Researchers and practitioners as co-designers of a learning environment in Biotechnology

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Abstract

There is a need to create learning communities of researchers and practitioners for designing motivating and sustainable curricula in science education. This work examines the process of participatory design of a diverse design team, consisting of two researchers and three educators, as they collaborated in developing an innovative web-based inquiry learning environment on the socio-scientific issue of genetically modified organisms. The data collected came from ten two-hour meetings and took the form of field notes, artifacts and videotapes of the meetings, which were later transcribed. The data were analyzed qualitatively, following grounded theory design, with coding and analysis focusing on identifying the challenges each team member faced and the tensions created along the design process. The analysis identified several challenges. Findings point to the need for structuring co-design experiences around activities for building common ground, initiating new members to the process of design, and helping them get acquainted with the rules of the game, especially when the work involves innovative software environments which challenge long established ideas about the teaching of science. A surprising finding was the strong disagreement, between the biologists, about the methodological approach in selecting the data for the inquiry environment. This tension was created by different views on the Nature of Science held by each teacher and points to the need to build such discussions into the frame of work of collaborative and participatory design teams.

Extended Summary

1. Aims

Science education in Europe falls short of the vision of preparing scientifically literate citizens who can engage in sound reasoning about everyday complex scientific issues (Osborne & Dillon, 2008), such as the consumption of genetically modified (GM) food. At the same time, there is evidence that students become disinterested in learning science and following science careers. Reform-based materials in science education often employ learning technologies, as a means to increase student interest and promote deep conceptual learning (Krajcik, 2003). However, researchers have often observed lethal mutations of innovative learning environments (Brown & Campione, 1996). To overcome these obstacles, researchers have called for the active involvement of teachers in the design teams, emphasizing that successful implementations require mutual adaptation of both curricula and practices (McLaughlin, 1987).

In this study we examined the ongoing collaboration of a diverse design team, consisting of researchers and practitioners, during the development of a web-based inquiry learning environment. The learning scenario held students responsible to reach an evidence-

based decision on whether their country should allow cultivation of GM plants. Data analysis focused on identifying challenges and tensions among team members, seeking to understand how the participants' differing roles and perspectives influenced the process of collaborative design.

2. Methodology/research design

The collaborating team (LWG) consisted of two university researchers, with background in science education and learning technologies, and three teachers with several years of teaching experience. One of the researchers was also the designer of the web-based platform used. Two teachers taught Biology in high school, while the third taught in elementary school. One of the high school teachers has a Ph.D. in Biology, while the elementary school teacher has a Ph.D. in Geography. The third teacher will enact the learning environment in her class. The teachers were chosen through a competitive application process at national level.

To-date, ten two-hour LWG meetings were completed within a period of the first six months of this three-year effort. The design-process was documented through researchers' notes,videotaped meetings and artifacts (email exchanges and PowerPoint presentations). Video data were transcribed and coded using qualitative analysis software and data coding and analysis were conducted using grounded theory. The analysis focused on identifying design challenges and tensions, and examining commonalities and differences between researchers and teachers.

3.Findings

All tasks that related to designing the learning environment were completed in a collaborative manner and in cases of work load distribution, the input of all group members was discussed during the meetings to reach final decisions.

A preliminary analysis revealed several major challenges: LWG members had different foci coming into the meeting. The teachers were excited about participatory design but had little experience in it. During initial meetings the researchers realized the need to establish common ground and focus the discussion on scientific data for the inquiry environment design. This challenge was resolved by introducing written, top-down guidelines for design. As a result, a challenge that was initially shared by the researchers became, in time, a common challenge that the group accepted and appropriated: as a result, the search for raw scientific data from experimental studies became the focus of the team's efforts.

Another challenge, initially only shared by the researchers, was the constraints imposed by the affordances of the software platform. As educators did not have experience with the web-based platform or design, they often did not realize the technological and pedagogical

issues that needed to be considered. Through repeated focused conversations the team gradually framed the design possibilities.

During discussions regarding the most promising direction for the design of the learning environment, there was tension between the two biologists who held opposing views on methodology. One supported the inclusion of data from a small-scale experimental research over a three-year period in a controlled setting that provided comparable results, while the other supported data from a large-scale, 10-year review of research at the international level. Despite the researchers' intervention in meeting 6 to reconcile disagreements, the same issue was revisited in meeting 9. The issue was resolved when the lead-researcher offered a suggestion that satisfied both group members but required extra work on behalf of the team as both approaches had to be followed.

4. Theoretical/educational significance

Curriculum design and teachers' inevitable adaptation of the designed materials has long been kept as a black box. This work sheds some light about the challenges that teacher-researcher collaborations face on the design of innovative curricula. Findings suggest that considerable work needs to be done to understand each collaborating member's worldviews, build common ground between participants, and make design priorities explicit. The lack of initial noticing of the software affordances and constraints can be explained using a novice-expert framework, as teachers were novices in this effort and they had to be initiated into the design process and scaffolded on both emphasizing empirical data for the students' investigation and considering technological affordances. An unexpected finding was that having educators with significant scientific expertise led to different interpretations of methodological issues of the study and to ongoing conflicts. This may have stemmed from the fact that teachers differed in their views of the Nature of Science (Smith & Scharmann, 1998). This finding suggests that reflective discussions about theory and its implications about practice need to be built into the ongoing team discussions.

References

Jenkins, E. (2002). Research in Science Education in Europe: Retrospect and Prospect. In *Research in Science Education - Past, Present, and Future* (pp. 17-26).

Krajcik, J. (2003). The value and challenges of using learning technologies to support students in learning science. *Research in Science education, 32*, 411-414.

McLaughlin, M. W. (1987). Learning from experience: lessons from policy implementation. *Educational Evaluation and Policy Analysis, 9*, 171-178.

Osborne, J., & Dillon, J. (2008). Science Education in Europe: Critical Reflections. *A report to the Nuffield Foundation*.

Smith, M.U., & Scharmann, S.C. (1998). Defining versus describing the nature of science: A pragmatic analysis for classroom teachers and science educators. Science Education, 83 (4), 493-509.