**Teaching Science using socioscientific inquiry-based learning: uk pre-service teachers’ perspectives**

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*In recent times there has been increased interest in how issues surrounding science for and with society are conceptualised, presented and discussed in science classrooms in a way that promotes active citizenship. One approach to enabling this way of teaching science is through socio-scientific inquiry-based learning (SSIBL). To promote the teaching of science using SSIBL, teachers need to have the appropriate teaching repertoire. Our aim was to work with secondary science pre-service teachers (PSTs) to explore the process of developing teaching skills consistent with SSIBL during their training year. Using a qualitative, interpretative design we report on PSTs’ in-depth views and perspectives of SSIBL, and the main affordances and constrains created when attempting to teach science using SSIBL. The research methods used include focus groups, interviews, lesson observations and evaluations, and field notes. Participants included 284 pre-service science teachers in two UK Higher Education Institutions, across two academic years. Our findings suggest that PSTs viewed SSIBL as a valuable approach for increasing both student attainment and engagement, by providing alternative ways to the traditional ‘teaching-to-the-test’ approaches they had previously experienced either as students themselves or as PSTs. Although PSTs experienced challenges with implementing SSIBL, initially on aligning it with the curriculum and subsequently organising and managing the learning environment, they continued to value this approach. Implications for teacher education are discussed.*

*Keywords*: socio-scientific issues; secondary science; pre-service teacher education

Introduction And Rationale

In recent times there has been increased interest in how issues surrounding science and society are conceptualised, presented and discussed in science classrooms (Zeidler, 2014). One way of promoting this way of teaching and learning science is through socio-scientific inquiry based learning (SSIBL), an approach that combines the teaching of science using socio-scientific issues (SSI) with inquiry-based learning (IBL) and citizenship education (CE) as a way towards achieving increased understanding of responsible research and innovation (RRI) (Levinson, in review). SSIBL can be operationalised in science education by (a) contextualising topics into authentic scientific questions and areas for investigation, (b) enacting SSIBL practices using strategies such as mapping controversies of SSIs, deliberation and discussion, scaffolding inquiry and considering the nature of science, and (c) taking action as this emerges from students’ inquiry. Attempts to implement the principles of SSIBL need to take into account the extent to which practising and pre-service teachers (PSTs) are willing and prepared to utilise SSIBL, and how they can be supported in doing so. For instance, Topcu et al. (2010) report that when engaging in SSI scenarios on topics such as gene therapy and human cloning, PSTs’ reasoning and argumentation during activities varied. Our aim was to work with secondary science PSTs to explore the process of developing teaching skills consistent with SSIBL. The research question posed is: *What are UK pre-service teachers’ perspectives on SSIBL and on its enactment as they learn to teach science?*

Methodology

Our study utilises a qualitative, interpretative design, to capture in-depth views of PSTs (Creswell, 2009) as they engage in professional development (PD) to develop SSIBL teaching skills during their teacher-training year in two UK Higher Education Institutions (HEI). Bell and Gilbert (1996) argue that for PD to be effective it needs to be (a) social/collaborative, with teachers sharing and exchanging views, (b) professional-based, where teachers develop their ideas of the area they are working on, and take action upon it, and (c) personal, with teachers developing a positive stance towards the new learning. Based on these principles we designed a series of PD sessions as part of the PSTs’ training year. This included session on SSIs and IBL and their place in the UK national curriculum, how aspects of SSIBL are practised in their placement schools, and how they could enact SSIBL within their teaching practice. Participants took part in SSIBL scenarios as learners (e.g. exploring questions such as ‘Would you vote against drugs testing on animals?’ and ‘Is it our fault our planet is getting hotter?). They then worked collaboratively in designing lessons around these topics, which they taught and reflected upon. The research methods used were focus groups, interviews, written reflective narratives, lesson observations and evaluations, and field notes, with data collected during 2014-15 and 2015-16. The full set of data/findings to be presented at the conference. The sample consists of 194 PSTs in HEI1 and 90 PSTs in HEI2. All audio-recorded data were transcribed and the constant comparison method was used to identify key themes of PSTs’ views of SSIBL and how it was enacted in secondary science classrooms.

Findings

Overall, findings suggest that PSTs viewed SSIBL as a valuable approach from multiple perspectives (Table 1). Reflecting on their own experiences as science learners, our participants noted their willingness to teach science in a more engaging and interesting way compared to their own experiences as students. The active engagement of their students in the learning process was also identified as important for using SSIBL. As one PST noted: *“SSIBL to me is probably the best way that I think learning should be because it is a way of delivering knowledge but not in a "here's just a bunch of facts"; it's a way of introducing concepts and how scientific processes work but in a way that allows the students to ask lots of questions, and come to their own [view], sort of create their own knowledge about a particular idea […]and just their ability to ask why is that happening, how is that happening, should that be happening, which you know it's definitely my type of learning” (PST13, June 2016 interview).*

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| Table 1. The main themes identified of PSTs’ views on the value of SSIBL  |
| **Theme** | **Extract from PSTs’ comments** |
| **Prior experiences as learners of science** | ‘It’s [SSIBL] the only way to go forward really, I'm really quite passionate about science but I found it really boring at school’ (PST6, focus group Nov15) |
| **Beliefs about teaching & learning** | ‘Say we just got to go through the exams, so we don't have time to do that, well maybe that's why they [students] are less interested, because at GSCE they are just being told you need this for the exam, you need this for exams, and they don't get any time to link it to the real world so maybe if you took the time to put the creative effort on it and made it all more real for them then they would actually enjoy science more and then maybe they would get a better grade because they retain more of it’ (PST8, focus group November15)‘SSIBL provides an effective mechanism for increasing both student attainment and engagement’ (PST12, written reflective task May15) |
| **Experiences as teachers of science** | ‘Students were very engaged and excited about the results they were getting (student-created survey about why teenagers smoke). They could see how they were going to use scientific information in their lives in something that really interested them’ (PST11, lesson evaluation April14) |

PSTs shared some common concerns about enancting SSIBL, such as the role of science subject knowledge and how this can be taught effectively through SSIBL, and the increased pressures that science teachers in the UK face to deliver a subject-knowledge heavy National Curriculum. PSTs’ reflections of enacting SSIBL lessons illustrate the tensions between teaching conceptual knowledge and science for everyday life:

*“[I]have witnessed for myself how the interest of the students increases. I also believe giving students the opportunity to explore the range of thinking and skills associated with science is more important than just teaching them facts to regurgitate. However, I have also experienced how hard it is to always incorporate this into your teaching, especially when battling with meeting the high demands of the curriculum”* (written task 1, January15, PST12)

Another tension that was identified in the PSTs’ enactment of SSIBL was the varying success they had in balancing the SSI with the IBL aspects of SSIBL. For instance, PST12 chose to teach a series of lessons on the effects of drugs to 13-14 year olds, and in doing so she planned her lessons mainly promoting aspects of IBL, and links between science and society were not as explicitly addressed or discussed with students. Conversely, PST13, who designed and taught a lesson on organ transplantation and emphasised the SSI element of SSIBL, which was in line with her views on using SSIBL to teach science since she commented in her interview that she found SSIs easier to implement *‘because inherently they tend to be interesting’* for students (interview, June16, PST13). Another challenge was creating a student-centred environment, discussed mainly in relation to the organisation and use of argumentation collaborative activities. Discussion-based activities and the consideration of different types of knowledge and values are important aspects of SSIBL, but these are aspects that teachers consider challenging and require further support with (Sampson & Blanchard, 2012). Lesson observation data further illustrate this challenge as in many of the SSIBL lessons observed, the PSTs’ questioning did not link prior factual knowledge to students’ reasoning and discussions: *“although I did have scaffolding questions in the lesson none of them really did link back to the science [content] even though at the time when I did them I thought this will guide them down the right road […]. So how can you actually build that into a lesson?”* (Interview, June16, PST13).

Discussion and Conclusions

PSTs who implemented SSIBL reflected positively on pupil learning and engagement, which supported the PSTs’ sense of success and their self-efficacy in relation to their teaching abilities. The reported impact on students’ engagement and learning seemed to make the participating teachers even more willing and motivated to continue with their efforts to adopt a SSIBL-oriented teaching practice (Shulman & Shulman, 2004). Creating a more student-centred classroom environment was a major challenge for PSTs, a finding which is consistent with related work with in-service teachers (Laius et al., 2009). Therefore, we argue it is important that teacher education about SSIBL should combine the need for (a) experiencing SSIBL in action in a supportive, collaborative environment for developing SSIBL teaching skills, with (b) developing science teacher identities (Avraamidou, 2016) consistent with such an approach. Implications for teacher education include the need to work more closely with PSTs on identifying critical moments in their training that help them develop SSIBL teaching practices education and integrating the SSIBL dimensions including personal relevance and taking action (Vesterinen et al., 2016) in relevant areas of the curriculum they are asked to teach.

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