Designing a module for authentic learning in upper secondary technology education

Joachim Svärd, Linköping University, Department of Social and Welfare Studies, S-601 74 Norrköping, Sweden,
+46735519171, joachim.svard@liu.se

Konrad Schönborn, Linköping University, Department of Science and Technology, S-601 74 Norrköping, Sweden,
+4611363609, konrad.schonborn@liu.se

Jonas Hallström, Linköping University, Department of Social and Welfare Studies, S-601 74 Norrköping, Sweden,
+4611363041, jonas.hallstrom@liu.se

Abstract

According to the Swedish upper secondary curriculum (Skolverket, n.d.), the subject of technology should allow students to develop entrepreneurial skills, defined as supporting curiosity, confidence, creativity and courage, resulting in the ability to act, in innovation and problem solving. Beghetto and Kaufman's (2014) view of creative learning includes, "having students identify a need and work collaboratively with each other and outside experts to develop a creative solution for that need will help them creatively and meaningfully use what they have learned in the classroom" (p. 65). This kind of learning is related to the notion of authentic learning. Herrington and Parker (2013) define authenticity by nine key elements, namely, authentic context, authentic task, presence of expert performances, multiple perspectives, collaboration, reflection, articulation, metacognitive support and authentic assessment. The aim of this study is to map key elements of authentic learning onto the development of a five-week innovation project for implementation in a Swedish upper secondary school context. Following design and a first round of module implementation, a subsequent pilot study has deployed written questionnaire and semi-structured interview methods to investigate students' opinions of the authenticity of the module and its outcomes. The paper also presents some early findings from this pilot study.

Keywords: upper secondary education, technology education, authenticity, module, Sweden, pilot study

Introduction

Designing authentic scenarios is a key challenge for any teacher, as risk taking, questioning, creating and imagining, cannot flourish under stressful conditions (Ciolan & Ciolan, 2014). Beghetto and Kaufman (2014) add that, "teachers should view themselves and their teaching as a creative act. They will then be in a better position to model, encourage, and support their students' novel ideas, sensible risk-taking, curiosity, and meaningful self-expression" (p. 65). Weimer (2013) has introduced Learner-Centered Teaching as a means to foster such an approach. This method requires teachers to transfer some of the teaching control to the students themselves, as well as encourage collaboration and reflective skills.

Authentic learning is described extensively in the literature, but with a major caveat; there is no clear-cut and operationalised definition for what elements actually constitute *authentic learning* per se. For example, the idea can comprise multiple aspects depending on whether you are a student or a teacher, on whether problems need to be perceived as authentic by the pupils themselves or with regard to technological praxis, as well as on the meaning of the term in relation to technology programmes (Turnbull, 2002). Furthermore, Turnbull (2002) has also asserted that an underlying challenge is having the idea of authenticity implicit in the curriculum in a manner that is both meaningful *and* useful to students. According to Hennessy and Murphy (1999), successful authentic activities that are associated with engaging and encouraging learning are those that are personally meaningful to the student, and purposeful from a societal point of view. Such an approach often takes the form of getting pupils to solve problems seen as real dilemmas where the pupils also become emotionally engaged in finding a solution to the problem. In a broad sense, most people concur with ideas such as authentic learning being about real-world problems dealt with within ill-defined borders in order to promote "21st Century Skills" such as creativity, critical thinking and problem solving capability (Brown, Collins & Duguid, 1989; Collins, Brown & Newman, 1989; Herrington, Reeves & Oliver, 2010; Nicholl, Flutter, Hosking & Clarkson, 2013; Reeves, 2002).

In terms of the connection of 21st-century skills with ideas of authentic learning, Rotherham and Willingham (2010) lucidly suggest that, "advocates of 21st-century skills favour student-centered methods–for example, problem-based learning and project-based learning–that allow students to collaborate, work on authentic problems and engage with the community" (p. 19). We also find such aspects of direct relevance to the idea of authentic learning in teaching. The aim of this paper is to map key elements of authentic learning onto the development of a five-week innovation project for implementation in a Swedish upper secondary school context. One advantage for students familiar with authentic learning is that due to the complexity of the tasks, they develop an ability to validate sources of information, patience, strategies for finding relevant patterns in unfamiliar contexts, and flexibility in working across disciplinary and cultural borders to generate innovative solutions (Lombardi, 2007). In support of this view, Brown *et al.* (1989) suggest that, "… in order to learn these subjects (and not just to learn about them) students need much more than abstract concepts and self-contained examples. They need to be exposed to the use of a domain's conceptual tools in authentic activities – to teachers acting as practitioners and using these tools in wrestling with problems of the world" (Brown *et al.*, 1989, p. 34).

Reeves, Herrington and Oliver (2002) characterise authentic activities as having real-world relevance, being ill-defined, complex and requiring a longer time to solve, providing opportunities for students to examine the tasks from different perspectives, providing collaborative and reflective opportunities, integrating different subject areas, including integrated assessment, ending in a polished product not part of a series of prepared steps, and, finally, being open to different answers or solutions. In a major study of Chicago schools, Newmann, Bryk and Nagoka (2001) found a significant difference in performance between students exposed to authentic classroom tasks and those who were taught in a traditional manner. No matter what group or background they analysed, the students always benefitted from being taught authentically in school.

Authentic tasks in technology

Typical for technology education is the focus on the process of design and development rather than merely on the learning of knowledge. Solving real-world problems enhances this ability. However, assessment of students' ability in designing and developing solutions is much more complex than the mere assessment of their knowledge and skills. The development of teaching activities to meet the demands of ever more complex daily life situations for students, involving new materials, technologies and systems, can be very demanding (Fox-Turnbull, 2006; Kimbell, 1997; Snape & Fox-Turnbull, 2013). In this regard, de Vries, Hacker and Burghardt (2010) assert that:

> Teaching about technology and engineering is a challenge, given the impressive speed of technological development. If the goal is to educate for the future instead of the present or past, rapid changes in the technological domain make this work challenging (de Vries *et al*., 2010, p. 15).

It is within this context we set out to develop a new teaching approach in Swedish technology education. All students in the Technology program at upper secondary level in Sweden have to attend the course *Teknik 1* (Technology 1), which makes it a good candidate course to study any potential intervention. Since we are interested in studying the effects of an authentic learning activity, a major product- or service development project will be included in the course, so that students can work authentically, in line with Beghetto and Kaufman's earlier assertion.

An Innovation Project (IP), where the students plan their own work, adopt their acquired skills and knowledge and test their abilities in an authentic real-life project, could be a task that could potentially result in the desired effect of nurturing keen and eager students (cf. Nicholl *et al*., 2013). The IP should last the entire first year at upper secondary school, but in the form of various smaller components and one major component of about 5 weeks. The students spend 26 – 40 hours of the total allocated teaching time on the project (up to a third of the entire course). The available time spent on the innovation project also depends on the possibility of cooperating with other STEM subjects and language subjects such as Swedish and English.

According to Herrington & Parker (2013), the key elements of authenticity are: Authentic context, Authentic task, Presence of expert performances, Multiple perspectives, Collaboration, Reflection, Articulation, Metacognitive support and Authentic assessment. Following the mapping of these key elements onto development of the IP module, a subsequent study will be conducted to investigate the influence of the module in the teaching of technology, as well as other subjects, in upper secondary schools.

Methodological perspectives

In a series of videos available on the internet, Herrington demonstrates examples of questions one could ask as to whether the conditions in each of the elements of authenticity are met. We are using these questions as a source of inspiration when designing questionnaires to be filled in by the students after the pilot study (http://authenticlearning.info /AuthenticLearning/Home.html). Since Ciolan and Ciolan (2014) have shown great discrepancies between the teacher's point of view and the student's, it could also be interesting to compare the view of the group with one of the teachers, by posing questions such as, Does the engagement during the IP module affect the outcome of the project? Do the students feel a higher degree of satisfaction with the outcome? Other interesting aspects to measure are how the entire course is perceived by posing questions such as, Did the course increase motivation among the students in other subjects such as Science, Mathematics, Swedish or English? Is there a correlation between perceived authenticity and grades in Technology? Has the course changed the students' ideas about the future? Do they see themselves as future engineers or designers? We hope to respond to such questions to some extent at the end of the study, after having analysed the questionnaires and interviews with approximately ten students. The pilot study took place during January and February 2016.

Preliminary results and significance of the research

The mapping of the nine elements of authenticity to an IP module (Table 1) and the results of the pilot study will inform the subsequent investigation of implementation of the module at a number of schools, involving more teachers and students.

Table 1. Mapping of nine elements of authentic learning to the design and proposed implementation of an innovation project (IP) module.

Element of authentic learning	Characteristics of the element (based on Herrington, n.d.; Herrington et al, 2010)	Example of proposed implementation of element in the (IP) module
Authentic context	•A design to preserve the complexity of a real life setting. •Provides the purpose and motivation for learning. •Ideas can be explored at length in the context of real situations.	The purpose of the project is a solution to a real-world problem. The task is constructed by the students themselves and has no pre-determined sequence that it should be solved in. Only a few things are mandatory, such as presentation at an exhibition at the end of the IP module.
Authentic task	•Clear goals and real-world relevance. •Require production of knowledge rather than reproduction. •Complex and ill-defined. •Completed over a longer period. •Tasks that can be integrated across subject areas.	The project is presented at an exhibition at the end of the main project. At this exhibition students present their solutions in a business-like manner, trying to interest the visitors in their solution with any appropriate tools such as digital presentations, information leaflets, business cards and verbal communication.
Expert performances	•Access to the way an expert would think and act. •Access to learners at various levels of expertise. •Opportunities for the sharing of narratives and stories. •Expertise is distributed.	Extensive search for information over the internet. The students can contact experts at companies and universities.
Multiple perspectives	•Not just a single perspective - such as a textbook. •Different perspectives of topics from various points of view. •Varied forms of media on the web.	The task should be solved using the best possible sources of information, regardless of whether this is through books, companies, organisations, the internet, or other sources.
Collaboration	•Teams or pairs rather than individuals. •Collaboration encouraged through technology. •Task addressed to groups, not individuals. •Appropriate incentive structure for whole group achievement.	The task is solved in groups of 3-4 students. Documentation is shared within the group, with the teacher, and through Google Docs. The performance of the group, rather than the individual, is the most noteworthy.

Reflection	•Opportunities to make choices. •Students are able to return to any part of the project if desired. •Opportunities to compare themselves with other students and experts.	Since all work is done within the group and over a significant time, there is plenty of opportunities for discussion and reflection during the process. At the exhibition the students evaluate the other groups' work. The evaluations are compiled by the teacher and the result is handed to the group members. After the exhibition, the students write individual reports on the project and reflect on what they have achieved and what they would have altered.
Articulation	•Public presentation of argument to enable defence of position and ideas.	The students prepare a professional presentation of their project at the exhibition. And present it roughly as many times as there are students present. This is especially demanding if there is an external professional present. Besides the oral presentation, they have to produce digital presentations, e.g. Power Point slides, leaflets and a technical report. It is important that the finished product or service is as professionally presented as possible.
Metacognitive support	•No attempt to "transmit" knowledge. •Teacher's role is supporting rather than didactic. •Collaboration where more able partners can assist.	The teacher's prime task during the project is to provide scaffolding support for students, principally at the metacognitive level. No real teaching should take place during the IP module.
Authentic assessment	•Seamless integration of assessment and task. •Opportunities to craft polished performances. •Significant student time and effort in collaboration with others.	The finished product / service is assessed primarily by other students, but preferably also by an external professional. If the project is successful, it is also possible to enter innovation competitions such as *Blixtlåset*, where the project is scrutinised by a professional jury.

Initial analysis of the level of authenticity as perceived by the students, showed an average of 65%, which incidentally, is similar to a study conducted by Bozalek *et al.* (2013) in a South African context (see Figure 2 and 3). The Radar chart (Figure 4) provides an easy-to-evaluate representation of the projects investigated in the pilot study.

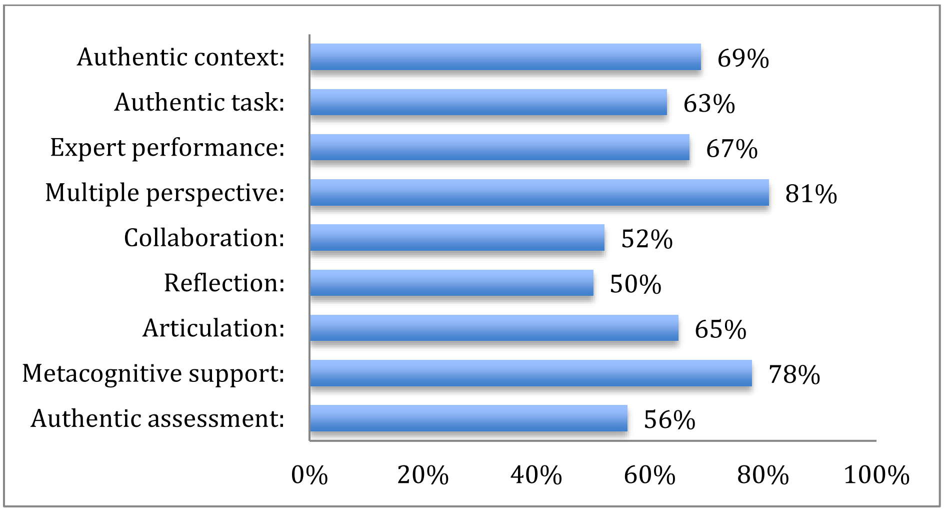


Figure 2. Level of authenticity per authentic learning element. Pilot study February 2016.

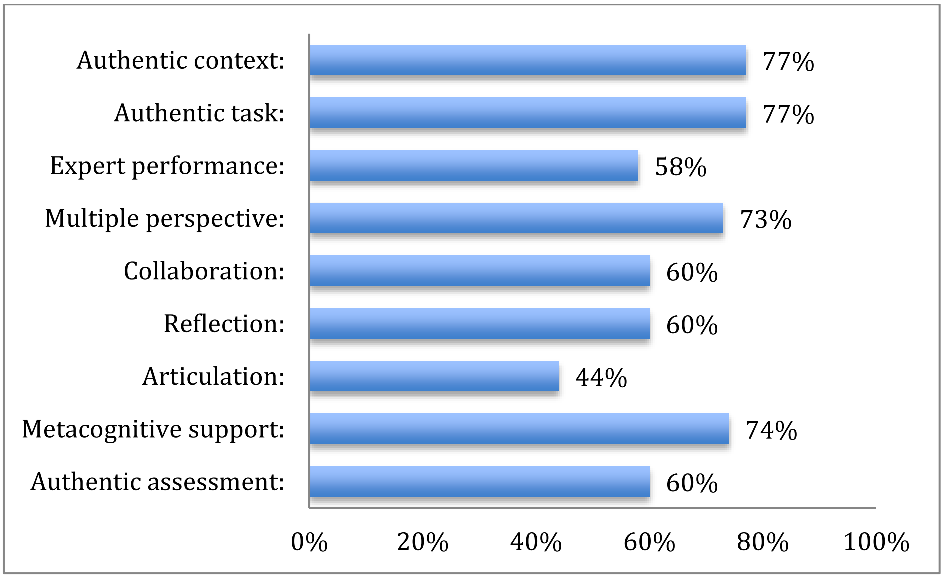
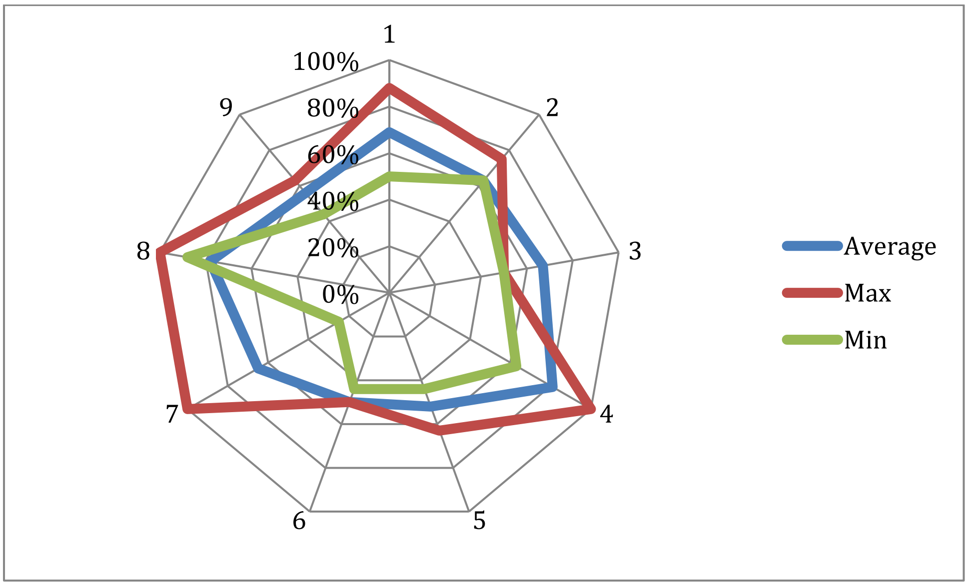


Figure 3. Level of authenticity per authentic learning element. Bozalek *et al.* (2013, p. 634).



1. Authentic context
2. Authentic task
3. Expert performance
4. Multiple perspective
5. Collaboration
6. Reflection
7. Articulation
8. Metacognitive support
9. Authentic assessment

Figure 4. Level of perceived authenticity per authentic learning element. Pilot study February 2016.

The evaluation of the pilot study followed the same principles as the South African study. Each parameter was given 0 to 2 points for level of authenticity by the group members, where 0 represents unauthentic result, 1 week signs of authenticity and 2 strong signs of authenticity. This results in an average score that was then divided by the maximum score, two. Figure 2 presents the average level of authenticity among all the participating groups in the pilot study. In figure 4 we present the same average levels of authenticity plus the group claiming the lowest and the highest levels of authenticity, for comparison. In the South African study the results come from 21 groups of students at different South African Universities, selected for showing signs of authentic learning. In the Swedish pilot study the data comes from all 13 groups of upper-secondary school students involved in the IP.

If any positive correlation between authentic learning in technology and measured results among the students (e.g. grades, enthusiasm etc.) is delivered, it could have implications for the teaching of technology in Sweden and elsewhere.

Implications and Future research

Authentic learning, as presented by Herrington's framework, provides a theoretically based definition that can be applied to inform the design of group activities that result in engaging, complex, and real-life tasks for students to act upon and find solutions to. Pilot study results indicate that the students were satisfied with the outcomes of the IP module. One compelling implication emerging from the pilot study is that students that entered the project having low self-esteem performed better than expected. Exploring implementation of the authentic learning module in the upcoming main study will aim to represent Turnbull's (2002) assertion:

> Authentic learning in technology education means that students need to be involved in practices which reflect understanding of the culture of real technological practice. Skills and knowledge are far less relevant and meaningful if taught in isolation. Students need to, and have a right to, understand the relevance and place of their learning (Turnbull, 2002, p. 39).

Unfolding future studies in the project will continue to pursue the question: Can an authentic innovation project module promote a deeper understanding and engagement in technology education, resulting in a genuine interest within students and meaningful learning outcomes?

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