Using infographic creation as tool for science communication assessment and means of connecting students to their departmental research

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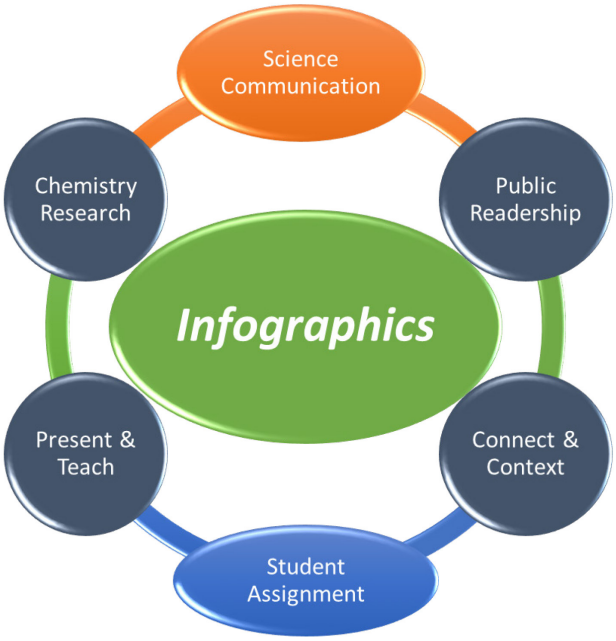
ABSTRACT

Students were asked to each create an infographic based on one of their host department's research articles as a new exercise within the "science communication" training programme of the degree. The use of local articles helped to connect students to the research of their lecturers and the assignment helped to contextualize why certain lecturers had been chosen to teach their allocated subject. Students also agreed that the activity helped them to recognize what research is associated to the traditional inorganic, organic and physical lecture themes. There was some benefit to this approach in helping students distil out key information.

GRAPHICAL ABSTRACT



KEYWORDS

INTERDISCIPLINARY / MULTIDISCIPLINARY, COMMUNICATION / WRITING, MULTIMEDIA-BASED LEARNING, FIRST-YEAR UNDERGRADUATE / GENERAL

INTRODUCTION

Students are often instructed in “the art” of communicating science during their degrees and its importance in building a connection with the public to ensure the future of science, technology, engineering and mathematics (STEM) subjects through the establishment of trust, understanding and an acceptance of scientific activities by those removed from them.[1,2] Science communication can also prove an invaluable tool to help researchers and universities secure funding and as a means of reaching a broader audience than publishing in peer-reviewed journal articles alone.[3] A quick search of the internet reveals many chemistry courses feature “communication” or “key skills” modules in which science journalism features, with instructor evaluations of these courses revealing their benefits to student presentation and science understanding.[1,4–8] Polman argues that such experiences facilitate better use of science and more sensible decision making since like journalists, the practice forces the students to behave as “competent outsiders”.[9] Traditionally in many of these classes students could expect to be assessed by writing an article or opinion piece of their own but alternative tasks are ever

emergent. Notable examples of divergent tasks include: editing Wikipedia pages;[10] one-minute paper seminar/flash presentations;[11] photography,[12] outreach,[13] video creation,[14] blogging[15] and designing comics[16]. Evaluations of the above activities agree that understanding of the science and communication skills are indeed improved by the engagement of students in such activities. Instructors have to tread carefully though, since traditional "writing-up" of science is mandatory for many final year dissertations, so it's important to design courses that feature both tradition and innovation. Many of the aforementioned innovations have come as a response to the shift in modern culture such that visual communication has become dominate in society.[17] The fact that the human mind processes information pictorially makes graphical alternatives an effective communication strategy, enhancing efficiency (time), retention and accessibility to various intelligences.

Infographics, literally a hybrid of the words information and graphics, are described as text efficient, visually stimulating stationary media used to present data or knowledge.[18] Prevalent in marketing campaigns and business environments, research suggests that infographics help improve cognition due to the human visual system's ability to see patterns and trends.[19] Within chemistry, the periodic table's visual appeal has found itself a common muse for infographic designers.[20] Additionally, infographics about the chemicals in products and items encountered daily have been frequently produced by Andy Brunning "compound interest" and are immensely popular.[21,22] Some instructors have also found a use for infographics to assist learning. Polman has for example deployed them as tools for critical appraisal and connection to science communication and studies.[9] Others have used them as science communication assignments within their degrees. Mitchell for instance tasked her students to create infographics about chemical reactions, finding that students became "*competent in information literacy and communication skills*" by doing the assignment.[23] VanderMolen and Spivey also found benefit to research skills, learning strategy and communication from tasking their students to create infographics.[24] For the task students had to research and present a topic of their choosing within a health economics course. Additionally research by Shanks *et al.* confirmed that infographics proved a useful way of teaching undergraduates to visualize and communicate "*key life science issues*".[25] Their group assignment was found adept at helping them communicate to non-experts, develop skills and understand the science. Using these positive reflections as inspiration, it

seemed logical to adapt these methods for an assignment focused on communicating local chemical research as a means of helping students disseminate information whilst also connecting them to their lecturer's profession. This paper describes an activity where students are too asked to create an infographic, but on this occasion focus it around actual/live chemical research.

INSTRUCTIONAL CONTEXT

Chemistry at Leicester is offered in three strands: pure; pharmaceutical and physical, each one following a common inorganic, organic and physical (IOP) core structure, with students also taking pre-defined electives tailoring the degree to its specialist title. The pure chemistry undergraduate degree course at the University of Leicester features a "core skills, ethics and communications" module with each of the titled components being delivered and assessed separately through coursework. The communication specific intended learning outcome (ILO) for this area was published as follows: *"communicate chemical concepts and ideas to a range of audience types using methods that will engage discipline specific and general audiences".* This ILO is set jointly by the department and module team, with each module (ILO, delivery and assessment type) being approved by a university program panel. Throughout the module students are shown examples of good practice in presenting scientific information, and sessions are focused toward: oral presentation skills (large audience and team environment); poster presentation skills; written presentation (report and blogs) and critical review. The last assessment addresses the visual and general audience aspect of science communication and is the focus of this communication. To this end students received a 50-minute lecture outlining the need to disseminate scientific research to the public, the common methods/sources of doing so and the need for peer review. To help contextualize the topic, the lecture concludes with three case studies: sensationalist journalism; scientist-led but still how not to do it; and a powerful example of good practice. Until recently these ILOs were assessed by asking the students to select a research paper of their choice and write both a short tabloid article of 500 words and a science magazine article of 2000 words. The key assessment criteria for these assignments included the student's skill at selecting core (key) findings of the work and the translation of science into non-specialist (lay) terms plus the scientific accuracy of their report and its presentation. Anecdotally, neither of the assessment tasks were popular and required more time from the students than the credit rating warranted. Students

commented that they "*felt it was irrelevant to the degree at the time*", it was very "*tedious*" and "*boring*", with one student even adding that "*they didn't gain anything from doing it".* Other students commented "*the exercise was too long to encourage selection of just the exciting, public friendly information*" or that "*it was too early in the degree to be asked to write 1000 words or more on research they struggled to understand*". From the assessor's point of view, a common problem with the assignment was that students failed to digest the science properly, perhaps due to a lack of understanding or being daunted by the task. This frequently led to unsuccessful selection and dissemination of the key information at the appropriate level for the non-specialist. Additionally, most students in the longer assignment had simply quoted, paraphrased or on occasion plagiarized the original journal article and therefore had failed to distil out the key information and present it at a level suitable for a general audience.

To combat the problems (*vide supra*) the assessment for the communication ILO was modified such that students were instead asked to create an infographic about one of the department's own research articles. VanderMolen and Spivey had in their paper found that 80% of their surveyed students preferred an infographic based assessment over writing short papers.[24] At the time of re-designing the assessment the department was going through its annual review of programmes and analysis of the student feedback provided by graduands in the UK's national student survey (NSS). This process also highlighted a disconnect between the lower-division undergraduates and the department's research activities, with many students "*picking projects without understanding what the lecturer did outside of their teaching*". This activity seemed an ideal opportunity to engage students with the research culture of Leicester, whilst also adjusting the assessment to suit their mood in the first year. The formal writing practice is retained in the second year as preparation for their dissertations. All academic members of staff where asked to provide two papers that were 'appropriate' for students in their first (freshmen) year of study. This part of the module featured the same case-study lecture as before with the final slides introducing the assessment updated to the subject of infographics. These slides introducing infographics and how the student's assessment would require them to create an infographic communicating the department's recent research to the public have been included in the supporting information. Students were given full freedom with program choice for

the creation and publishing of their graphic and reminded that whilst the graphic had to be visually attractive, the assessment criteria were weighted on the effective communication and accuracy of the science. The assessment guidelines, infographic creation tools and a pot pouri of the department's research papers were distributed to the students by the university's virtual learning environment.

EVALUATION

From an instructor point of the view, the students produced an excellent set of high-quality, attractive and public friendly infographics and their assignments allowed them to score credit against the module's ILO. When assessing the work it was clear that students had been able to grasp the science within the paper and all had done a reasonable job at selecting the key messages, and a better job had been done than previous. When thinking about the traditional assessment, it was a pleasing contrast that none of the students had simply copied or paraphrased the article. Of course, the text-limit on the infographic would have most likely forced the students to read and then select what information they should report. The lower scoring submissions were more poster-like, but even then it was clear the students had tried to not perform a copy and paste of the original article. Some examples of their work are included in figure 1.

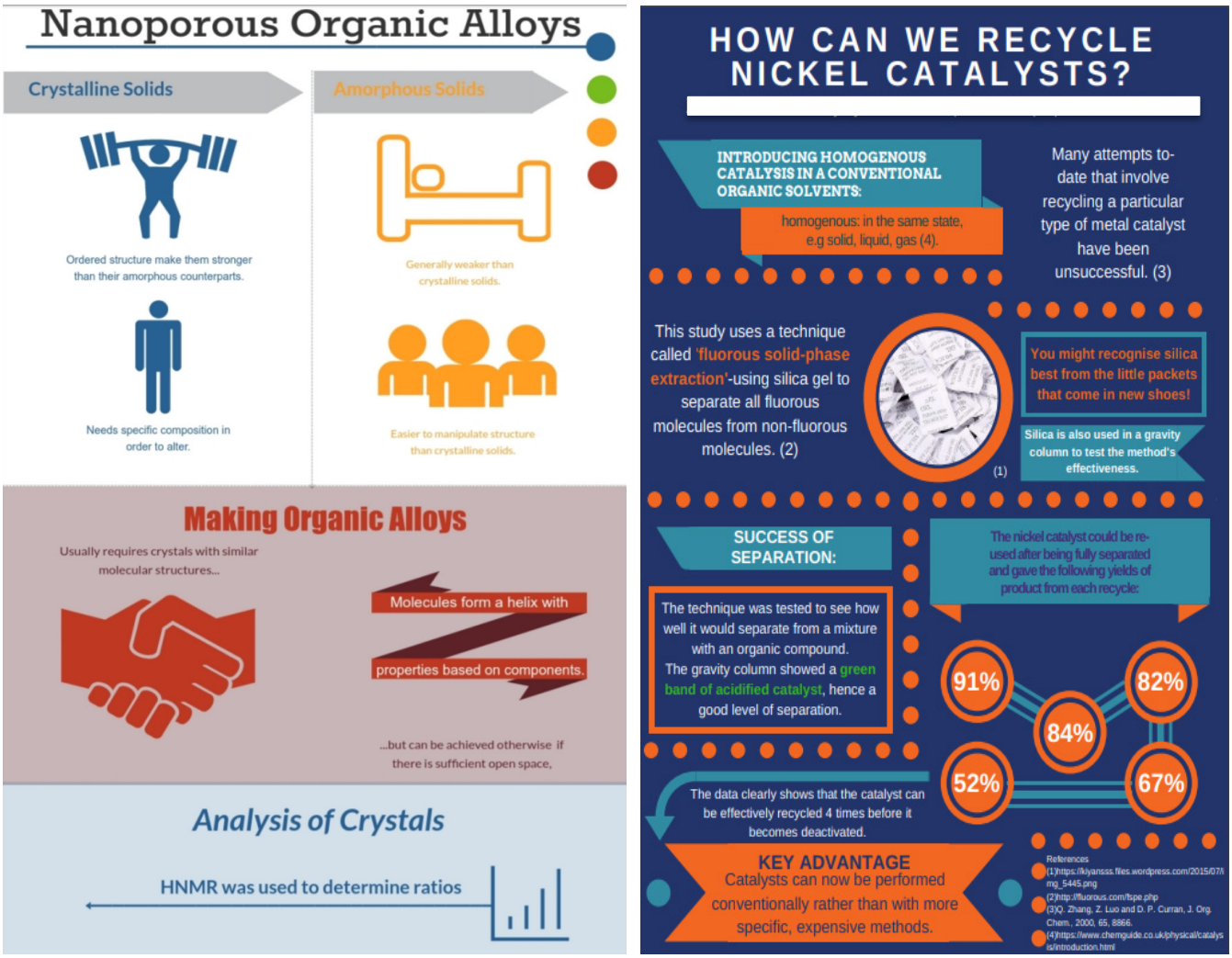


Figure 1 – Examples of student produced research infographics for their assignment.

The end of module feedback (open ended/free text comments) highlighted that students enjoyed the task with one student commenting "*great activity, thoroughly enjoyed the challenge of reading into and learning about the research areas of the lecturers to create the infographic*" whilst another commented "*this task honestly opened me up to the idea of science journalism as a career*". Pleased with the activity's reception, the instructors distributed a survey solely about the media assignment (infographic creation). This was distributed electronically once the marks for the module had been returned, a strategy that had yielded good returns before.[26] This survey was also based on a series of Likert style questions with each student being asked to rank their agreement with a series of statements. In order to rank their agreements, students were asked to select whether they strongly

agreed, agreed, disagreed or strongly disagreed with the statement presented about the assignment. Of the 44 students who submitted an assignment 33 responded to the survey and their responses are published in figure 2.

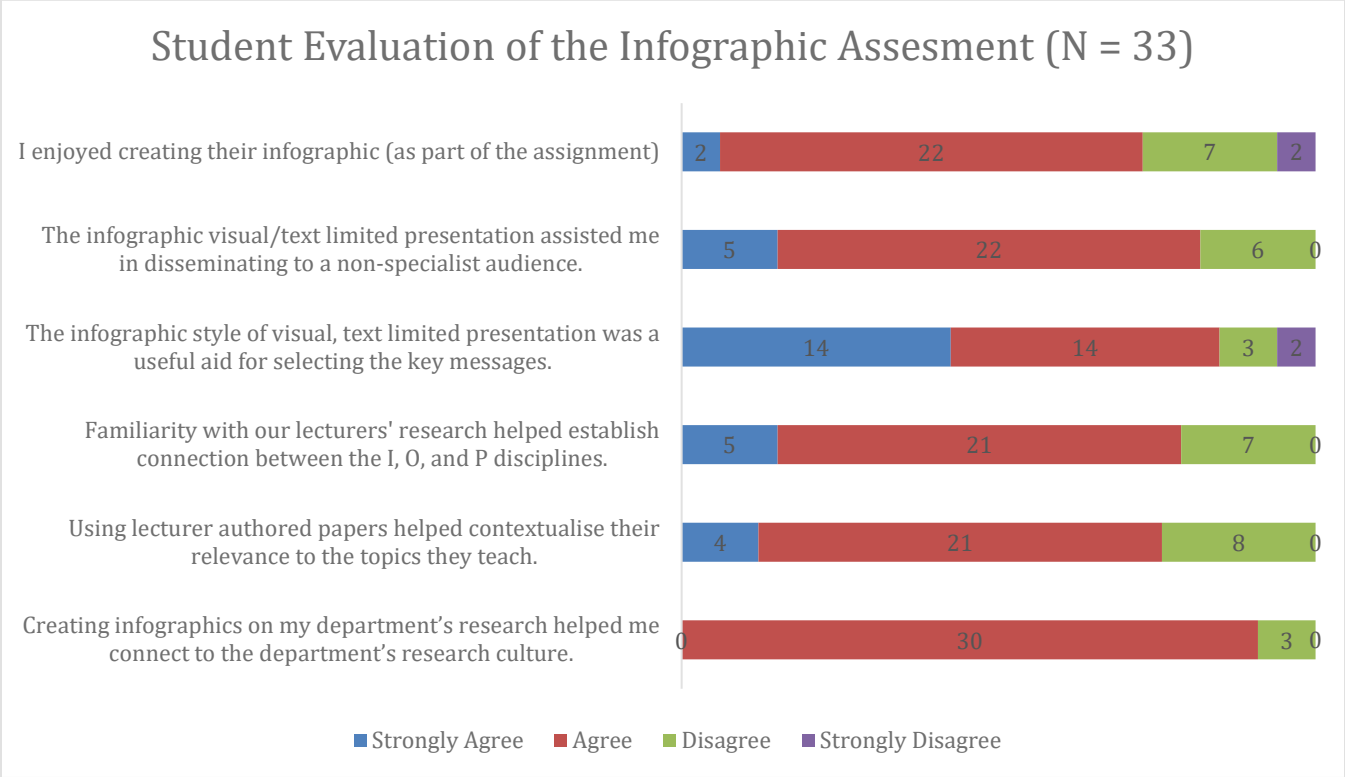


Figure 2 – Likert data for the positive student reception and usefulness as a tool to help students share research and connect to their department's research.

The data gathered by this targeted survey was overwhelmingly positive toward using infographics as part of the assessment of the module. In addition to the positive free text comments above, 72% of the students stated that they enjoyed creating their infographic when asked directly. An objective of the task, and its assessment, was to get students to discriminate between the key messages of the paper and the additional detail. In figure 2, 85% of the students agreed or strongly agreed that designing the infographic was helpful to this end, highlighting that this text-limited format aided them to select only the essential (key) science to communicate from the paper. From an instructor's point of view marking the work, the papers were on the whole well reported. For the question about audience, 85% of the respondent's strongly agreed or agreed that the infographic style helped them to pitch their

communication to the non-specialist (public) audience. The social side of the experiment was also a success since 30 out of 33 students clearly now feel better connected to the department's research activities, with 75% of students agreeing or strongly agreeing that seeing a lecturer's research output helped contextualize their deployment as instructors on selected modules. After this activity, 78% of the students felt that familiarity with a lecturer's research did help to contextualize the I, O and P disciplines. It is interesting to note that for the majority of the questions 20-30% of the students responded negatively. Analysis of the free text comments solely revealed that students had "*issue with the design element*" of the assessment with a notable quote to this effect being "*it was quite design heavy for people who don't like designing*". Others using infographics had seemingly mitigated for this by supporting their students with feedback on draft versions,[24] and upon asking our course alumni if this would have helped, they unanimously "*agreed*" it would have. However, given that the majority of the feedback for the infographic assignment was positive (vide supra), ways in which infographics and research connectivity could be incorporated into other areas of the degree are being explored.

When designing this activity as a means of assessing the aforementioned ILO, guidance was sought from module colleagues and the director of learning and teaching. Post submission these colleagues also viewed the work and agreed that the submissions were successful in their purpose of communicating scientific principles. Collectively we noted that the graphics selected made the infographics very accessible, meaning we were able to understanding concepts outside of our disciplines and agreed that this could potentially be extended to "non-scientists". It was pleasing to see that the unsuitability of large volumes of text had naturally led to the generation of succinct synopses that were highly accessible. Formal assessment of the work with respect to the "non-specialist" audience was based on the style used, avoidance of jargon and effort taken to explain things in rudimentary terms. A copy of the assessment criteria/marking rubric is included in the supplementary information. Furthermore, the instructor was not an author on any of the papers communicated in the infographics, enabling it to be assessed by an outsider, albeit an "educated" outsider. Since submission the work has been displayed during undergraduate recruitment events, and some colleagues have made use of them to showcase research to prospective project (dissertation) students.

CONCLUSIONS

Creation of infographics based on peer reviewed papers published by the student's own lecturers has been successful at helping students: connect to their department's research; understand lecturer selection for instruction of particular topics and how these link to the traditional IOP disciplines. The activity was on the whole popular with the students and has aided them to meet key assesment critieria for the ILOs of the related module. Future iterations will however include more assistance with the design element of the task, more explicit stressing that the criteria is weighted to substance over style and there will now be opportunity for feedback for draft versions. Selected infographics from the current portfolio of submitted work will also be included, with instructor generated annotations highlighting good practice and showing how the paper information is now represented pictorially. The research papers associated with these exemplar infographics will not be available for use by the subsequent cohort. Some students from the study were contacted during manuscript preparation and they agree that this has the potential to ease student concerns and increase satisfaction with the activity.

ASSOCIATED CONTENT

PDF of copies the Science in the Media: Assessment Details and Instructor Marking Criteria are provided for context. A PDF synopsis of the supporting lecture is also included.

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Notes

The methods used to evaluate the student perceptions and performance data was carried out in accordance with the University of Leicester's Code of Practice for Research Ethics.

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