STeP into Science Project: Engaging Students, Teachers and Parents in Debates

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This project aims to facilitate the teaching and learning of Irish lower second-level curricular objectives on Nature of Science, through engaging teachers, students and guardians in school debate events on socio-scientific issues. The Junior Cycle science specification promotes skills such as communication and argumentation which are also required for engaging in debates. Yet the kinds of pedagogical strategies demanded by debates are not typically part of teaching practice (Osborne, Erduran & Simon 2004). The first stage of this project therefore is CPD supporting science teachers to implement argumentation into their teaching of science in order to provide students with a foundation for the kinds of skills they need to draw on when debating scientific issues. Argumentation has been a significant area of research in recent years (Erduran, Ozdem & Park, 2015) and has been advocated in science teacher education (Erduran, 2006). The teachers involved will subsequently implement argumentation activities into their teaching and coordinate a debate event in autumn 2016. Involving the community in school science is a critical element of this project. Hence students will prepare for their debate event with the support and involvement of a family member with targeted homework activities, provided to teachers during the CPD workshop. Evaluation instruments will be used to assess (i) teacher perspectives on the CPD and (ii) teacher, student and guardian perspectives on participation in debates. This paper will outline the overall design of the project and report on initial findings from the teachers' evaluation of the CPD element of the programme.

INTRODUCTION

The STeP into Science project aims to facilitate the teaching and learning of the Irish lower second-level curricular objectives on Nature of Science, through engaging teachers, students, and guardians in school debate events on socio-scientific issues. Effective engagement of students in STEM requires addressing a range of issues such as the curricular context, the teachers, and the guardians. The proposed project is thus needed to address coherence between the curriculum, teaching and guardian involvement in a coordinated fashion. The project is funded by Science Foundation Ireland, and is led by Professor Sibel Erduran at EPI-STEM, The National Centre for STEM Education at University of Limerick with the partnership of Junior Cycle for Teachers (JCT).

The new Irish lower second-level science curriculum, referred to as the science specification, aims to develop key skills, two of which are "*being literate*" and "*communicating*". A student learning activity that encompasses being literate is stated as "*Students will plan, draft and present scientific arguments, express opinions supported by evidence, and explain and describe scientific phenomena and relationships*". The student leaning activity associated with communicating is "*Students will interpret, compare, and present information and data using a variety of charts/ diagrams fit for purpose and audience, using relevant scientific terminology"*. Furthermore, the Nature of Science Learning Outcomes state that pupils should be able to "*conduct research relevant to a scientific issue, evaluate different sources of information including secondary data, understanding that a source may lack detail or show bias; organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and*

representations and evaluate media-based arguments concerning science and technology" (NCCA, 2015, p. 16). It is proposed that socio-scientific debates can provide learning opportunities that meet these criteria. The inclusion of socio-scientific issues in STEM Education is a goal that has been promoted internationally (Zeidler, et al., 2009). Examples of socio-scientific issues include alternative sources of energy and genetically modified foods. It is proposed that students' participation in debates around socio-scientific issues will engage them in ways that will raise their interest and motivation in STEM. While some students may not be drawn to STEM subjects from a disciplinary perspective in learning STEM knowledge, they are likely to be interested in STEM when it is situated in meaningful, socially relevant contexts that have an impact on everyday life. Pedagogical strategies required for school debates (e.g. mediating role play and argument evaluation) are not typically part of traditional teaching practice (Osborne et al. 2004). Hence the project has two main aims: (a) to facilitate science teachers' professional development in teaching of socio-scientific debates; and (b) to engage students and guardians in socio-scientific debates.

This project invites guardians to assist in preparing pupils for the debate by involving them in homework tasks. Including guardians in homework tasks can assist family members in getting an insight into their child's learning (Walker, et al., 2004). Although there is much research to indicate the positive impact of facilitating school-family partnership (Walker, et al., 2004), these partnerships deteriorate in second level education. Simon (2004, p186) suggests that "*parents may become less involved because, with high schools' complex environment and complicated curricula, they do not know how to be involved as their adolescents progress through high school"*. Teachers providing ideas to guardians about how they can contribute to pupil homework can increase family member participation (Walker, et al., 2004). This project includes a very close link between formal (school-based) and informal (home-based) learning opportunities.

METHODOLOGY

Considering both socio-scientific issues and the coordination of debates are aspects of pedagogy that are relatively unfamiliar to teachers (Sadler, 2004), the training aspect is crucial. In order to facilitate the debates, thirty three science teachers were trained nationally in May 2016 to learn about effective pedagogical strategies for coordinating debates in class and as an event. Relevant resource packs were developed for teachers, students and guardians by EPI*STEM in consultation with JCT and the workshops were facilitated by the JCT. In September 2016, teachers will implement lessons on debates and set homework tasks for students to complete with guardians. The project will engage guardians by providing resources that students will take home for their input. Debate events will be coordinated by the teachers during Science Week 2016 where guardians will be invited to attend as audience members. The debates will take place in schools and will be mediated by teachers. Hence, the project will promote engagement of students, teachers, and guardians in STEM related debates in the context of socially relevant issues.

This research takes a case study approach, collecting data from multiple participants to explore the impact of the programme (Leedy and Ormrod 2001). Four questionnaires were generated with the intention of evaluating the impact of the project**.** Evaluation instruments will be used to assess (i) teacher perspectives on the CPD (ii) teacher perspectives on debates (iii) student perspectives on debates (iv) guardian participation in debates. Existing tools and ideas were modified for context and used (e.g. Sadler, 2004;

Zeidler et al., 2009) for an evidence-based approach and for ensuring robust analysis. The first questionnaire assesses the impact of the teachers' engagement in the CPD workshops. The second questionnaire will explore the impact the debate intervention had on the teachers teaching and their view on the student learning. The third questionnaire will focus on students and their evaluation of engagement in the preparatory lesson for debates, the homework in preparation of the debates and their attitude towards the tasks following the debates. The fourth questionnaire will be prepared for evaluating the impact of the project on guardians' attitudes towards their engagement in the debate topics and their assessment of their children's learning through debates. Participation in and preparation for the debate was part of the classroom teaching and learning but participation in the evaluation/research was voluntary.

Open ended questions will be transcribed by the listed investigators. Thematic analysis will be performed according to Braun and Clarkes (2006) six phases: data familiarization, produce initial codes, look for themes, review themes, name themes and report themes. Closed questions will be analysed using SPSS. Perspective triangulation will be performed on survey data collected from teachers, pupils and guardians to check the consistency relating to their attitudes towards the use of social scientific debates. The success of the project will be measured for the quality of impact on teachers', students', and guardians' attitudes and understanding of socio-scientific issues and their engagement with socially relevant STEM topics.

INITIAL RESULTS

The teachers' evaluation questionnaire consisted of 16 questions, with 10 closed questions and 6 open questions. The following results are from the first phase of the data collection, to assess (i) teacher perspectives on the CPD (N=33). This data was collected after teachers completed the workshop sessions. Thirty two teachers answered the question "*Do you think argumentation is a relevant skill for students studying science?"* All of the teachers responded *yes*. One teacher commented "*It (argumentation) is a relevant skill for students studying science to further develop scientific thinking and a better understanding*". When the teachers were asked how often they used argumentation (Figure 1), 13% (n =32) of teachers responded *yes frequently*, 53% responded *yes infrequently* and 34% responded *no*. Teachers who selected infrequently referred to time constraints and argumentation not being part of the old curriculum. Another teacher who responded *no* stated "*Never thought of it, not my comfort zone*"

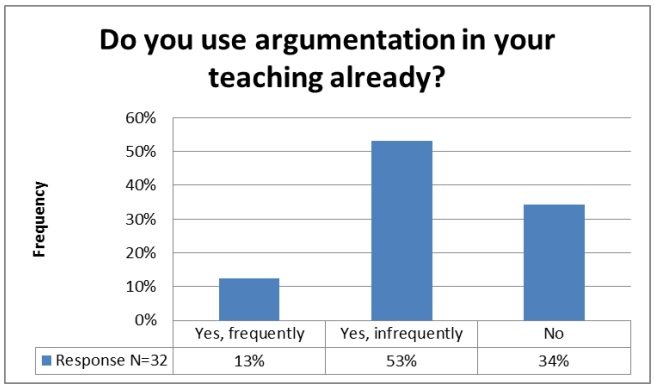

Figure 1: Teacher response to "Do you use argumentation in your teaching already?"

Teachers were asked if the resources supplied for the workshop were adequate for carrying out the project (Figure 2). Approximately 57% (N=33) of teachers *agreed*, 24% were *undecided* and 18% *disagreed*. Teachers who disagreed claimed that the language was too difficult for the pupils. One teacher stated "*The resources are far too advanced for junior cycle. The literacy level of some students is quite poor and the resources are very wordy*". In contrast, a teacher who agreed the resources were adequate said "*activities are very insightful about how to introduce argumentation into the classroom*".

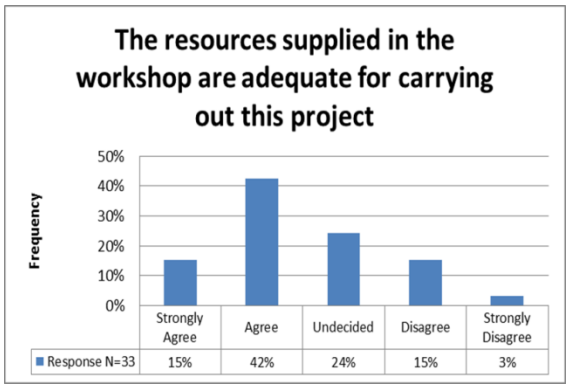

Figure 2: Teacher response to "The resources supplied in the workshop are adequate for carrying out this project"

The teachers were asked what their initial attitudes to running a debate were (Figure 3), 56% (n=32) said *positive*, 43% said *positive and negative*, 6% were *neutral* and 3% were *unsure*. No teacher responded that they had negative feelings. Teachers who had mixed feelings towards the use of debate could see the benefits however they were concerned about the amount of work it would require and also how students with learning difficulties would cope. One teacher who selected both positive and negative responded "*Good for average and bright students. Students with low literacy skills, not sure*". A teacher who responded positive said "*Exciting and engaging for students, empowering*"

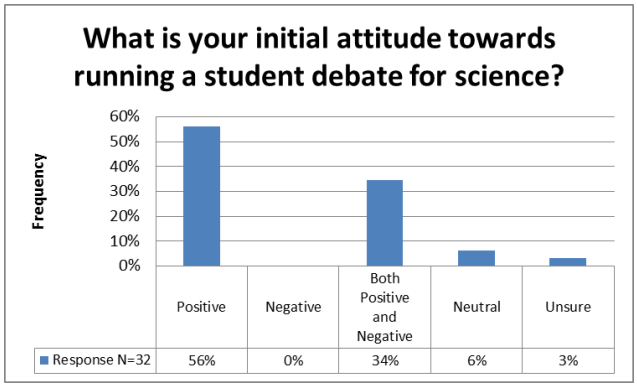

Figure 3: Teacher response to "What is your initial attitude towards running a school debate?"

The teachers were asked what their initial feelings towards involving guardians in homework tasks and attending the debate were (Figure 4), 28% (n=32) said *positive*, 66% said *positive and negative*, 3% were *neutral* and 3% were *unsure*. No teacher responded that they had negative feelings. One teacher who selected both positive and negative stated "*Some parents*

are very involved in students learning. Others would know very little of what students do in their lessons". Another teacher who answered *positive* noted "*Getting parents involved is extremely important to help 1st years settle into school"*.

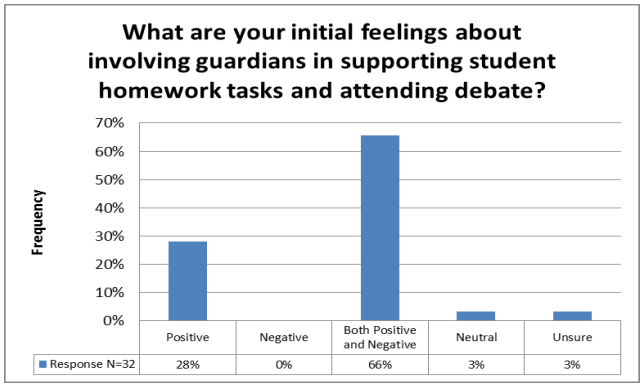

Figure 4: Teacher response to "What are your initial feelings about involving guardians in supporting student homework tasks and attending debates?"

CONCLUSION

It was intended to investigate if the CPD workshops support teachers' implementation of debates. Overall, the teachers believed the use of argumentation to be relevant, however prior to the workshop the majority of teachers infrequently used this strategy. Negative comments regarding the complexity of the language used in the resources were addressed by simplifying the text used. This revision increases the suitability of the resources hence improving their use in teachers' generic teaching styles. Teachers' initial attitudes towards the use of debate are positive as it assumes a student-centred approach in teaching and hence, it is likely to encourage teachers to adapt these strategies for use in their everyday science teaching as well. Furthermore, teachers' initial attitudes towards guardian involvement indicate that this project can provide a positive step to developing relationships between teachers and guardians with homework tasks. It can be considered an example model for schools, guardians and teachers in forging collaborations to ensure coherence between students' learning in different contexts. Project schools will have access to this model to implement in future years.

POTENTIAL LONG TERM IMPACTS

There are several potential long term impacts of the project: (a) Impact on teachers: The project will produce innovative resources and pedagogical strategies that are likely to influence teachers' generic teaching styles. In this sense, the project has the potential to contribute to teachers' subject knowledge. (b) Impact on students: The project will be based on a student-centred teaching and learning model. Empowering students in their learning processes is likely to improve motivation and engagement in STEM particularly when the issues have relevance to society. The skills of communication and argumentation that will be fostered through the debate lessons and the actual debates are transferrable not only to STEM topics but also more widely. (c) Impact on guardians: Target resources produced especially for guardians will be distributed which can act as guidelines for guardians which can potentially support guardians in supporting their children's STEM-related homework in the future.

References

Braun, V. & Clarke, V., 2006. Using Thematic Analysis in Psychology. Qualitative research in psychology, 3(2), pp. 77-101.

Erduran, S., 2006. Promoting ideas, evidence and argument in initial teacher training. School Science Review, 87(321), pp. 45-50.

Erduran, S., Ozdem, Y. & Park, J., 2015. Research trends on argumentation in science education: a journal content analysis from 1998-2014. International Journal of STEM Education, 2(5), pp. 1-12.

Leedy, P. & Ormrod, J., 2001. Practical Research: Planning and design. 7th ed. Upper Saddle River, NJ: Merrill Prentice Hall.

NCCA, 2015. Junior Cycle Science Curriculum Specification. [Online] Available at: http://www.curriculumonline.ie/Junior-cycle/Junior-Cycle Subjects/Science [Accessed Feb 2016].

Osborne, J., Erduran, S. & Simon, S., 2004. Ideas, Evidence and Argument in Science (IDEAS) Project. Video In-service Training Resource Pack. London: King's College.

Sadler, T., 2004. Informal reasoning regarding socio-scientific issues: A critical review of research. Journal of Research in Science Teaching, 41(5), pp. 513-536.

Simon, B., 2004. High school outreach and family involvement. Social Psychology of Education, 7(2), pp. 185-209.

Walker, J., Hoover-Dempsey, K., Whetsel, D. & Green, C., 2004. Parental involvement in homework: A review of current research and its implications for teachers, after school program staff, and parent leaders. [Online] Available at: http://kids-connect.org/homework.pdf [Accessed Jan 2016].

Zeidler, D., Sadler, T., Applebaum, S. & Callahan, B., 2009. Advancing reflective judgment through socio scientific issues. Journal of Research in Science Teaching, 46(1), pp. 74-101.