Perceptions of Identity in Science Education (POISED): A study of some Secondary school students and teachers in England

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Abstract

This paper is based on a study of the views about schooling, science education and science in their lives of some Year Ten (Y10) (15 year old) students and some of their teachers in two schools in the Midlands of England, one of which serves multicultural urban areas, and one of which serves a rural and largely mono-cultural area. It was carried out from 2010 -2011. Data was collected by online surveys and blogs from students and from students and teachers by face to face interviews. Early findings from students' questionnaire responses suggest among other things that students think good teachers are centrally to their learning but they appreciate a relaxed and collaborative approach to work supported by a variety of resources and pedagogic methods. They recognise the positive impact of science on their lives and generally don't perceive it as antithetical to their faith, where they have any.

Introduction

Students' voices are conceived as heterogeneous, not homogenous, and students are perceived as constructors of learning, in this case in science education, and co-constructors of education with their teachers. Student voice acknowledges the rights of students to influence the shaping of their own learning (Fielding, 2004) and helps to democratise schooling (Rudduck and Flutter, 2004). Students' involvement in decision-making about how learning is carried out can be seen as part of the enactment of children's rights to take part in decision making about their own lives under the UN Convention of the Rights of the Child (UNCRC) (Sebba and Robinson, 2011). 'Interaction with others' and 'iterative identity construction' (Giddens, 1991) are central theoretical constructs in people's self-development, of which learning forms a part.

Accessing students' perspectives on education is encouraged in England by central government (DCSF, 2008; QCA, 2006) because it fosters student engagement in learning and helps to develop a more inclusive school environment. Listening and talking to students about their perspectives on teaching and learning (Rudduck, 2004, Demetriou and Wilson 2010) helps teachers reflect critically on their practice and improves the quality of schooling (Flutter and Rudduck, 2004). Pupils' learning is significantly improved through engagement in group discussions (Bennett

et al., 2004). However, teachers' approaches to science education are influenced by their own identities as science educators and the policy and socio-cultural contexts in which they work.

Students' identities as science students are affected by various social factors such as ethnicity and cultural contexts. In an international study drawn from 20 countries on the Relevance of Science Education (ROSE), Schreiner and Sjøberg (2007) noted that the more developed the society the more negative was the response to a questionnaire item 'I like school science better than most subjects'. They concluded that in each country this was a reflection of values and identity of contemporary youth and that girls had a more overall negative response. For example, the average English boy scored 2.3 while girls scored 1.6. In Gujurat the average Indian girl scored 3.2 while boys scored 3.3. In the UK the majority of pupils do not want to continue studying sciences at KS5 and even KS4 because of their perceived difficulty (Spall et al, 2004). The focus on education in England and India in this study is because people of Indian origin form significant minorities in many cities in England. In Leicester 'approximately 40% of Leicester's population has an ethnic minority background and Gujarati Indians form 28% of the total population (LCC, 2008).

Although the study focuses on the views of some Year 10 (Y10) students and teachers involved in science education in schools in the Midlands of England, this paper focuses only on students' views on the teaching and learning of science and on the importance of science to their lives as they were expressed in the closed and open questions of the questionnaire. This study focuses on three main questions:

- In what ways do national policy frameworks and socio-cultural contexts influence teaching and learning in science education?
- How do students and teachers in secondary schools perceive the teaching and learning of science and themselves as science students or science educators?
- In what ways do secondary school students relate science education to society, community and home life?

Literature Review

An important element in the Key Stage 4 (KS4) Science curriculum in England (QCA, 2006) is the nature of science or 'How Science Works' (HSW). This presents and perceives science as 'being a practice which is both shaped by and which shapes society' (Osborne and Dillon 2010, p. 59). Essential elements of HSW are that the pupils learn to develop arguments, use scientific, technical and mathematical language, conventions and symbols and ICT tools. Pupils are also taught to consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions (QCA, 2006). These elements require students to 'talk science', helping students to learn how to communicate effectively and increasing their understanding of concepts (Howe at al., 1992). This fits with the view that curriculum opportunities should be made for students to discover real life moral issues embedded in all subjects and which are relevant to their own narrative experience (Deakin et al., 2004).

Student participation also needs to be fostered through positive attitudes or progressive practices. Inclusion, influence and strategies for consensual change have to be worked on (Taylor, 2002). Bennett et al. (2004) found that pupils' learning was significantly improved through group discussions based on conflicting views (a combination of existing views within the groups and views presented by a facilitator).

In the UK the majority of pupils don't want to continue studying science at KS5 and even KS4 because of a perceived difficulty; this is particularly because of an increased need of mathematics in Physics (Spall et al, 2004). One of the reasons for this dislike of science seems to be the perception by parents and students of the repetition of topics and the lack of time to discuss issues of more

contemporary relevance (Osborne and Collins, 2001). A complementary study of Osborne et al. (2003) focused on what ideas about science should be taught in school science. It appeared there was a clear consensus. Girls in particular have a negative attitude towards Science because of the way it was taught in school (Murphy and Whitelegg,2006). Their research into student identity found that deeply rooted ideas are embedded in British culture and society about the nature of science: the scientist being in a white coat, male dominated, empirical evidence, all based on data analysis. But science is a lot more than this. Unsurprisingly, girls don't necessarily want to be the kind of people who fit this stereotype of the scientist, especially in Physics.

School processes often serve to disempower students from levels of responsibility which they experience as a matter of course outside school. 'Out of school many young people find themselves involved in complex relationships and situations, and carry tough responsibilities, but that 'in contrast, the structures of secondary schooling offer, on the whole, less responsibility and autonomy than many young people are accustomed to…' (Ruddock and Flutter, 2004, 1). Where young people are consulted and have the opportunity to discuss public policy and issues that have direct relevance to their own lives, this can have the impact of serving as a catalyst for future community involvement, whilst raising their general levels of motivation and productivity (Potter 2002 and Clough and Holden 2002).

Although the idea that teachers should consult children in order to be better informed professionals has been increasingly recognised, education lags behind some other child services in terms of heeding what children have to say (Hancock and Mansfield, 2002). To legitimate stronger student influences on the construction of schooling, Ruddock and Flutter (2004) outline five 'advocacies'. These are: the importance of helping students to develop their identities and individual voices; the need for young people to be able to 'speak out' about matters that concern them; a recognition that in the task of change, students are the 'expert witnesses'; the need for policy-makers and schools to understand and respect the world of young people; and the importance of preparing young people to be citizens in a democratic society' (p. 101).

Learning through interactions needs to employ multiple social activity structures, encourage pupils to listen and learn from each other and engage pupils as critics of diverse scientific information (Linn and Hsi, 2000). Collaborative learning can be supported by computers (Bennett et al., 2004). Although high achievers become deeply interested and knowledgeable or skilled in a topic (Ito et al., 2008) through the uses of technology, there is much less evidence about what motivates young people and low users of technology (CIBER, 2008). In this study we intend to involve students of all different levels of attainment.

Methodology

This study, focused on 14-16 year old students' and their teachers' views on schooling, science education and science and society, used a linked case studies design in two Secondary schools in the Midlands of England in 2010–2011, one of which (InnerCity) serves multicultural urban areas, and one of which, Smalltown, serves a rural and largely mono-cultural area . The study was carried out from 2010-2011 with the support of a small amount of funding from the College of Social Science, University of Leicester. In the preceding pilot study in 2009-2010 students, teachers and web-technicians, helped to construct the project website, define ethical practice on it, construct the elements of the questionnaire, and pilot its practice (Tas and Busher, 2010). This encouraged students, teachers and other staff to take part-ownership of the project rather than merely being objects of study (Busher and James, 2007), enhancing the trustworthiness of the study.

The main platform for the project was a secure website to facilitate participants' asynchronous interaction through, for example, the completion of online questionnaires, the keeping of blogs and the use of discussion boards. The use of the website was important for

facilitating communication between busy students, teachers and researchers who could not always meet face to face. However, the website needed to be secure to protect participants from having their privacy breached (James and Busher, 2009).

Data was collected by online surveys and blogs from 83 female and male Year Ten (Y10, 14-16 year old) students, a year before taking their school leaving examinations (GCSEs) in England. There were 64 (37 girls and 27 boys) students involved in Smalltown, from a stratified random sample (16/64, 10 girls and 6 boys) of whom questionnaire data was analysed, and 19 students (11 girls and 8 boys) involved in InnerCity. Data was also collected by semi-structured face to face interviews from students in pairs (3 boys and 4 girls in Smalltown, 7 girls and 3 boys in InnerCity) and teachers singly about their views on the same topics. Participants were all volunteers who gave their informed consent to participate. In the case of students their parents also gave permission for them to participate.

The study used a mixed methods approach to investigate the research questions set out in the introduction to this paper. Data was collected by online questionnaires supplemented by face to face digitally recorded semi-structured interviews with students, interviewed in pairs, and teachers and by students' blog-diaries on students' changing thoughts on science and being involved in science lessons. Quantitative data was analysed by simple descriptive statistics. Qualitative data was analysed thematically.

Findings

About the schools and participants

Smalltown school	*InnerCity school*
Organisation: A large Comprehensive school (2100 pupils), including almost 800 students in a large sixth form (post-compulsory schooling). It is a specialist Technology College, so all pupils take Design and Technology (D & T) at GCSE level. Science students can follow a Triple Science course, 21st Century Science (OCR). *Catchment:* A wide rural area. Families come from a broad range of social and educational backgrounds. Compared with national figures, the proportion of students entitled to free school meals was very low. *Students:* aged 14-18 years, predominantly from white British. Only 7% of students identified as have learning difficulties and disabilities. Most of the participants in the study had high current and expected grades for Mathematics (49%, A*/A), Science (48%, A*/A) and D & T (46%, A*/A)	*Organisation*: A Comprehensive school with 1400 pupils that is oversubscribed. It is a Science & Sports and Leadership Partner Specialist College with a reputation for innovation and success. Science students can follow an AQA Triple science programme. *Catchment:* A multicultural, multi faith area with 93.2% of students from ethnic minority backgrounds. *Students:* aged 11-16 years (no sixth form -post-compulsory schooling). Most of the participants in the study had high current and expected grades for Mathematics (43%, A*/A), Science (48%, A*/A) and D & T (15%, A*/A)

Students' perspectives on learning/teaching and the impact of science on their lives

Numbers against categories in the tables below indicate the number of students who gave a particular answer. Quotations are examples of what students were saying under particular categories

What I enjoy about school / learning

Smalltown	*InnerCity*
friends & socialising: enjoy myself more when I have friends in lessons that I can share ideas with *learning new & interesting things:* the challenge of learning new things; learning things i wouldn't find out about anywhere else, r*elationships with teachers:* some teachers are ok *ways of learning:* lessons are fun; Art (3); English - being able to write stories; the library;	*friends & socialising:* meeting friends; friendly atmosphere *learning new & interesting things:* In (mentioned) subjects; extracurricular r*elationships with teachers:* teachers explain things thoroughly *ways of learning:* interactive ways teachers present; very useful to gain important skills such as communication skills and a lot of confidence (1); Independent study

What I like about our Science teachers

Smalltown	*InnerCity*
how they support/treat us: (5) always try their hardest to help me to learn / get the grades I want; easy to approach if struggling; (6) They treat us responsibly, and speak to us clearly; they are nice; kind; they're ok *encouragement and enthusiasm: (*2) my biology teacher is good a teaching and gets along with you. They are funny and jolly (2) but get through the work and don't take things too far or let students get carried away; [mine] worked for NASA (1) *nothing / not much:* (4) nothing, nothing really; I don't really like them that much; not much, I don't	*how they support/treat us:* (4) we can go to any preferred teacher and ask for help *encouragement and enthusiasm:* (3) gives us continuous encouragement and rewards us for achievements; they motivate us to work harder and they believe in us *behaviour for learning:* she can control the class *time /availability:* (3)willing to spend breaks and lunches to help us secure and pass our grades; The fact that she is always there, making time for us whenever needed

What I like: how science teachers teach me

Smalltown	*InnerCity*
Practicals: Personally I like how my science teachers use experiments to get across the point; (3) Questions and practical work (7) i like that we do practicals because I learn more easy this way; experiments *Explanations:* (3) they are very clear, how they talk/explain to the class and myself; not too complicated *supported independent study:* (4) Independent study is also available, which is how I learn best; How they set a task and let us get on with it and come round to see how we are getting on	*Practicals*: (5) many practicals which help us to visualise concepts *Explanations:* (6)she explains things to us in an understandable way; things are explained clearly and gone over if they are hard to understand *teaching & learning resources:* (5)they provide us with resources that can help to boost our grades; use the interactive whiteboards and active expressions; uses diagrams

What I like most about Science lessons

Smalltown	*InnerCity*
Practicals: (3) *group / interactive activities:* it is really interesting to see people's ideas about topics; we all work together and you don't feel embarrassed *fun:* [teachers] try and make the lessons as fun as possible (2); whatever happens, you are guaranteed a laugh, someone will always fail; I enjoy performing the experiments as they are very hands on *relationships:* we enjoy our lessons; informal relationships between the teachers and the students as it means that people have more fun; collaboration *variety:* I like the powerpoints (1) use videos (1) I like how they sometimes change how we learn	*practicals:* (6) I am a kinestetic learner, so i prefer doing things with my hands *group / interactive activities* (2) we get to share our ideas with other classmates; it helps us to learn *fun:* (1) make the lessons fun so its easier to understand *easy to understand:* (2) *interesting:* (5) it gave us an insight *variety:* games that are associated to the lesson; being able to makes notes effectively which help to revise later on

What I dislike about science lessons

Smalltown	*InnerCity*
too much to take in (5) certain things are very hard to understand meaning that it can put you off, but going to science clubs is helpful; sometimes, we get overpowered with information *nothing* (2) *too much theory/ writing (*4) Sometimes a specific topic can be very theory based; I don't like lots of theory work; When we have supply teachers. They don't have a clue about what to do; it can be tedious, and i don't always learn that way *Other:* practicals; seating plan	*some topics:* I find them hard to grasp; (1) genes and chomosomes; (1) chemistry *social aspects:* (2) behaviour control; (4) she cannot control our class: i end up teaching myself out of a book; *teachers approaches to teaching:* she just makes us copy things off the board which isn't helping at all; one of my teachers doesn't explain anything so i don't understand; Personally, I do not learn well from answering questions on a worksheet, I prefer to listen/discuss; I don't like copying from a board; Poor teaching material; *Poor teaching*(3); (1) teachers are unorganised; *Too much writing/ theory:* being left to read textbooks: too much information/ theory

Who or what encourages you to learn

Smalltown	*InnerCity*
Teachers: (10) teacher who have a laugh *my friends:* (10); makes me proud and my parents proud when I do well; *my parents, myself* : (8) *future / job opportunities* : (11) e.g. good education /qualifications so I can get a good job; good grades; will have something to show for the hours of hard work.	*Teachers:* (4) Good relationships between teacher and individual students; teachers encourage me to learn by giving praise; teachers who have life experaince *friends and family:* (2) *future / job opportunities:* (3) reputable and well paid job so that I can support my parents financially; knowing the benefits of learning in the long term *aspects of pedagogy:* (4) competitive things; Interesting things; History; good working environment /atmosphere

How Science is useful in my life

Smalltown	*InnerCity*
Health related: To stay healthy (3); Using science for medical treatment (2) i learn more about the human body and about some animals; *Enhances knowledge:* makes me more sure of what I already know (1); answers questions I have (1); It is also useful to know about evolution because it effects you (1); *it doesn't* (1);	*Health related:* To stay healthy (3); stem cell research (3); Abortions (3); Learning about fertility as it is important to know about these kinds of issues for when you are older (1); *Enhances knowledge:* helps understand how things work (2); why things happen (3); Solving problems (1); Genetic engineering (2); Cloning (2); Intensive farming (2); Technology (2); Global warming (1)

How science has changed life at home

Smalltown	*InnerCity*
medicine (1); Environment (1); *technology* (4); Electricity has revolutionised my home (1) Computers we use them everyday more or less; Mobile Phone's; I switch the TV off because it uses 50% electricity on standby (2); i save energy (1); *it hasn't:* (4); NA (2); don't know (2)	*Health related:* I was able to advise my mum on how to deal with treating diabetes (type 2); what requirements are needed in order to stay fit and healthy (3); *affects social lives*; in physics we learn about the centre of mass and this is a key concept in many sports and leisure activities like skiing; wondering about things we have learnt in school and making these skills and applying them to your real life *technology* (3); gaming; communication (radio, tv, computer); knowing about insulation (save money); *not alot (1)*

How science affects my beliefs

Smalltown	*InnerCity*
Belief in science theory than Christian (1); Big Bang theory God Created Universe; confirms what I know (1); its made me think about whether god made the universe or scientific happening made the universe (1); no comment (3); not religious/aetheist (3); no effect (3)	*Contradicts* (3) *:* I think that science sort of contradicts my religious faiths and beliefs, e.g. the creation of the world; *makes me doubt* (3) : not acceptable (1) e.g. it makes me doubt some things i learn however i have no solid opinion on how science affects

	religion as of yet; No effect (2)

Emergent conclusions

Students think good teachers are centrally to their learning but they appreciate a relaxed and collaborative approach to work supported by a variety of resources and pedagogic methods. This fits with some of the literature on the importance of teachers involving students as partners in learning.

Students recognise the positive impact of science on their lives and generally don't perceive it as antithetical to their faith, where they have any. Only some pupils from the urban school mention contradiction

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