, they readily supported the innovation. Past experience taught them that a transitive period might condemn the attempt to a perpetual experimental stage. It was preferable, therefore, to apply the plan immediately, imperfect or faulty as it were, to dooming it to elimination.

Finally, a third category of parents should perhaps be mentioned here. Their response lies somewhere in the middle between the first and the second categories. It is not that they did not have their objections or complaints, but they eventually accepted the change, not because they believed in it, but because

it served their purposes. The new system eliminated the burden of homework from both their children and themselves. Moreover, taking no part in their children's progress, they were always able to blame their child's teacher for his possible bad achievement, lack of interest and/or any undesirable behaviour. Indeed certain parents went so far as to denounce a teacher for having dared to give their child homework. Such actions resulted in discouraging those teachers who really cared and did their best to help their pupils improve their achievement level to beat a retreat and confine their class and themselves to the strict limitations posed by the book and the syllabus.⁴

b. The parents' reactions to the new book of Mathematics.

The new Mathematics book was so different compared with the old one that parents were greatly surprised. Colourful, with nice drawings and pictures, all pleasant and familiar, it hardly approached their notion of a Mathematics book. The latter had traditionally been a dull, thick, colourless book, loaded with numbers and shapes, making all concepts seem difficult and repulsive, even if they were not. We could, therefore, claim that the first reaction towards the books was surely positive: parents were glad that their children could at last use modern books. A second, closer look, however, at the content of the book this time made them realize that it was beyond their knowledge and potential. New symbols, new concepts, different approaches made them feel ignorant and unable to help their children or even follow their progress.⁵ Moreover, the book included no theory or rules, therefore, they were not given the opportunity to get acquainted with the new concepts and procedures suggested by the book. Thus, some parents, projecting their own anxieties, claimed that the book confused rather than helped the child; the fact that the child lacked the support of a detailed theoretical background hindered the systematic arrangement of his knowledge. Furthermore, they continued, the various approaches suggested strained children with a lot of unnecessary analysis and did not facilitate their choice of a

"typified" process for all problems belonging to the same category. Finally, the material of the book was not very well organized: the topics were not always completed but were often interrupted so that concepts and exercises concerning another irrelevant topic were inserted. Thus, the child was confused, lost the continuity of the concept, was not given the chance to consolidate a topic before proceeding to the next one.

There was another category of parents, who despite pointing out some weaknesses or omissions of the new book, nevertheless, they did not doubt the radical change it brought about to the educational matters of the country. They were able to discern and rather favour the modern spirit of the book which embodied the contemporary learning concepts. They did their best, therefore, to approach and understand the new book in order to keep up with their children's education. To them, it was a language they felt obliged to learn if they were to communicate with their children efficiently.

In conclusion, it should be mentioned here that parents as a whole were sceptical about the effectiveness of the new system. They feared that this turn from formal to progressive⁶ teaching might result in a decline of standards. Parents seemed to believe that children had better not get used to the idea that learning was fun but must at times feel obliged to undertake a task no matter how unpleasant or difficult they found it, because there are certain basic skills which demand real effort to be acquired. Their experience taught them that society is really competitive and often demands its members to undertake quite harsh and unpleasant tasks so children had better get used to hard work before leaving school. The difference between the reactions of the two categories of parents was that the former obstinately attached to the formal education in which they were brought up were ready to reject the innovation without a second thought, while the latter gave it credit and supported it, even if they were sceptical about the results of its application.

2. Fundamental mathematical concepts.

Sets, subsets, partitioning into subsets.

Grouping	of objects according to their qualitative characteristics.
"	of objects according to their quantitative characteristics
Partitioning	into subsets
Graphical	representation of partitioning
The symbols	greater than, less than and equal to.

3. Shape.

Solid Shapes.

Solid Shapes	that we take by appropriately dividing a solid shape
Measuring	the volume of a solid shape (a tentative approach)
Matching	natural objects and geometrical solid shapes, i.e., a house to a rectangular.
Defining	general characteristics of solid shapes (it rolls, it stands, it rolls and stands)
"	particular characteristics (number of faces, vertices, ...)

Plane Shapes

Plane shapes	as faces of solid shapes
"	that we get by appropriately cutting a plane shape

Dimensions

Decomposition / composition of a shape to / from smaller shapes
Defining particular properties
Making shapes on a geoboard

4. Graphic Representations.

Phase A: Graphic representation using the objects themselves
Phase B: Pictorial (using pictures of the objects)
Phase C: Symbolic (using symbols)

Numerical comparisons (differences based on the graphic representations).

5. Length - Width - Area - Capacity - Time - Money.

Length

Measuring the length of different objects using the same arbitrary unit.
Measuring the length of the same object using different arbitrary units
Introduction to the standard units (m, cm)
Measuring the length of non-straight lines in centimetres
" the perimeter of plane shapes.

Area Measuring area using squares (cm^2)

Capacity

How many glasses of water fill the jug?
How many glasses of water does the jug fill?

Time

Ordering chronological facts (...o'clock)
Relating chronological facts of everyday life to the corresponding time (...half past)

The clock (analogue only) o'clock ... half past
The concepts: now (present), before (past), after (future).

Money

Coins recognition
The value in drachmas of a set of coins
Sets of coins of the same value in drachmas
Matching sets of coins to their value in
drachmas.

6. Numbers 0-10 - Operations using sets - Mathematical operations.

Whole number ordering whole numbers
Ordinal number
Union of sets
Addition of two numbers the sum of which is ≤ 10 (using number line)
Mapping
Subtraction (using number lines and tables)
Simple arithmetical equations
The complement of a set - subtraction as the reverse operation of addition
Multiplication as repetitive addition of the same elements.
Computative property of multiplication
Numerical formulation of a problem given by pictorial representation.

7. Numbers 10-20 - Operations using sets - Mathematical operations.

A set of tens and units - cardinal number - ordering cardinal numbers.
Correspondance of numerical cards to symbols.
The sum of two numbers as a result of the union of two sets.
The sum of two numbers (using number line, equivalent sets and commutative property).

Subtraction of two numbers (using number line and partitioning of the set).

The numerical calculation of complement and difference.

Associative property of addition.

Numerical formulation of problems given by pictorial representation.

Exploring products (using a number line).

Exploring the factors of sums, differences and products when the sums, differences and products are given.

Formulation and solving of problems.

8. Numbers 10-100 - Whole and ordinal numbers - Place value in the first 100.

Classification of sets in tens.

Equivalence between tens and units ($3T=30$).

Ordering sets of tens (using a number line)

Adding, Subtracting, Multiplying tens.

Problems using tens.

Partitioning sets in subsets of tens and units.

Correspondance of numerical words to numerical symbols.

Counting up to 30 in twos, threes and fives.

Exploring the one of the two factors in sums, differences, products (solving simple equations).

Decomposition of a number in tens and units.

Counting up to 40 in fours and fives.

Adding in two stages: a. decomposition of a number; b. associative property, e.g. $10+32=10+(30+2)=(10+30)+2=40+2=42$.

Comparison and ordering of numbers - Place value.

Writing a number as a product of two factors ($70=7 \times 10$ - 7 sets of tens...).

Writing a number of units (more than 40) as a sum of tens and units.

9. Fractions

Partitioning shapes into two and four equal parts.

Fraction's recognition and matching with the correspondent part of a shape.

Fraction's comparison, ordering and formulation from their parts.

Partitioning sets of objects into equivalent subsets and matching them to the appropriate symbol.

Recognition of fractions given by pictograms.

VOLUME 2

1. Addition - Subtraction.

Instances in which addition is used.

Commutative property of addition.

Addition of two-digit and one-digit numbers (without a remainder)

Addition of numbers according to some properties (of numbers and operations)

Addition of two-digit numbers (without a remainder).

Union of sets the cardinal number of which is a two-digit number.

Addition in vertical setting of numbers.

Subtracting a two-digit number from a two-digit number (with a remainder).

Number sentences.

Formulation and solving of a problem.

2. Multiplication.

Formulation of equivalent sets - using sums and products to express the repetition of the same set ($a+a+a+a$, $4a$).

Commutative property.

A number expressed as the product of two factors.

Venn diagrams and matrices.

Multiplication tables.

Distributive property ($a * (\beta + \gamma) = a * \beta + a * \gamma$)

Problem solving

3. Division

Sharing the elements of a set into equal parts.

Multiplication and sharing.

Sharing involving repetitive subtraction of the same number.

Partitioning sets

Problems involving distribution and using counting.

4. Shape

Recognition of shapes, measuring the sides and the perimeter

Using the geoboard to make plane shapes.

5. Graphs

The results of a research in graphs.

Advantages and disadvantages of the pupils' Mathematics book.

The book-exercise book syllabus in use involves a number of advantages as well as disadvantages

The **advantages** of the book are:

1. The book is more "flexible" than its predecessor in that it succeeds not only to be read but mainly to be used by the children. Some rules and general statements are included but its emphasis is upon activities, problems and exercises.

A more informal approach is used the pleasant appearance of which appeals to the children who respond positively to the mathematical content.

2. There is a considerable time economy since the children do not waste any time in copying texts or exercises. Therefore, wider mathematical syllabus can be attempted.

3. Pupils are given the chance to revise already solved problems and relevant theory thus finding answers to their questions. Consolidation occurs and self-confidence is achieved.

4. Children learn a definite work procedure. Reasoning and logical thinking are encouraged.

The **disadvantages** of the book may be considered to be:

1. Generalizations and the formulation of patterns are difficult for the children to perceive and to understand from the lay-out of the text. The various concepts often remain unconnected. Relations and correlations are not adequately revealed and conclusions are not always readily drawn. It could be claimed that this change has led from one extreme to another. Previously, theory was unrelated to practice, but now although they correlate with each other, theory is rather neglected.

2. The formulation of the problems, the lay-out of the solution and the presentation of the results are all offered by the book. All the children have to do, therefore, is to complete brief number facts. Thus, they get accustomed to easy work and find logical thinking difficult.

3. The charm of the unknown in introducing a new concept is lost. The eager, enthusiastic pupil is anxious to continue to the next unit after he has finished the daily homework. Therefore, considering the Greek teaching system the next day's lesson is deprived of its novelty or interest.

4. The pupil is given a uniform, predetermined kind of work that does not allow for any creativity or inventiveness on his part. Children are not encouraged to invent original procedures and individual differences are ignored.

The disadvantages and advantages mentioned above are bound to be met in all books of Mathematics throughout the Greek primary school.

THE TEACHER'S MANUAL

As it has already been mentioned, a teacher's manual is provided in each class of the primary school for the teaching of Mathematics. In this manual, the teacher could find suggestions on the teaching of the various mathematical concepts and on the procedure to be followed during the lesson. A very brief description of some suggestions in the second class teacher's manual concerning the planning and organization of the lesson and mathematical activities is made below.

Lesson Planning.

1. Introduction (Teacher's Manual, p. 12)

Study carefully the theoretical comments on the concept you are about to teach. If you wish to enrich your knowledge on the subject, consult relevant projects.

Set the goal you are aiming at and design your teaching activities accordingly. The Teacher's Manual can help you here. You can choose among the various proposed activities (if you have enough time) or invent your own course of action which best caters for the particular situation.

Create an educational climate which favours the pupils' participation in learning.

Never teach theoretically. Let your pupils "play" with the objects. teach them how to use them and help them draw their own conclusions. discover the concept sought and express their thoughts.

Never forget the motto: "the less the teacher talks the more efficient his teaching is".

When you are certain that the introduced concept has been fully comprehended ask your pupils to work on the manual.

Show your pupils how to use their books properly. The careful observation of the picture and the analysis of its elements will help them in reproducing it in their minds and comprehending its relation to the problem. Thus the pupils will not work mechanically but know each time what they do and why they do it.

By checking their work, sort out the pupils who have not assimilated the concept taught and offer them additional help.

Keep always in mind that the children's answers to the exercises of the book are not the safest evaluation of their competence. You must evaluate their abilities considering their behaviour and attitude in class when a concept is taught as well as their participation in the various activities, the way of expressing themselves, etc.

Finally, take into consideration the fact that practice is very important to the consolidation of concepts as well as to the general progress of the pupil in Mathematics.

Therefore, do not neglect to give your pupils adequate practice daily in calculating result of addition, subtraction, multiplication, and division.

Pupils should gradually become able in finding the result of a fact easily, quickly and in a logical way.

2. Organization of the activities (pp. 9, 10 of the Teacher's Manual).

The activities on each concept taught should follow this pattern:

Class work

Group work

Pair work

Individual work

The innovation of Mathematics teaching attempted through the new curriculum as well as through the books which aim at realizing its purposes should be viewed through the general perspective of modern attitudes towards education.

These attitudes are in general the following:

Free and spontaneous activities undertaken by the pupil.

Employment of various (especially solid) material appropriate for the consolidation of a concept.

Individual and group work.

Oral and written communication.

Respect of everybody's opinion.

In this theoretical framework we should place the attempt at innovating the syllabus and methodology of Mathematics. Modern Mathematics should be inspired by a basic principle. Mathematics learning should follow an active procedure. This means that in order to be successful mathematical education must be based on the personal, active participation of the pupil in searching and discovering the various mathematical concepts.

To encourage such conditions we must provide the child with the opportunities to handle the various objects (solid material, mostly) in order to discover the relationships among them. Nevertheless, let us keep in mind that the logico-mathematical concepts are constructed not by objects themselves but the individual's actions with them. It seems equally important to stress the fact that by favouring the opportunities which encourage the child to form a logico-mathematical thought, we actually favour the birth of inductive thinking.

From the above it may be concluded that the teacher must create the necessary conditions so that pupils, with the proper support, learn how to research and formulate the mathematical concepts themselves. Nevertheless, it must not be considered that the mathematical skills and processes are to be neglected. Children must learn how to add, subtract, multiply and divide methodically, logically and accurately. They should, moreover,

become competent in applying these skills in problems and situations of everyday life. Once they have grasped the various mathematical concepts, they are sure to retain them and also acquire the mathematical skills necessary in order to apply them.⁷

NOTES

1. In the teacher's manual it could be discerned that the new spirit of change in Mathematics teaching existed. Under this spirit Mathematics consisted of everyday activities through which children "perform" Mathematics rather than simply complete the colourful exercises in their books on a rote learning basis. The manual aims to offering an outlet to children's needs for action and movement as well as creating restless and investigating minds. Moreover, the teacher's manual purposes to familiarize teachers with the modern concepts of Mathematics teaching, and supply them with a framework to move in and also the practical and theoretical background in order to face successfully the new mathematical challenge". (Teacher's Manual, 2nd class, p. 7).

2. On Mathematics teaching as it is proposed in the Teacher's Manual, see below, pp. xix-xxii.

3. As mentioned on p. 59, the government changed the Mathematics books in an effort to introduce a new teaching approach in the teaching of Mathematics. No one, however, could claim that the teaching method of the subject changed. The benefits deriving from the use of apparatus or from group work were never actually explored. The teacher, simply introduced the new topic, analysed or explained the new concepts and then the children were asked to complete the exercises in their books. It was, therefore, imperative that all the children proceeded at the same pace, otherwise they should have to be given individual attention. Thus, once more, the children realized they should not take the initiative and they should restrain their enthusiasm. Fortunately, it could be safely claimed that children still find the new books attractive and like working on them. Mathematics has ceased to cause them fear or repulsion. Nevertheless, their original positive reaction to the books has not been fully exploited. The teaching system has not changed, no actual innovation has been attempted, the modern concepts on Mathematics teaching have not had much appeal in the Greek class.

4. It should be mentioned here, though, that those same reactions protected and supported the system against these teachers who either out of a barren conservatism or objection or perhaps even inability to adopt the new system insisted on using the new manuals following, however, the old teaching methods.

5. See Ernest Choat, "Children Acquisition of Mathematics," p. 42. "The changing primary school and the new approach to the teaching of Mathematics have confused many parents to the extent that they are reluctant to attend the school for fear that they may appear ignorant of what the children are doing..."

6. That is, individualized or group teaching and the freedom given to the child to express his opinion and to progress at his own pace.

7. It should be stressed here that in Greece it is now that the Educational innovation takes its first steps. It should perhaps more appropriately be called a tendency towards a more progressive educational system than anything else.

APPENDIX C

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Letter

To the Headmaster
of the School

Dear Sir,

You are well aware that during the school year 1985-86 I conducted a research at your school after permission of the Ministry of Education (Ser. No. 583 / 9-1-84) and following a preposition of the Director of the Secondary School Board.

During the research concerning the teaching of Mathematics from an English teaching programme, namely SMP 7-13 (School Mathematics Programme), it became obvious that:

A. The two hours per week that I took up from the children's regular programme teaching them Mathematics from the SMP cards did not disturb, at least not seriously, their school schedule.

B. The fact that two different teaching programmes of Mathematics and methods of work coexisted in the same class did not seem to cause serious problems to either the teacher or the pupils.

C. It is not difficult to carry on one's plans in a spirit of sincere and friendly cooperation.

I would like, however, to stress here that the successful conduct of the research owes a lot to the pleasant cooperation I enjoyed from Mrs. , the teacher of the second class, who not only did not raise any obstacles or difficulties to my project but on the contrary was absolutely understanding and sympathetic to the application of a new teaching programme.

Furthermore, the fact that during this year of coexistence of the two different teaching methods there appeared no serious problems and also that the children's reaction to the programme was ideal shows that in the Greek school both teachers and pupils are open to new ideas and any kind of research.

I would like to thank you heartily for willingly accepting my applying the research in your school and for the warm environment of cooperation you offered to me.

Yours sincerely,

Letter

To the teacher

Dear Madame,

I would like to thank you for your cooperation during the school year 1985-86, when I conducted my research for the teaching of Mathematics from the English programme SMP 7-13 in the second class.

I found myself in a friendly environment and the fact that I worked with a colleague open to new ideas, and collaboration, full of understanding and sympathy made my work a lot easier.

I would like to believe that my two-hour intrusion in the school curriculum and my presence in your class did not disturb your work very much.

Thank you once more and I remain,

yours faithfully,

Teacher's Questionnaire

During the school year 1985-86 a research programme was applied in your school concerning the teaching of Mathematics from an English teaching method, namely SMP 7-13 (School Mathematics Project).

Your answers to the following questions would be a great help to the results of this research:

1. Is there something that you object to concerning the teaching method or the way the various mathematical concepts are given through the cards?
2. Do you think that the children enjoyed being taught with the particular programme and if YES, which, in your opinion, are the reasons?
3. Do you think the children were benefited from the use of the cards and in which way?
 - a. Academically
 - b. Socially
 - c. Personally
4. Do you think the SMP cards teaching system helped the children appreciate and understand Mathematics better?
5. How do you compare the SMP to the existing teaching method of Mathematics?
6. What is your opinion concerning the use of apparatus? Do you think that it helps or is it just a waste of time? Do you think the children enjoy working with apparatus? Would you introduce the use of apparatus in your Mathematics lessons?
7. Could, in your opinion, such a teaching programme be applied to your school and if YES, after what changes?
8. Suppose the Ministry of Education decided to introduce the programme to the State schools. Do you think the teachers would be willing to adopt it? In case they would be willing to adopt it would the teachers need some kind of in-service training?

Parent's Questionnaire

May 1986

Name:

School:

In the school year 1985-86 a research programme was conducted in your child's class. During this research a new programme in the teaching of Mathematics was tested. It is an English programme called SMP 7-13 (School Mathematics Project).

Would you be kind enough to answer the questions below:

1. Did you supervise your child while he/she was working with the cards? How do you think he/she felt?

- A. Did he/she like working with the cards?
- B. Did he/she sometimes like working with them?
- C. He/she didn't like working with the cards at all?
- D. Please give your opinion about the cards as teaching material, as well as about the teaching method.

2. A. Why do you think he/she enjoyed working with the cards so MUCH?

BECAUSE...

B. Why do you think he/she liked working with the cards so LITTLE?

BECAUSE...

C. Why do you think he/she did not like working with the cards AT ALL?

BECAUSE...

NOTE: Please answer ONE of the three questions.

3. How do you think your child faced the fact that he/she did two extra hours of Mathematics? (His/her regular programme from the state book and twice a week from the SMP cards)

A. He/she found that he/she had too much of Mathematics.

B. He/she preferred to be taught Mathematics only from the SMP cards.

C. He/she preferred to be taught with one of the methods only.

D. He/she liked to be taught Mathematics with both systems simultaneously.

NOTE: Encircle the suitable answer.

4. Did your child ask you to help him/her with his/her work with the cards?

A. YES.

B. NO

A1. In case you helped him/her did you find any difficulties? What were your difficulties?

B1. If your answer is NO why do you think he/she did not need your help?

NOTE: Would you please fill in this questionnaire and send it back with your child or bring it yourself if you intend to attend the parents' meeting on....

If you have any questions or difficulties in filling in the questionnaire I would be glad to look them through during our meeting.

Thank you very much.

Children's Questionnaire

SMP 7-13

May 1986

Name:

School:

During the past year you were taught Mathematics from the SMP cards twice a week.

Please answer these questions:

1. Did you enjoy doing Mathematics from the SMP cards?
2. Name the cards you liked best.
3. Name the cards you liked least.
4. Which of the subjects were the most difficult for you?
5. Why did you find these subjects difficult?
6. Which of the subjects were the easiest to understand?
7. Would you like to spend more time doing Mathematics from the SMP cards?
If YES, what else would you like the cards to include?
If your answer is NO, what are your reasons?
8. What exactly did you like about the SMP cards?
What did you dislike about them?

Children's Family Background

May 1986

Name:

School:

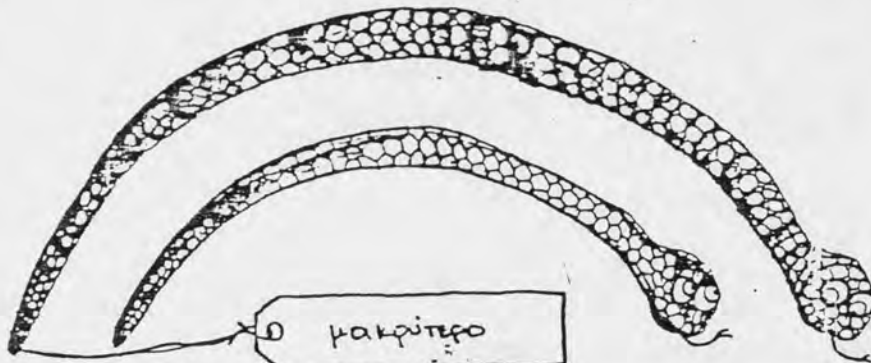
1. I live with...
2. We are ... people in our house.
3. My father is a ...
4. My mother is a ...
5. My brother'(s') / sister'(s') age(s) is/are:
6. When I grow up I want to become a....

W1 (Μαρία 9-4-86)

Βάλε της τωμπελλίτσα στο μακρύτερο



XO μακρύτερο
(+holonect)



XO μακρύτερο

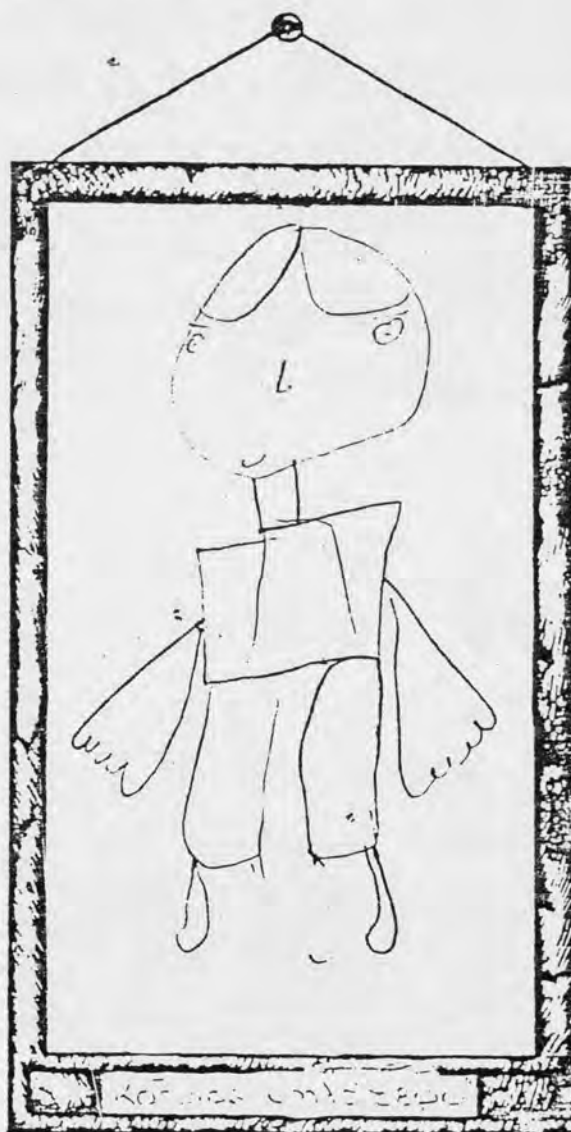
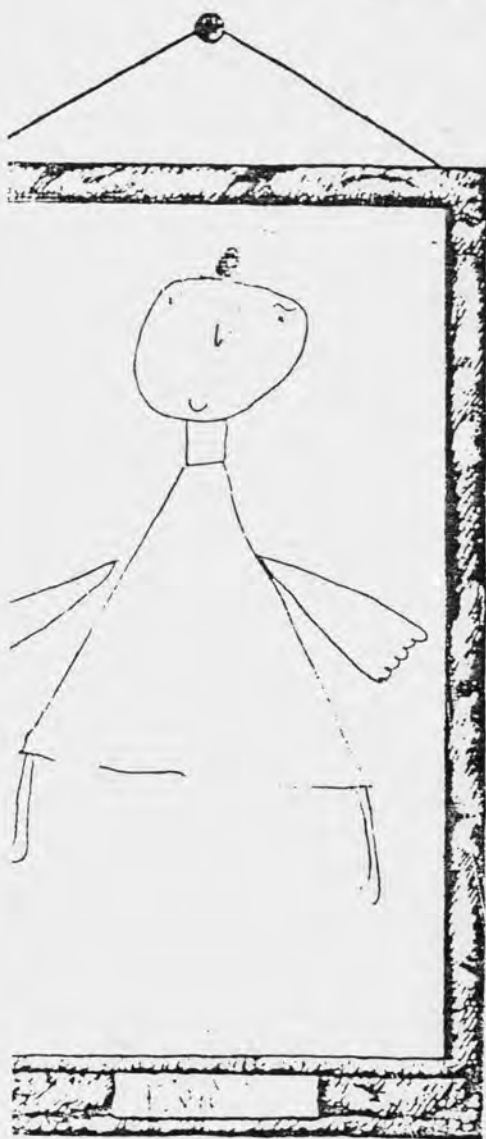


XO μακρύτερο

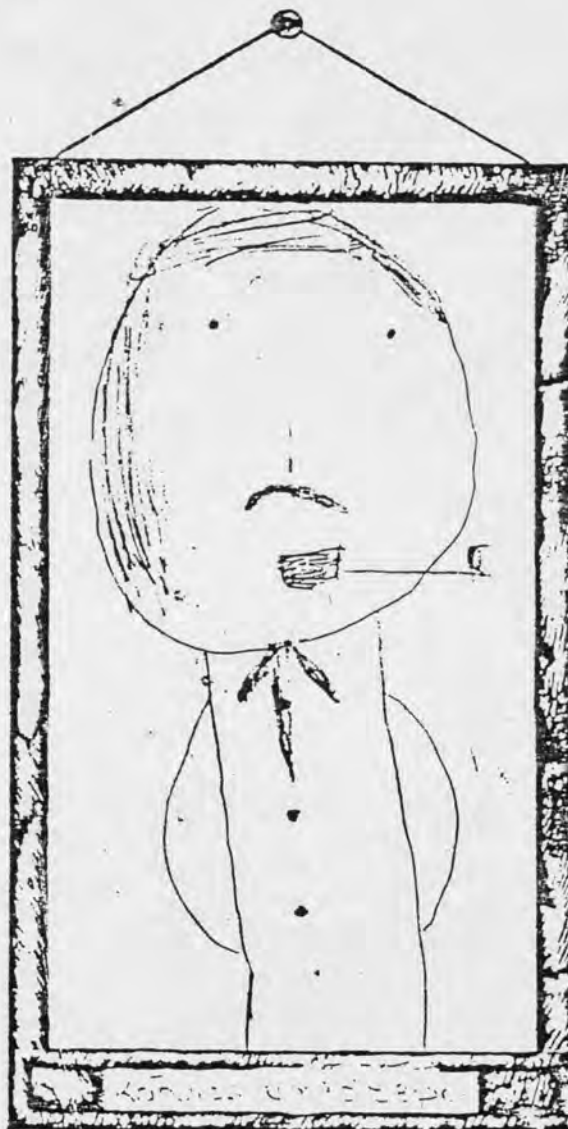
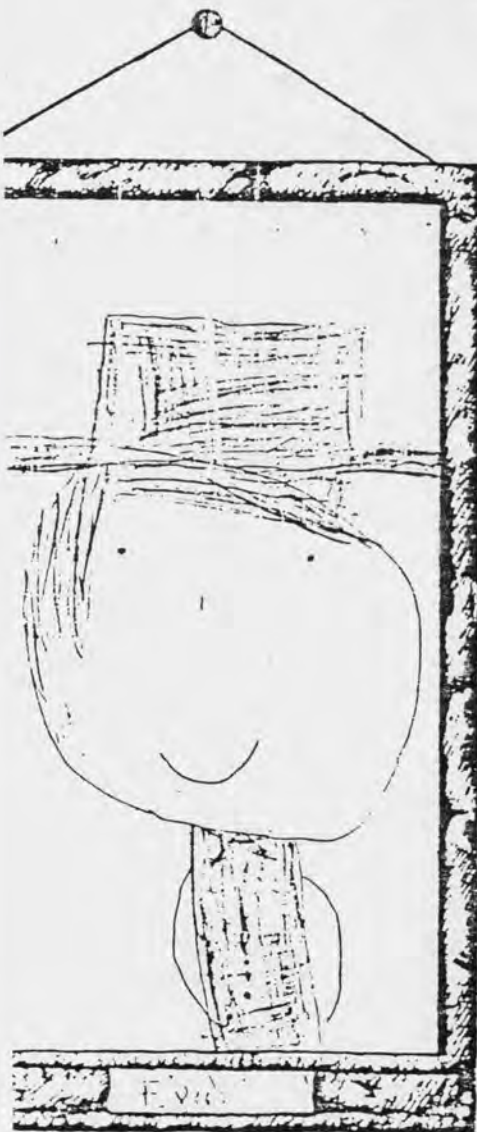




W₂ (Horia 14-4-86)

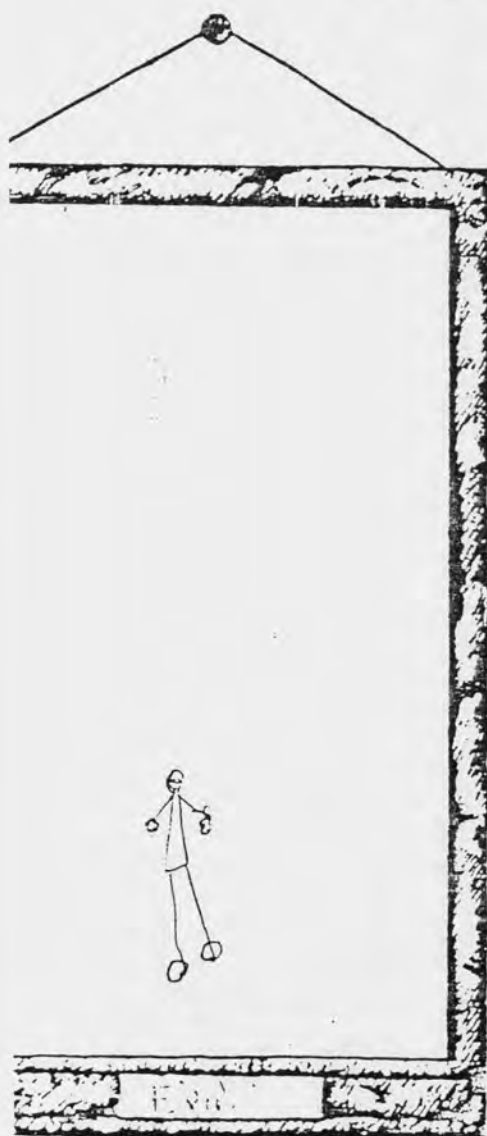


W₂ (Spivos 9-4-86)

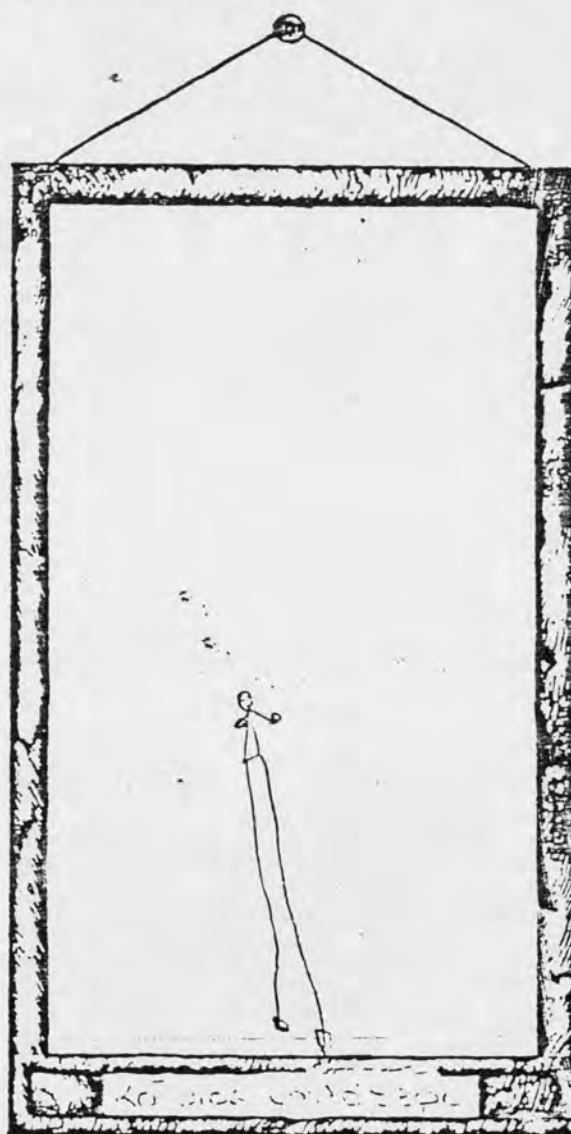




W₂ (Vogel is 9-4-86)



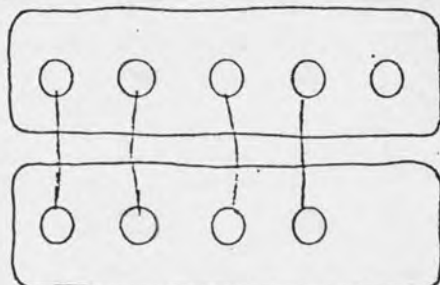
Me



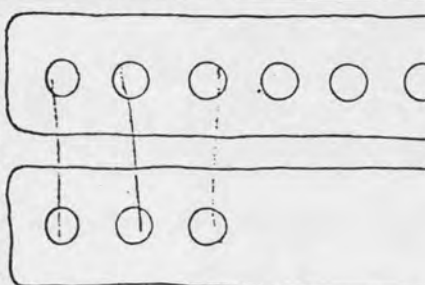
My father

Ανελίζονται για
να δουν το όμοιο.

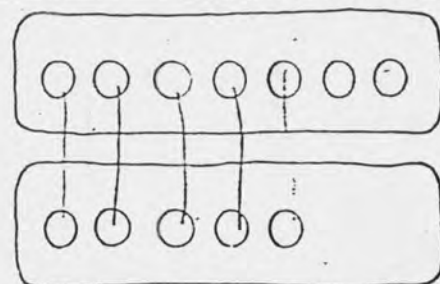
W₃ (Maria 7-4-86)



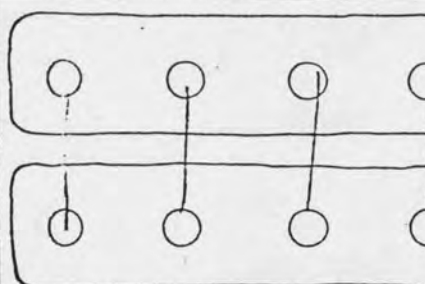
$$5 - 4 = \boxed{1}$$



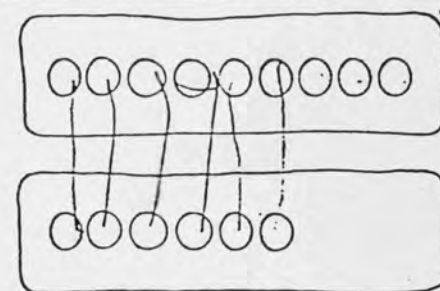
$$6 - 3 = \boxed{3}$$



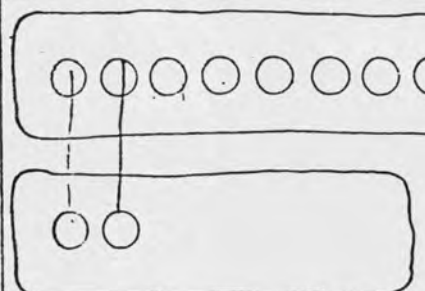
$$7 - 5 = \boxed{2}$$



$$4 - 4 = \boxed{0}$$



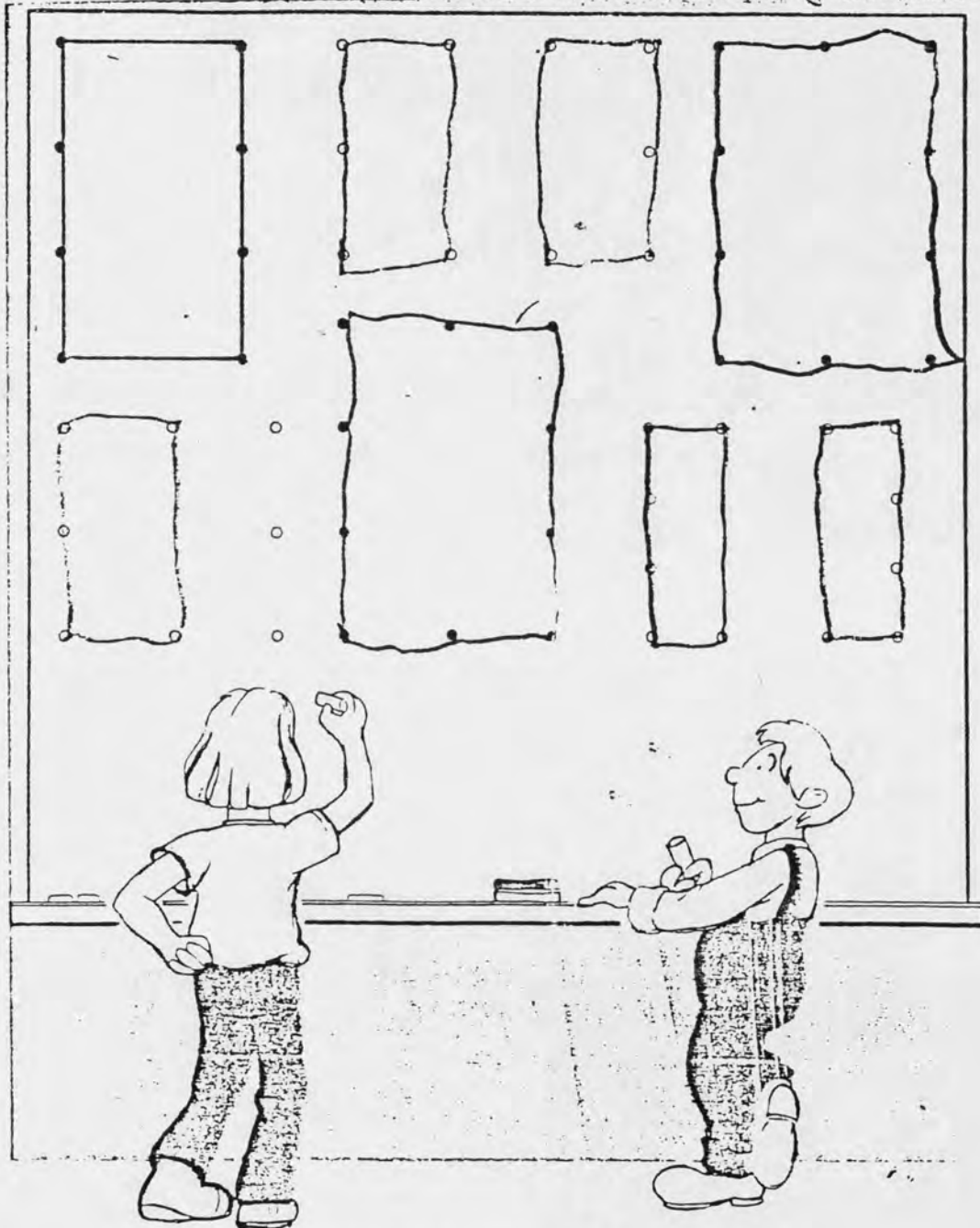
$$9 - 6 = \boxed{3}$$



$$8 - 2 = \boxed{6} \times$$

W₄ (Vogels 16-4-86)

Ορθογώνιο
Κόψε 6 ορθογώνια

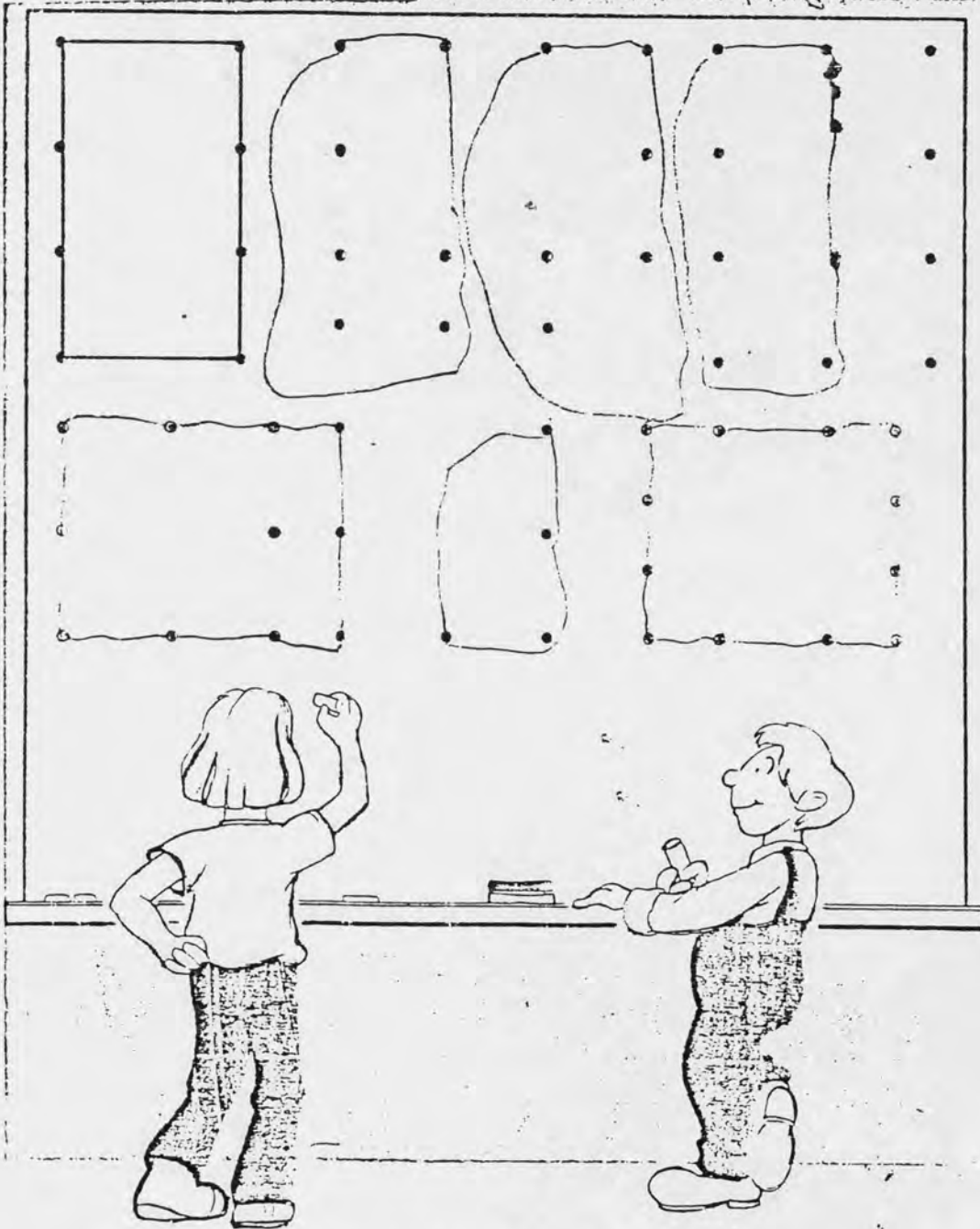


Join the dots to form 6 separate rectangles.

W₄ (Voss: 16-4-86)

Ορθογώνιο

Και 6 ορθογώνια

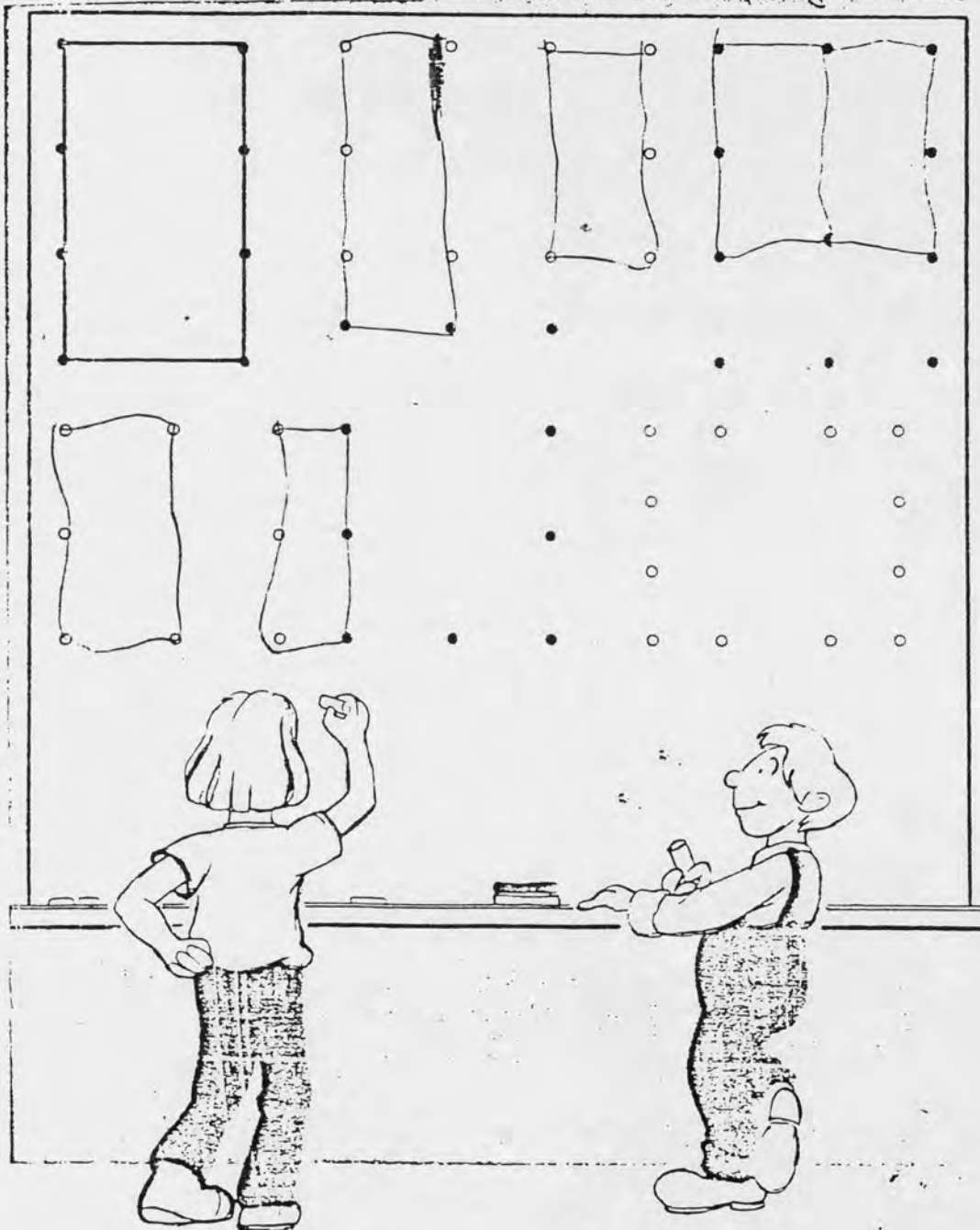


Join the dots to form 6 separate rectangles.

w4 (Spinos 16-4-86)

Ορθογώνιο

Κόψε 6 ορθογώνια



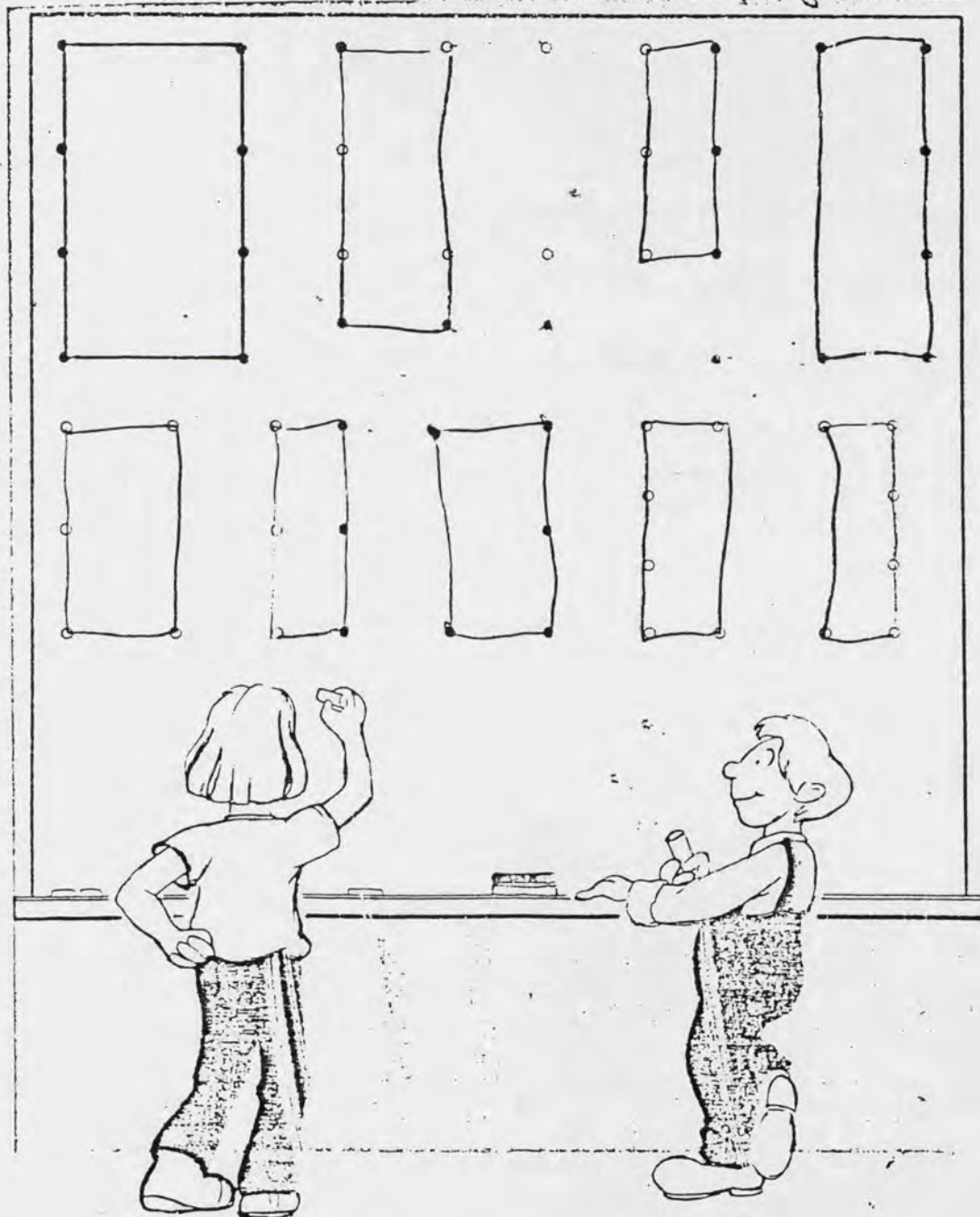
Join the dots to form 6 separate rectangles

λαρία
στην αυλή

W4 (Mario 16-4-36)

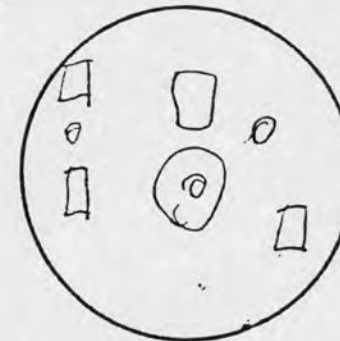
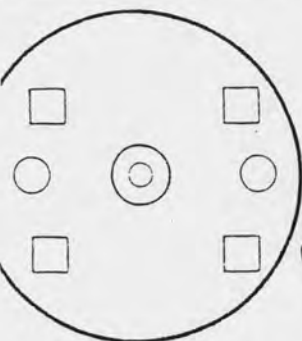
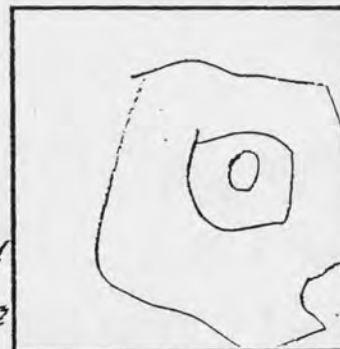
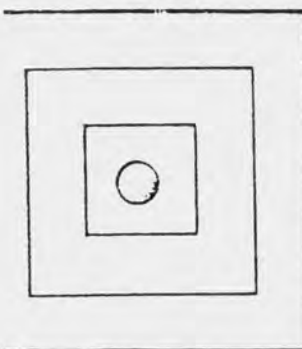
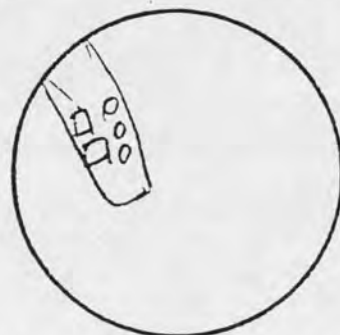
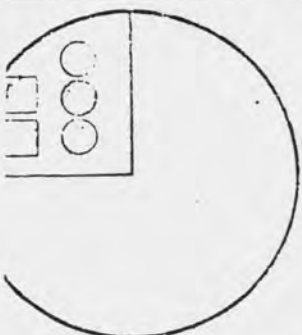
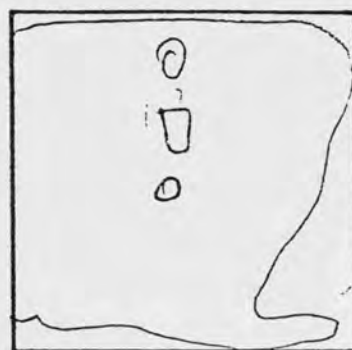
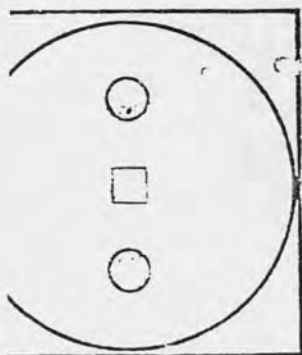
Ορθογώνιο

Κόψε 6 ορθογώνια



Join the dots to form 6 separate rectangles

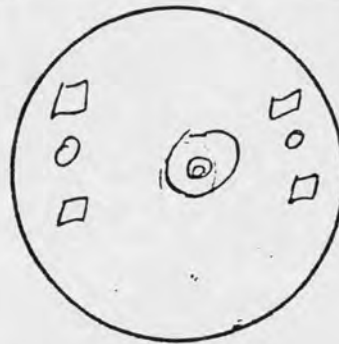
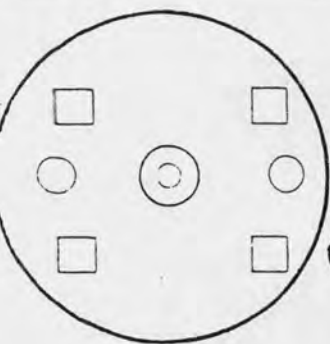
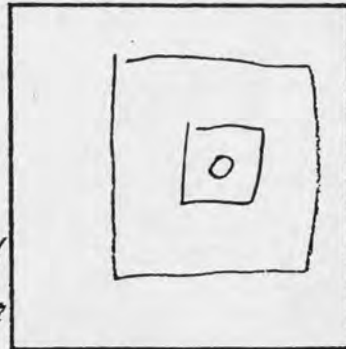
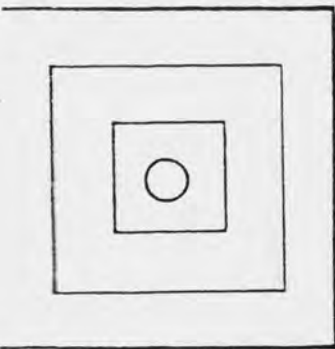
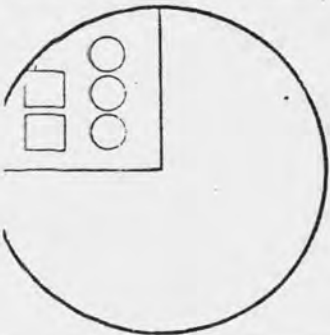
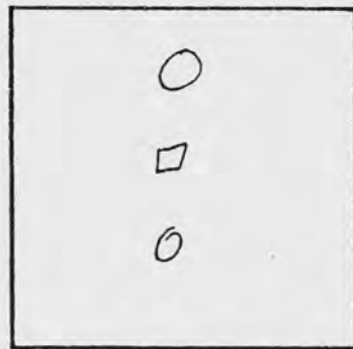
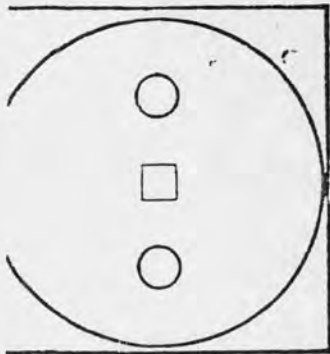
W₅ (Vosses 16-4-88)



Reproduce the given pattern

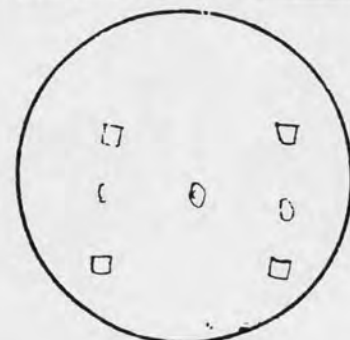
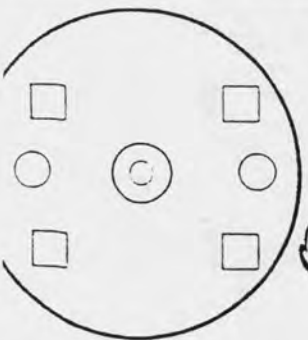
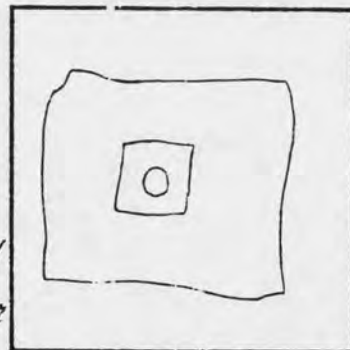
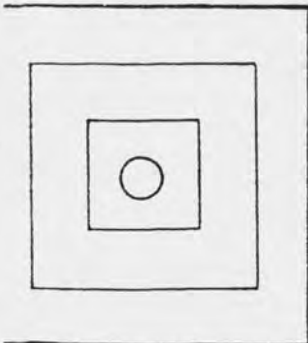
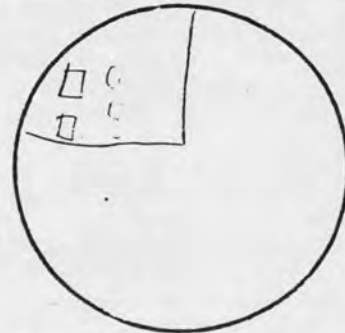
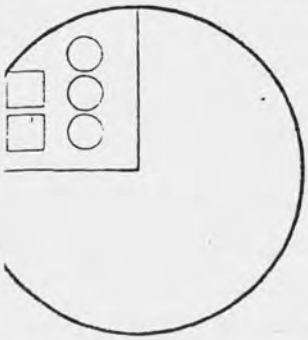
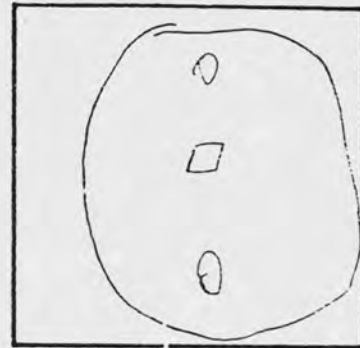
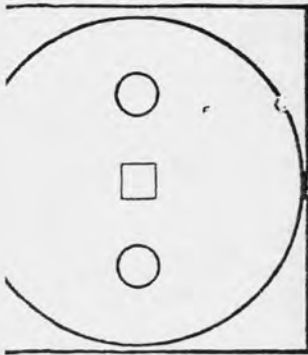
W3 Maria (16-4-86)

Μαρία
Στηλένδ



Reproduce the given pattern.

W3 (Spiros 16-4-86)



Reproduce the given pattern.

**Test Samples: Pilot Study
(11th School)**

Name _____

Date _____

Class _____

1. Fill in the missing numbers.

1. $8 + 9 = \square$

3. $25 + \square = 29$

5. $\square + 13 = 13$

2. $14 + 0 = \square$

4. $\square + 6 = 31$

6. $12 + \square = 20$

2. For each of the numbers below write the units and the tens in the right column.

1.

25

2.

Δ	M

17

3.

Δ	M

8

4.

Δ	M

10

5.

Δ	M

31

3. Fill in the missing numbers :

1. $17 - 8 = \square$

3. $14 - \square = 11$

5. $\square - 5 = 10$

2. $11 - 4 = \square$

4. $19 - \square = 14$

6. $\square - 7 = 0$

4. My father is 40 years old and my brother is 30 years younger than him. How old is my brother ?

5. Draw arrows to show which name belongs to which shape.



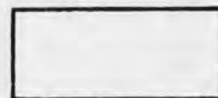
triangle



rectangle

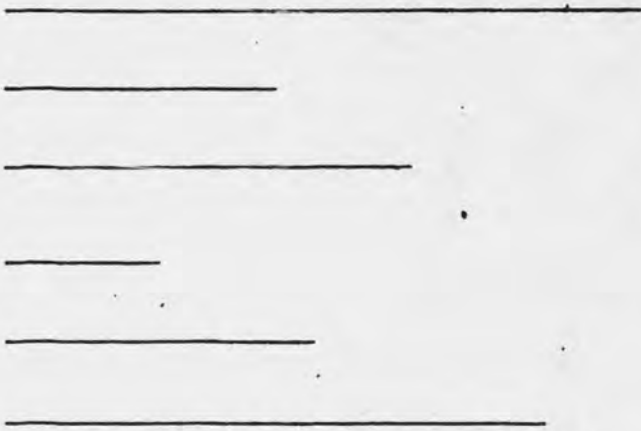


circle



square

6. Put the shortest line in a circle.

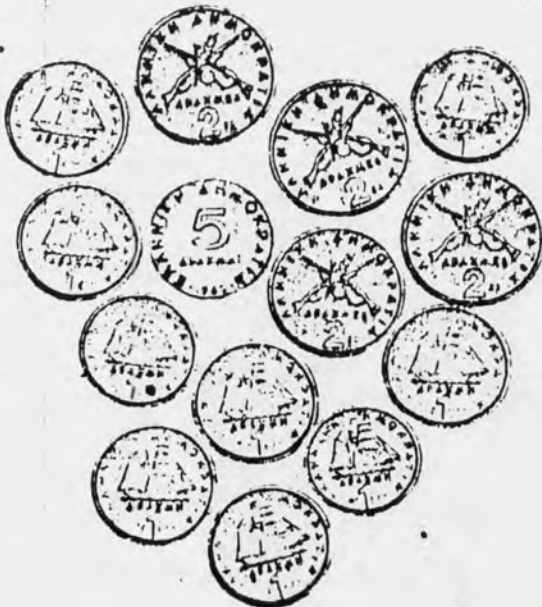


7. Use the right symbol for the pairs of numbers below.

(=, <, >)

1. (2, 5) 2. (7, 7) 3. (8, 5)

8.

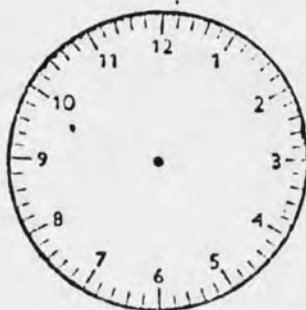


Use as few coins as possible
to make 9 pence.

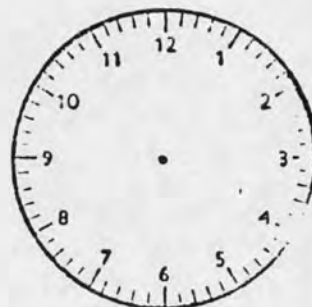
9. Make these clocks show :



1. 2 o'clock



2. Half past 12



3. 5 o'clock

10. Write the time that each of the clocks below shows :



1. _____



2. _____



3. _____

Name _____

Date _____ Class _____

Would you like to put the hands on the clocks below ?



8 o'clock



Half past 9



Half past 4

This clock shows 12 o'clock.

One hour earlier it was

This clock shows quarter

past 12.

One hour later it will be



This clock shows

o'clock.



Find two different ways to take 8 pence in coins.

α.

β.

$\square + 9 = 12,$ $4 + \square = 15,$ $5 + 8 = \square$

$10 - \square = 3,$ $\square - 12 = 4,$ $17 - 3 = \square$

Use the right symbol for each of the pairs of numbers.

(< , > , =).

(15,11), (2,7), (5,5), (0,0), (4,20)

Answer : _____

Draw arrows to join the equal sets.

$8 + 4$	$10 + 3$
$9 + 7$	$10 + 6$
$7 + 6$	$10 + 7$
$8 + 9$	$10 + 2$

Start at 1 and count in twos up to 15.

1, _____, 15

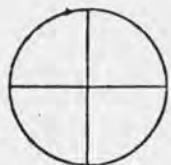
Start at 0 and count in fours up to 16.

0, _____, 16

Could you put the numbers in the right order starting from the smallest ?

48 69 52 70 32 68 94

Put in a circle the fraction which each shape shows.

			
$\frac{1}{4}$ $\frac{1}{2}$ $\frac{2}{2}$	$\frac{2}{2}$ $\frac{2}{2}$ $\frac{3}{4}$	$\frac{1}{2}$ $\frac{2}{4}$ $\frac{1}{4}$	$\frac{2}{2}$ $\frac{2}{4}$ $\frac{3}{4}$

			
$\frac{1}{2}$ $\frac{2}{2}$ $\frac{2}{4}$	$\frac{3}{4}$ $\frac{1}{2}$ $\frac{2}{2}$	$\frac{2}{4}$ $\frac{1}{4}$ $\frac{1}{2}$	$\frac{3}{4}$ $\frac{2}{2}$ $\frac{4}{4}$

			
$\frac{1}{4}$ $\frac{1}{2}$ $\frac{2}{2}$	$\frac{2}{4}$ $\frac{2}{2}$ $\frac{1}{2}$	$\frac{1}{2}$ $\frac{2}{4}$ $\frac{4}{4}$	$\frac{3}{4}$ $\frac{2}{4}$ $\frac{1}{2}$

Complete :

$$44 + 15 =$$

$$25 + 13 =$$

$$35 + 12 =$$

Complete :

Δ.	M.
3	7
+ 4	2

Δ.	M.
4	3
+ 5	4

Δ.	M.
8	1
+ 1	3

Complete :

Δ.	M.
5	9
+ 6	

Δ.	M.
6	8
+ 2	5

Δ.	M.
5	7
+ 2	8

Write the answers :

$$87 - 34 = \quad , \quad 49 - 15 = \quad , \quad 58 - 37 =$$

Write the answers :

75
- 32

57
- 43

48
- 26

Test Samples: Main Study
(All Schools)

1. Join the equal numbers.

2. Write for how many pence you can change

four 2 p coins $\longrightarrow$

two 5 p coins $\longrightarrow$

one 10 p coin $\longrightarrow$

3. The pupils of a class have their P.E. session. The boys are arranged in 2 sets of fives and the girls in 5 sets of twos. How many are the boys and how many the girls ?

Answer : The boys are :

The girls are :

4. Catherine has 7 sweets. She ate 4 of them during the break. In the afternoon her mother gave her four more sweets. How many sweets has Catherine got now ?

Answer :

5. Write the Tens and Units for each of the numbers below :

		T	U
17	$\longrightarrow$		
19	$\longrightarrow$		
10	$\longrightarrow$		
8	$\longrightarrow$		

6. Fill in the missing sign.

19 $\square$ 20

13 $\square$ 14

18 $\square$ 17

15 $\square$ 15

7. Complete

$10 + 6 = \square$

$16 - 6 = \square$

$6 \cdot 2 = \square$

$16 - 9 = \square$

$7 + 5 = \square$

$14 - 6 = \square$

$2 \cdot 6 = \square$

$17 - 0 = \square$

$8 + 3 = \square$

$11 - 3 = \square$

$1 \cdot 12 = \square$

$9 + 7 = \square$

A

Assessment

Name _____

Unit 1

Date _____ School _____

Section 1

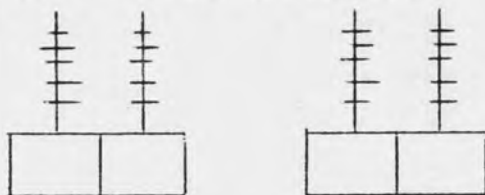
1.  $\xrightarrow{\text{Add}}$ 

$12 + 7 = \square$ $13 + 9 = \square$

$5 + \square = 13$ $7 + 21 = \square$

$3 + 7 + 6 = \square$ $12 + \square = 19$

2. Use the abacus to show the numbers : 54, 20.



3. Fill in the missing sign ($<$, $>$, $=$) :

$10 \square 13$, $5 \square 5$, $7 \square 12$

4. Write :

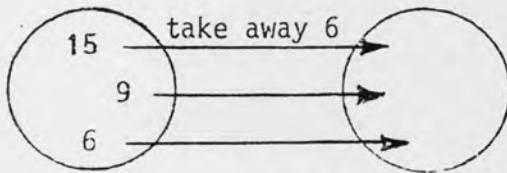
3 Tens and 9 Units make $\square$ units

6 Tens and 0 Units make $\square$ units.

5. Find the difference between the numbers :

$12, 7 \xrightarrow{\text{difference}} \square$ $9, 15 \xrightarrow{\text{difference}} \square$

6.



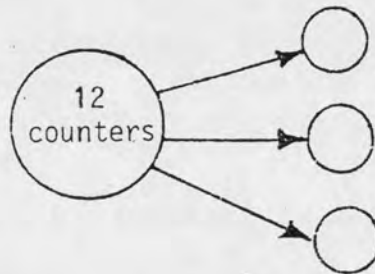
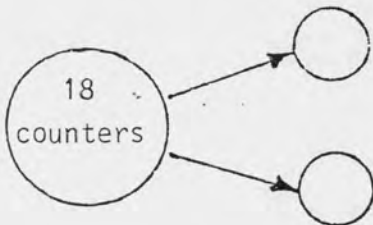
$$18 - \square = 11$$

$$\square - 7 = 8$$

7. Start at 1 and count in threes up to 19 :

1, 4,, 19

8. Share the counters into 2 equal sets.



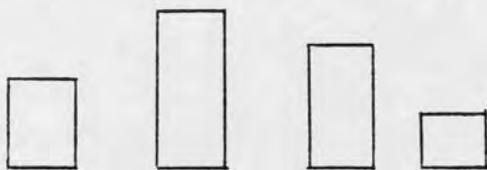
9. Write :

I can change four 2 p. coins for $\square$ p.

10. Use as less coins as possible to get $\square$ p.

11. Use coins to make 2 sets worth 15 p.

12. Colour the longest strip blue and the shortest red.

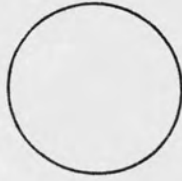


13. Write : If today is Thursday then yesterday was _____.
_____ is two days before Saturday.

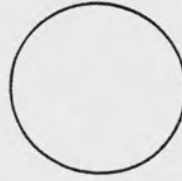
14. Make these clocks show :



7 o'clock

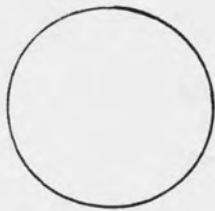


6 o'clock

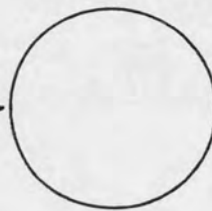


12 o'clock

- 15.



1 hour later



B

Assessment

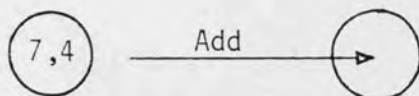
Name _____

Unit 1

Date _____ School _____

Section 1

1.



2. $15 + 3 = \square$

$8 + 14 = \square$

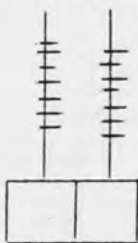
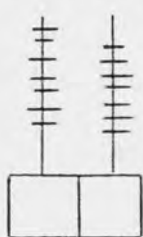
$\square + 8 = 17$

$\square + 2 = 7$

$2 + 6 + 5 = \square$

$7 + \square = 18$

Write the number that each abacus shows.



3. Fill in the missing sign : ($<$, $>$, $=$)

$5 \square 9$, $12 \square 7$, $8 \square 8$

4. Write :

5 Tens and 2 Units make $\square$ Units.

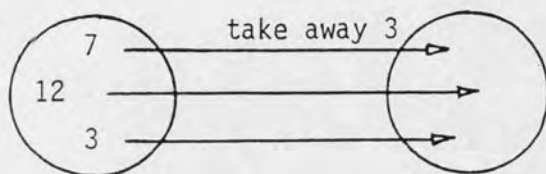
2 Tens and 0 Units make $\square$ Units.

5. Find the difference between the numbers.

$10, 3 \xrightarrow{\text{difference}} \square$

$7, 17 \xrightarrow{\text{difference}} \square$

6.



$13 - \square = 6$

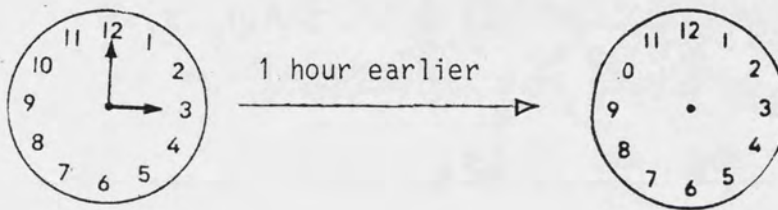
$15 - \square = 9$

7. Write : If today is Tuesday then yesterday was _____ .
_____ is two days after Monday.

8. Write the time that these clocks show.



- 9.



C

Assessment

Name _____

Unit 1

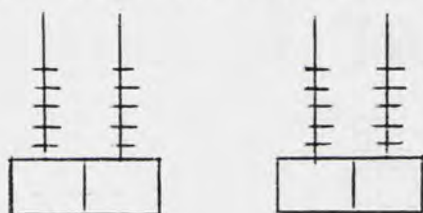
Date _____ School _____

Section 1

1. $\textcircled{7, 4} \xrightarrow{\text{Add}} \textcircled{\quad}$

2. $15 + 3 = \square$ $8 + 14 = \square$
 $\square + 8 = 17$ $\square + 2 = 7$
 $2 + 6 + 5 = \square$ $9 + \square = 18$

3. Write the number that each abacus shows.



4. Fill in the missing sign : ($<$, $>$, $=$)

$5 \square 9$, $12 \square 7$, $8 \square 8$

5. Write :

5 Tens and 2 Units make $\square$ Units.

2 Tens and 0 Units make $\square$ Units.

6. Write :

If today is Tuesday, yesterday was _____ .

_____ is two days after Monday.

7. Write the time that the clocks show.



D

Assessment

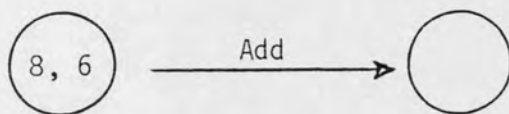
Name _____

Unit 1

Date _____ School _____

Section 1

1.



$$12 + 7 = \square$$

$$13 + 9 = \square$$

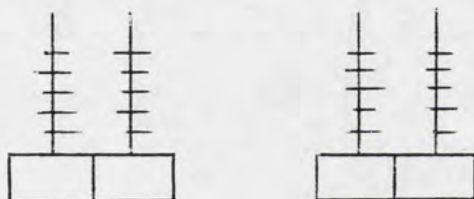
$$5 + \square = 13$$

$$7 + 21 = \square$$

$$3 + 7 + 6 = \square$$

$$12 + \square = 19$$

2. Use the abacus to show the numbers : 54, 20.



3. Fill in the missing sign : ($<$, $>$, $=$).

$$10 \square 13, \quad 5 \square 5, \quad 7 \square 12$$

4. Write :

3 Tens and 9 Units make $\square$ Units.

6 Tens and 0 Units make $\square$ Units.

E

Assessment

Name _____

Unit 1

Date _____ School _____

Section 1

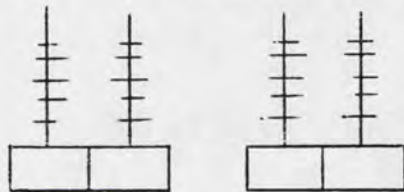
1.  $\xrightarrow{\text{Add}}$ 

$12 + 7 = \square$ $13 + 9 = \square$

$5 + \square = 13$ $7 + 21 = \square$

$3 + 7 + 6 = \square$ $12 + \square = 19$

2. Use the abacus to show the numbers : 54, 20.



3. Fill in the missing sign : (<, >, =).

$10 \square 13$, $5 \square 5$, $7 \square 12$

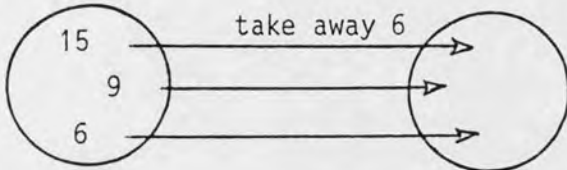
4. Write :

3 Tens and 9 Units make $\square$ Units.

6 Tens and 0 Units make $\square$ Units.

5. Find the difference between the numbers :

$12, 7 \xrightarrow{\text{difference}} \square$ $9, 15 \xrightarrow{\text{difference}} \square$

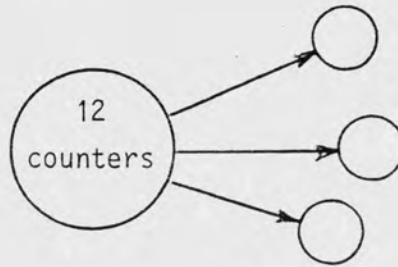
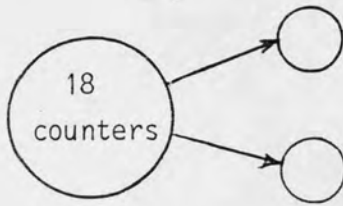
6.  $18 - \square = 11$

$\square - 7 = 8$

7. Start at 1 and count in threes up to 19 :

1, 4,, 19

8. Share the counters into 2 equal sets.

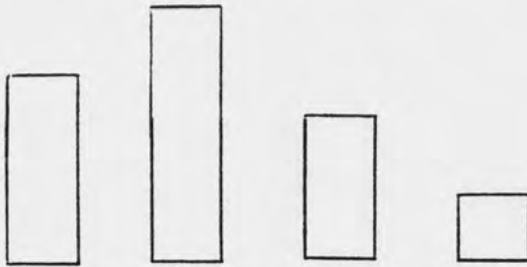


9. Write : I can change four 2 p coins for p.

10. Use as less coins as possible to get 9 p.

11. Use coins to make 2 sets worth 15 p.

12. Colour the longest strip blue and the shortest red.



Assessment

Name _____

Unit 1

Date _____ School _____

Section 1

1.  $\xrightarrow{\text{Add}}$ 

$$12 + 7 = \square$$

$$13 + 9 = \square$$

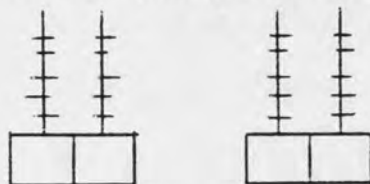
$$5 + \square = 13$$

$$7 + 21 = \square$$

$$3 + 7 + 6 = \square$$

$$12 + \square = 19$$

2. Use the abacus to show the numbers : 54, 20.



3. Fill in the missing sign : ($<$, $>$, $=$)

$$10 \square 13, \quad 5 \square 5, \quad 7 \square 12$$

4. Write :

3 Tens and 9 Units make $\square$ Units.

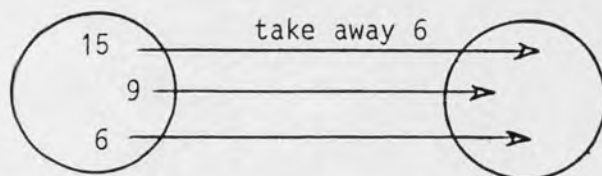
6 Tens and 0 Units make $\square$ Units.

5. Find the difference between the numbers :

$$12, 7 \xrightarrow{\text{difference}} \square$$

$$9, 15 \xrightarrow{\text{difference}} \square$$

6.



$$18 - \square = 11$$

$$\square - 7 = 8$$



Assessment
Unit 1
Section 1

Name _____

Date _____ Class _____

1. $4 + 3 = \square$, $8 + \square = 13$, $\square + 11 = 18$

2. Write the days in the right order :

Sunday, Tuesday, Saturday, Monday, Friday, Thursday, Wednesday.

Answer : _____

3. Complete :

Today is _____

Tomorrow it will be _____

Yesterday was _____

We do not come to school _____ and _____

4. Start at 5 and count in fives up to 40 :

5, 10, — , — , — , — , — , 40.

5. $15 \xrightarrow{\text{take away } 6} \square$ 9

21 $\xrightarrow{\quad\quad\quad} \square$

6 $\xrightarrow{\quad\quad\quad} \square$

19 $\xrightarrow{\quad\quad\quad} \square$

6. Write the fraction of represented by each shaded part.



_____ is shaded



_____ is shaded

7. Complete

$$\begin{array}{r} 12 \\ + 34 \\ \hline \end{array}$$

8. Complete

$$\begin{array}{r} 27 \\ + 70 \\ \hline \end{array}$$

9. Add

3, 12 $\rightarrow$ (15)

9, 4 $\rightarrow$ ()

8, 5 $\rightarrow$ ()

10. Fold a paper circle in fourths.

Paste it here.

Fold a paper circle in half.

Paste it here.

11. $\frac{1}{2} + \frac{1}{2} =$

12. $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{4} =$

13. (a) Start at 0 and count in twos up to 14.

0, 2, _____

(b) Start at 1 and count in threes up to 16.

1, 4, _____

(c) Fill in the missing numbers :

0, 4, 8, 12, 16, 20, 24, 28, , , , 44, , , 54.

14. Write your answer in the circle.

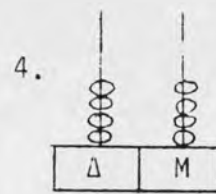
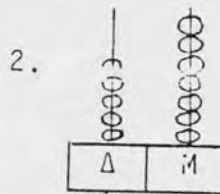
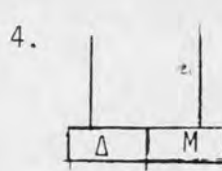
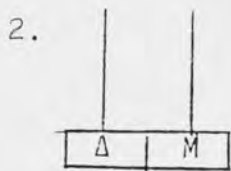
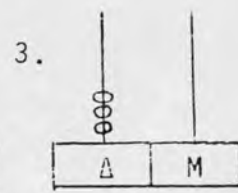
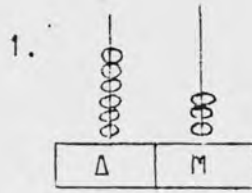
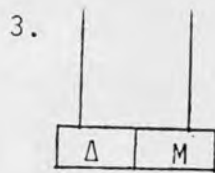
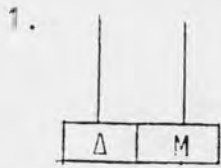
(22) $\xrightarrow{\text{Minus 5}}$ ()

15. You need: coins

Use your coins to take 65 p.

16. Show the numbers 40, 53, 94, 18 on each of the abacus below :

17. Write below each of the abacus the number it shows.



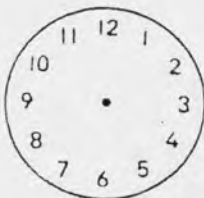
- 18.



This clock shows o'clock.

1 hour later it will be o'clock.

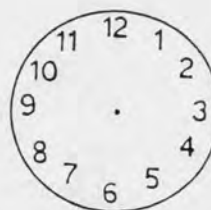
19. Make these clocks show :



12 o'clock

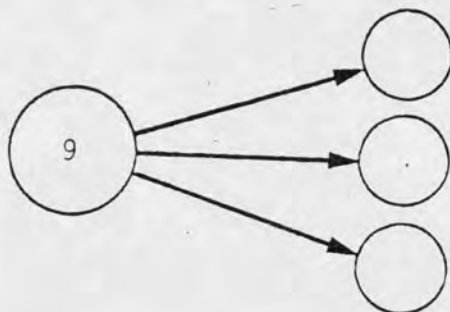


6 o'clock



1 o'clock

20. Share into 3 equals sets.



21.



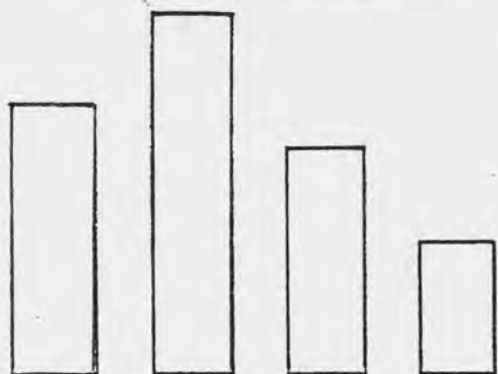
I can change two 5 p coins
for 2 p coins.

22. Use coins to get 7p in
two different ways :

a.

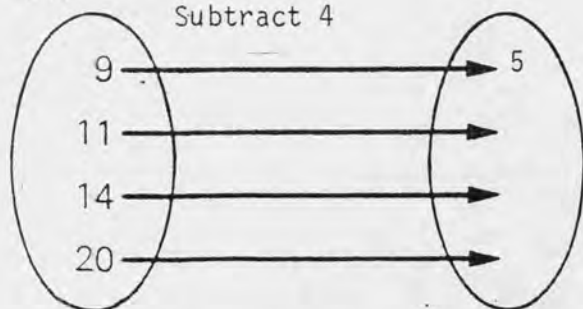
b.

23. Colour the longest strip
red and the shortest blue.



24.

Subtract 4



25. You need 8 marbles.

Share them into 3 equal sets.

Answer : Each set has _____
marbles.

26. Viky is looking at the car.
Complete the sentences with
the missing words.



car



flag



dog



church

_____ is on her left.

The dog is on _____.

If she makes a complete round
she will look at _____.

27. Write the right name
underneath each shape.









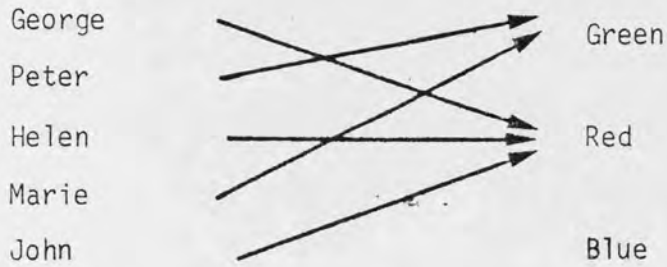
square
oblong

circle
triangle

28. Write the difference for each pair of numbers.

Difference : (a) 5, 3 (b) 20, 6 (c) 9, 17

29. Here are the favourite colours of some children.



Answer the questions :

How many children prefer red ?

Write the name of the girl who likes green.

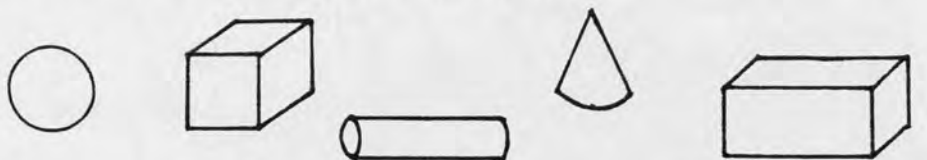
30. Peter has 26 p. He buys a pencil for 4p and a book for 16p.

How much money has Peter now?

31. John has 14 marbles. Bill has 23 and George has 19 marbles.

How many marbles have the three of them together?

32. Give its name to each of the shapes below. Draw arrows to show which name corresponds to which shape.



Cone Cube Sphere Cylinder Cuboid

1. Write the number which is 7 more than 21.

2.

11
20
0
5

 $+ 9$ Complete this mapping of +9.

3. Complete :

4 , 9 , 14 ,

8 , 15 , 22 ,

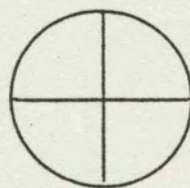
4. What will I have left from 40p if I spend 15p ?

5. (a)



Colour $\frac{1}{4}$ of this shape.

(b)



Colour $\frac{1}{2}$ of this shape.

6. Write the number which is 12 less than 31.

7. There are 34 sweets in a bag. 10 of the more eaten. How many are left?

8. Complete :

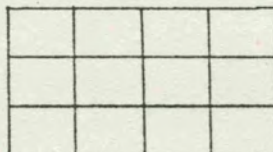
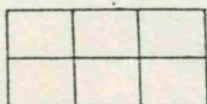
$$\begin{array}{r} \Delta \quad M \\ 2 \quad 9 \\ - \quad 8 \\ \hline \end{array}$$

$$\begin{array}{r} \Delta \quad M \\ 6 \quad 4 \\ - 2 \quad 7 \\ \hline \end{array}$$

9. Complete this table :

I have	I spend	my change
50 p	26 p	
50 p	12 p	
50 p	45 p	

10.



Colour $\frac{1}{2}$ of this shape.

Colour $\frac{1}{2}$ of this shape.

11. Complete :

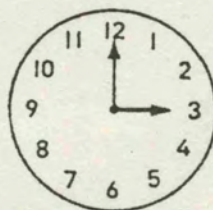
11. $4 + 4 + 4 = \square (\square)$

12. Another way of writing 2(7) is :

13. Write two sets of 3 numbers which add up to 17.

17 $\begin{array}{l} \nearrow (\quad , \quad , \quad) \\ \searrow (\quad , \quad , \quad) \end{array}$

14. Write the time this clock shows



Complete :

15. $8(5) = \square$ sets of $\square$

16. Complete :

20 is 2 sets of $\square$

or 4 sets of $\square$

or 5 sets of $\square$

17. Peter has 30 toy soldiers. John has 14. How many more has Peter than John ? $\square$

18. Four coins add up to 30 p. Draw these coins below.

30 p

19. Choose a plane shape.

Complete :

It takes $\square$ of my shape to cover an SMP card.

20. You need : cuboid :

How many edges has it ? $\square$

How many vertices has it ? $\square$

How many faces has it ? $\square$

21.



Make this clock show 7.55

22.



Complete : This clock shows:

23.

You need : jug, cup

Complete :

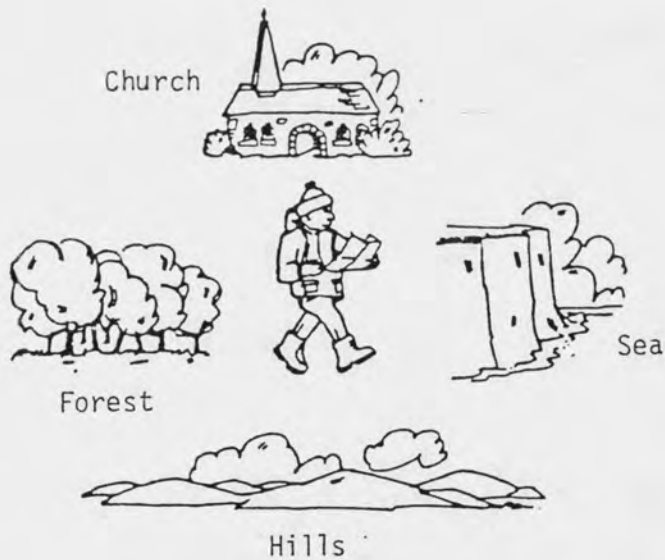
It needs cups to fill the jug with water.

24.

Measure the length of this page in spans.

Write : The length of this page is spans.

25.



(a) Peter faces the sea.

He turns a $\frac{1}{4}$ turn clockwise.

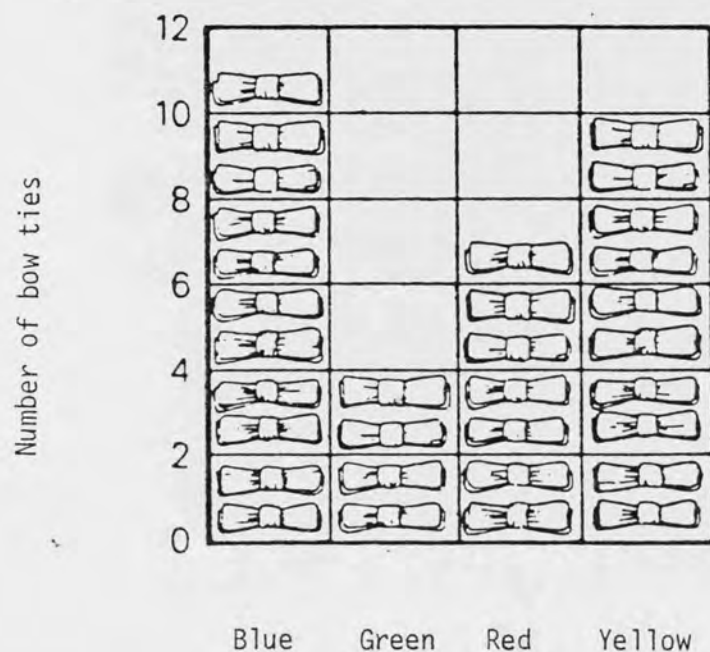
Now he faces : _____

Peter faces the forest.

He turns a $\frac{1}{4}$ turn anti-clockwise.

Now he faces : _____

26. Look at the graph and use it to answer the questions :
Graph to show colours of bowties owned by a clown.

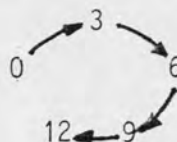


- (a) How many yellow bowties does the clown own? ☐
- (b) How many more red bowties has he than green ones? ☐
- (c) Which colour has he most of? ☐
- (d) How many bowties does the clown own altogether? ☐

1. $7 + 10 + 22 = \boxed{}$

2. Find the total of 163 and 27 : $\boxed{}$

3. The arrow shows : I added : $\boxed{}$



4. Fill in the missing sign : ($<$, $>$, or $=$)

(a) $9 \boxed{} 15$ (b) $6+7 \boxed{} 13$ (c) $19 \boxed{} 14 + 13$

5. Fill in the missing sign : ($<$, $>$, or $=$)

(a) $14 - 5 \boxed{} 7$ (b) $5 + 2 + 3 \boxed{} 4 + 1 + 8$

6. The 3rd multiple of 4 is : $\boxed{}$

7. Complete : $\begin{array}{r} 26 \\ \times 3 \\ \hline \end{array}$

8. Complete : $\begin{array}{r} 59 \\ \times 2 \\ \hline \end{array}$

9. You need : book, marbles, balance

Estimate, then find out, how many marbles balances the book.

Complete : My book balances :

Estimate

Actual number

marbles

10. You need : egg-cup, peas, beaker

Estimate, then find out, the number of egg-cups full of peas that will fill the beaker.

Complete :

Estimate

Actual number

egg-cups of peas will fill the beaker

11. 15 felt-tip pens are shared equally between John, Philip and Peter.

Each boy has felt-tip pens

12. Complete this table.

The sweets are shared equally.

Number of sweets	Number of children	Each has
12	3	
20	5	
16		8
	5	4
30	10	

13. Find the difference between 93 and 27.

Work it out here :

14. Five greater than 3 is :

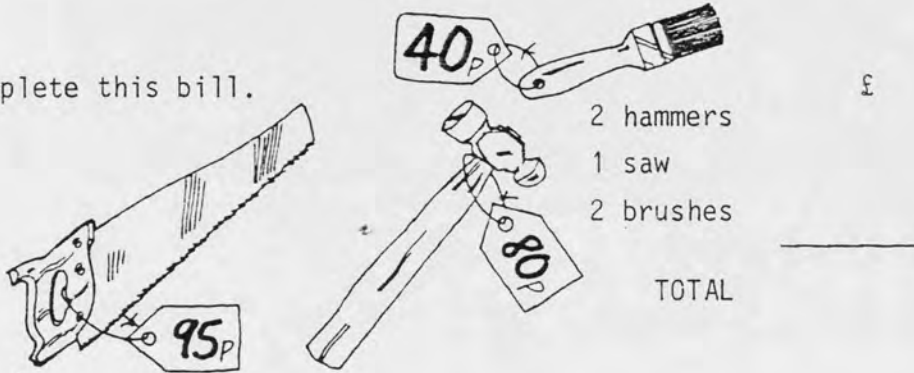
15. Three less than 8 is :

16. You need : hexagon

Draw round the hexagon.

Complete : A hexagon has sides and vertices.

17. Complete this bill.



18. Complete these patterns

(a) 4 8 12 16

(b) 15 12 9 6

(c) 2 5 8 11

19. Draw a line 7 cm long.

20. Measure and record these lengths :

(a) cm

(b) cm

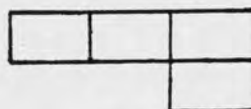
(c) cm

21. $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} =$

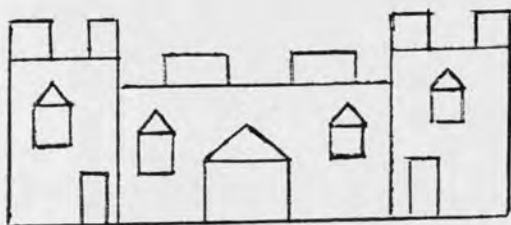
22. Complete : (a) $8 \times 10 =$

(b) $10 \times 10 =$

23. Colour in $\frac{3}{4}$ of this shape :



24. Write the names and number of all plane shapes you can see in this drawing.



Name	Number

25. You need : triangular prism

Complete : 2 faces are shaped.

3 faces are shaped.

26. Complete :

(a) The area of shape

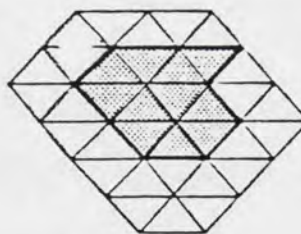
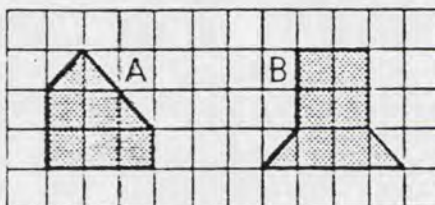
A = squares.

(b) The area of shape

B = squares.

(c) The area of shape

C = triangles.



27. The table shows the favourite vegetables of all the children in class 4.

Vegetable	Carrots	Peas	Brussels	Cabbage	Turnip
Number of children	8	10	6	5	3

On squared paper draw a column graph to show this information. Label your graph and give it a title.

28. In question 27 :

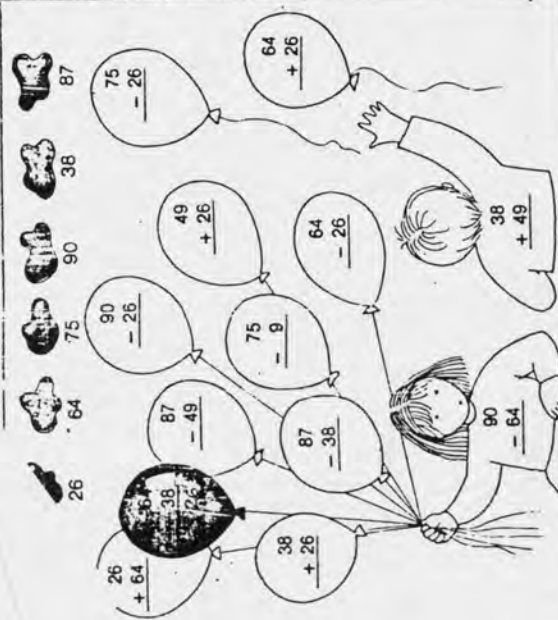
(a) What is the most popular vegetable?

(b) What is the least popular vegetable?

(c) How many children are there in Class B?

Samples of assessment tests
of the Greek Mathematics manual.

ΑΞΙΟΛΟΓΗΣΗ



2. Να βάλλεις ανάμεσα στις πράξεις ($>$, $=$, $<$)

$49 + 26$	$26 + 49$	$38 + 26$	$26 + 38$
$87 - 26$	$87 - 49$	$64 - 26$	$64 - 38$
$64 + 28$	$26 + 64$	$38 + 49$	$49 + 38$
$80 - 28$	$80 - 64$	$87 - 49$	$87 - 38$

2ο ΚΡΙΤΗΡΙΟ ΑΞΙΟΛΟΓΗΣΗΣ

Θα ήθελες να συμπληρώσεις τον πίνακα:

	0	1	2	3	4	5	6	7	8	9
0	0.0	0.1	0.2							
1	1.0	1.1	1.2							
2										
3										
4										
5										
6										
7										
8										
9										

Μπορείς να συμπληρώσεις το σταυρόλεξο:

1.	2.	3.	4.	5.	6.	7.	8.	9.
3	4	6	2	4	3	4	4	9
8	6	2	6	6	6	6	8	8
3	2	6	6	6	6	6	8	8
6	9	6	6	6	6	6	8	8
7	7	7	7	7	7	7	8	8
6	7	8	9	6	7	8	8	9

A sample of two consecutive pages of the manual
(an example of how the book pages could be implemented as cards
facing each other).



Μαντέματα...

1. Το στερεό που έχω βάλει στο κουτί έχει 6 έδρες. Μπορεί να είναι...
(Βάλτε στο κουτί ένα Ναι ή ένα Όχι)

στερεό ορθογώνιο
πυραμίδα
κύβος
κωνίδριος

2. Αν οι έδρες του στερεού είναι τετράγωνα, τότε το στερεό είναι...

α) στερεό ορθογώνιο
β) κύβος
γ) πυραμίδα

3. Αν όμως οι έδρες του στερεού είναι ορθογώνια, τότε το στερεό είναι...

α) στερεό ορθογώνιο
β) κύβος
γ) πυραμίδα

1. Το επίπεδο που έχω βάλει στο κουτί, έχει 4 έδρες. Μπορεί να είναι...

τετράγωνο
τρίγωνο
ορθογώνιο
κύκλος

2. Αν οι έδρες του επιπέδου είναι ίσες, τότε το επίπεδο είναι...

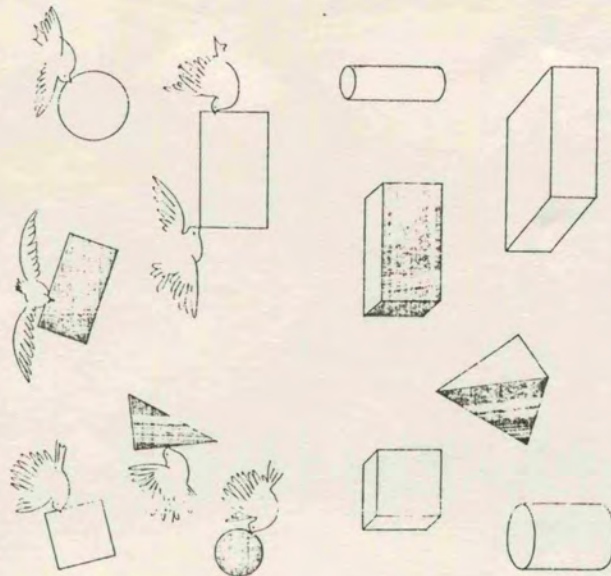
α) τρίγωνο
β) τετράγωνο
γ) ορθογώνιο

3. Αν οι έδρες του επιπέδου δεν είναι ίσες, τότε το επίπεδο είναι...

α) τρίγωνο
β) τετράγωνο
γ) ορθογώνιο



Μπορείτε να σχεδιάσετε τόξα, για να δείξετε σε ποια στερεά ανήκουν τα σχήματα που πήραν τα πουλιά...



A sample of two consecutive pages of the manual
(an example of how the book pages could be implemented as cards
facing each other).

14!

$9 + 5 = \square$



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Πόσο μακρύ γίνεται...

1. $\square + \square = \square$

2. $\square + \square = \square$

3. $\square + \square = \square$

4. $\square + \square = \square$

5. $\square + \square = \square$

98



0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Πόσο κοντό γίνεται;

1. $\square - \square = \square$

2. $\square - \square = \square$

3. $\square - \square = \square$

4. $\square - \square = \square$

5. $\square - \square = \square$

99

ABSTRACT

The present study examines the possibilities of applying an individualised programme of Mathematics, namely SMP 7-13, in Greek primary schools. The research was prompted by the fact that the changes in the philosophy and practice of primary education as well as the evolution in the theory of Mathematics manifested at the outset of the 20th century hardly affected Greek educational matters, whilst they revitalised and transformed the British educational system.

It was a programme which extended over three stages, the pre-pilot, the pilot and the main study. The latter was conducted for one year in three schools each one of which accepted children of different social strata. The application of the research exposed a number of difficulties innate either in the individualised programme itself or in the Greek school environment and function. Despite those difficulties, however, and the impediment of the limited sample the present research allowed for certain encouraging implications. An attempt to innovate the content, and moreover the teaching of Mathematics is not only imperative but it is also feasible provided, however, that certain conditions are taken into consideration. In relation to the applicability of SMP 7-13 to the current Greek educational system, the aspect adopted by the present study is that it could constitute a valuable supplement to the existing Mathematics programme.