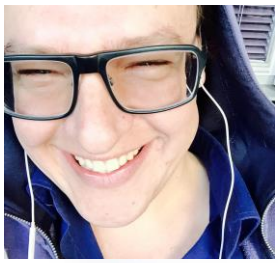
Does Authentic Learning Work? Evaluating an Innovation Project in Upper Secondary Technology Education in Sweden

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

Creativity is widely viewed as a key component of human development. Creativity is part of the "21st century skills" movement as well as a cornerstone of the *technology* subject in the Swedish school system. Could authentic learning, as described by Herrington, Reeves and Oliver, be one way to promote creativity? In a pilot study conducted in 2016, 13 groups of upper secondary students participated in a five-week authentic innovation project where they cooperated in the design of solutions for real-world problems. This approach mirrors Brown, Collins and Duguid's statement that in order to learn a subject, students need more than abilities that focus on acquiring abstract concepts; they need to use and apply conceptual tools while performing authentic activities. The outcome of the innovation project was displayed and presented at an exhibition where professional inventors provided feedback on students' created solutions. This paper presents results from the pilot study as well as preliminary findings from a main study, involving 25 groups, currently underway. Data from the pilot study was collected through questionnaires after each lesson, following the five-week module, and at the end of the entire course, as well as through semi-structured interviews with nine students. The results from the pilot study indicate that the students perceived the project as being authentic, and departed the course with an increased sense of comprehension and understanding. Future studies will explore learning activity within groups, and differences between students' and teachers' understanding of authenticity.

Keywords: Technology education, Upper secondary school, Authentic learning, Innovation

Introduction

Innovation is closely related to creativity and novelty. The Organisation for Economic Co-operation and Development provides the following definition: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (The Organisation for Economic Co-operation and Development [OECD], 2005, p. 46). Creativity is also one of the “four Cs” in the 21st century skills movement comprising Creativity, Critical thinking, Cooperation and Communication (Partnership for 21st century learning, n.d.), and flagged as a necessity in a reformed curriculum (National Education Association [NEA], 2012; Council of the European Community [EU], 2008). In 2008, the EU stated that schools need to foster creativity as well as a spirit of innovation and enterprise in their pupils. In the Innovation Project described in this paper, the demand for creativity and novelty was pitched at a “non-Googleable” standard. Here, the aim is to approach the definition of creativity as suggested by Plucker, Beghetto and Dow (2004, p. 90), who state that, “Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context”. The latter points to the fact that a creative act must be viewed within the context it is deployed, such as an upper secondary school.

The Swedish National Agency for Education defines Technology as a subject in upper secondary school that is interdisciplinary, aiming to fulfil human needs and preferences by transforming the physical resources of nature or immaterial assets in products, processes, facilities or systems (Skolverket, n.d.). The Innovation Project is thus not only interdisciplinary in nature but also student-centred and authentic, in line with Rotherham and Willingham’s (2010) claim that “advocates of 21st-century skills favour student-centred 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).

Authentic Learning

Authentic learning is described extensively in the literature, but with a major caveat; there is no universal and clear-cut definition for what elements actually constitute authentic learning *per se*. Eddy and Lawrence (2013) point to the Greek origin of “authentic” as being “auto” and “-hentes”, meaning “self-doer”, and state that “what lies at the foundation of ‘authenticity’ in learning is the notion that the individual is not only the learner, but also the doer” (p. 265). Such an insight connects strongly with Plucker *et al.*’s (2004) earlier assertion regarding the social context of creativity.

Authentic learning, as described by Herrington and Oliver (2000) in the form of key elements is built upon a situated learning paradigm previously described by Brown *et al*. (1989). In 2010, Herrington *et al*. defined nine key elements of authenticity comprising of *Authentic context*,

Authentic task, *Presence of expert performances*, *Multiple perspectives*, *Collaboration*, *Reflection*, *Articulation*, *Metacognitive support* and *Authentic assessment*. At the same time, they described the role of Authentic learning in an academic setting. This definition constitutes the basis for interpreting the meaning of authentic learning in the Innovation Project in this study.

The Innovation Project

Louis Pasteur once said that "chance favours the prepared mind" (Harnad, 2004), and school students are in no more a privileged position 150 years later. Therefore, prior to engaging in the Innovation Project (IP), basic knowledge and skills will have to be obtained. These include problem-solving skills, using "Six thinking hats" (De Bono, 1987), basic insights in material properties and processing, as well as fundamental drawing techniques, including the use of CAD.

Brown *et al*. (1989) have suggested that, "...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" (p. 34). It is in this spirit that the Innovation Project was formulated, enabling the students to plan their own work, adopt their acquired skills and knowledge, and test their abilities in an authentic real-life project, in line with the nine elements of authenticity (Herrington *et al*., 2010; Herrington, n.d.).

The IP was implemented for the entire first year of upper secondary school technology at the first author's school. This consisted of a 5-week period when the students spent about 20 hours of the total allocated teaching time working collaboratively in small groups of three to four students, solving a problem of their choice. The students are urged to tackle problems pertinent to their everyday life, and anything that does not have a trivial solution will certainly serve as a starting point for the IP. During these weeks, the students are aware of the fact that they are attending their own classes, not the teacher's class. The students plan and carry out their own projects, including searching for necessary information, appropriate materials and manufacturing techniques, analysing the potential market (including market research when appropriate), and calculating the financial aspects of the project. The project's main period ends with an exhibition where the students exhibit their results, mostly as models but also sometimes as operational prototypes. At the exhibition, the students are required to explain to fellow peers, interested viewers as well as invited professional inventors, how their product or service functions (Svärd, Schönborn & Hallström, 2016).

Methods

In the current study, 25 projects (groups of students) within the IP module were evaluated by the students themselves as well as by their teachers. The assessment was performed using a four-point Likert scale questionnaire, which enabled a possibility to both compare the results of the study by Bozalek *et al*. (2013) that used a three-point Likert scale, and Ciolan and Ciolan (2014), using all four points. Each student's evaluation was performed immediately after the exhibition at the end of the IP module. The questions about the IP module were designed in

such a way that students' opinions about the nine elements of authenticity could be obtained. The teachers used Herrington *et al*.'s (2010) guidelines to evaluate the group performances in a similar way.

Bozalek *et al*. (2013) used a three-point Likert scale to evaluate 21 university student projects in South Africa for signs of authenticity as described by Herrington *et al*. (2010). Scores of 0 (*no evidence*), 1 (*weak evidence*) and 2 (*strong evidence*) were assigned to each of the nine elements of authentic learning. The evaluation was made by five members of the research team and a mean value was used. The results were presented as a percentage of the maximum scores as assessed by the researchers. Apart from the percentage of each of the elements, a median score of authenticity was calculated for each of the projects, as well as for the entire study.

In the current study, when calculating the degree of authenticity of each of the elements, the four points were assigned the following scores; 1 (*0 – no evidence*), 2 and 3 (*1 – weak evidence*) and 4 (*2 – strong evidence*). A mean value was then calculated for each group. In this study we only have one teacher to evaluate the group, compared with having a mean value of five researchers per group in the South African study, resulting in an imprecise presentation. We therefor choosed to use all four points instead, resulting in the following percentages of authenticity; 0%, 33%, 67% and 100%.

Ciolan and Ciolan (2014) have shown great discrepancies between the teacher's point of view and the student's. We therefore compared the views of the student groups with those of the teachers. Using a four-point Likert scale made it possible to compare data from our study with the results of Ciolan and Ciolan (2014).

The findings of our 2016 and 2017 studies are presented together with the results of Bozalek *et al.*'s (2013) results to place the data into perspective.

Results

Findings from Bozalek *et al*. (2013) on the levels of authenticity in 21 university projects are presented in Figure 1, which also yielded a mean authenticity rate of 65%. The results from our respective 2016 pilot study and 2017 main study are presented in Figure 2, together with Bozalek *et al*.'s (2013) original South African study for comparison. The data in Figure 2 is also presented as a Radar chart in Figure 3. Interestingly, the mean authenticity rates for both the current 2016 and 2017 study were found to be 65%, which is similar to Bozalek *et al*. (2013).

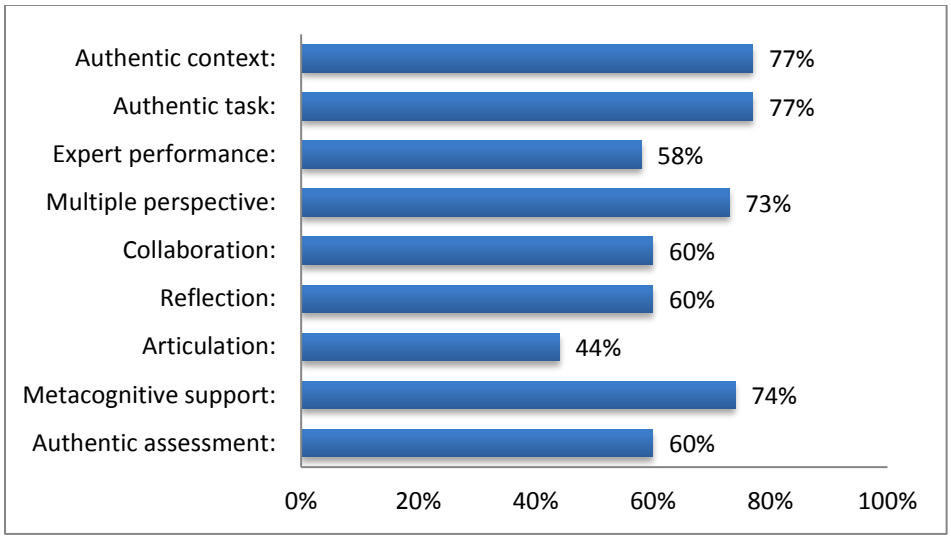


Figure 1. Students' perceived level of authenticity for each respective element of authentic learning found by Bozalek *et al.* (2013, p. 634).

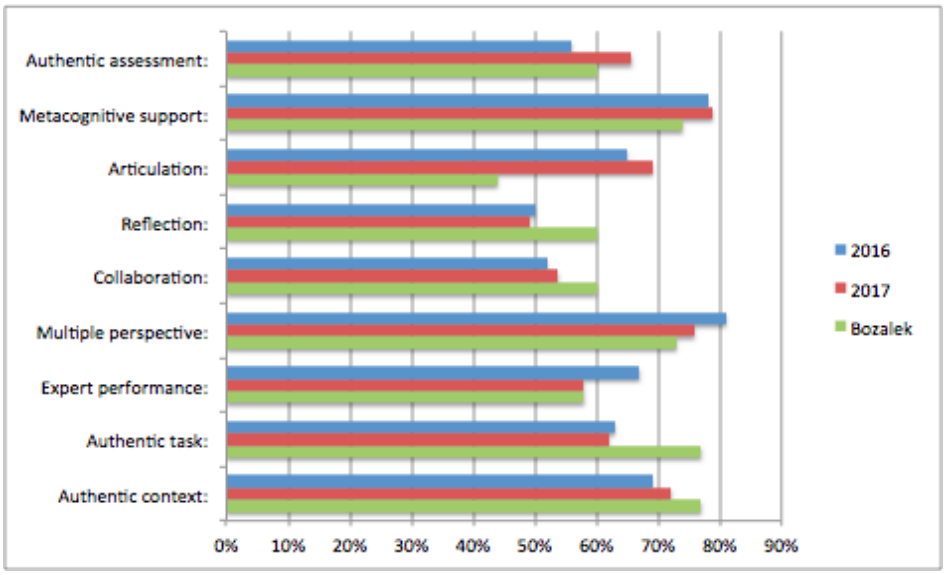


Figure 2. Level of authenticity per authentic learning element generated in the current 2016 and 2017 studies, and also compared with Bozalek *et al*.'s (2013) results.

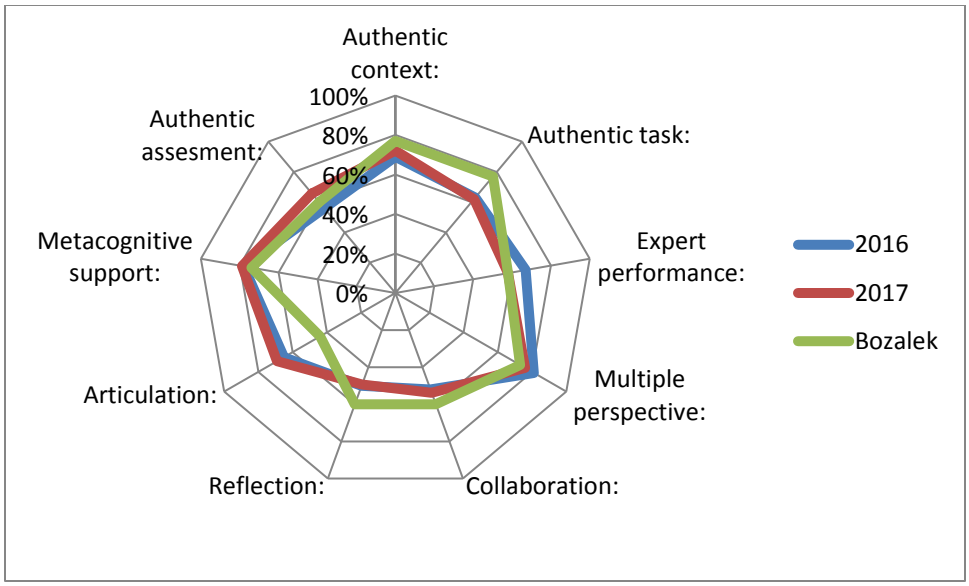


Figure 3. Radar chart representation of level of authenticity per authentic learning element in the 2016 and 2017 studies, and compared with the data from Bozalek *et al.* (2013).

The radar chart method was also used to explore the variance of results in the pilot study. In the 2016 pilot study, we found that the average authenticity levels of the groups ranged between 52% and 76%, with the average of all the 13 groups found to be 65% (Figure 4).

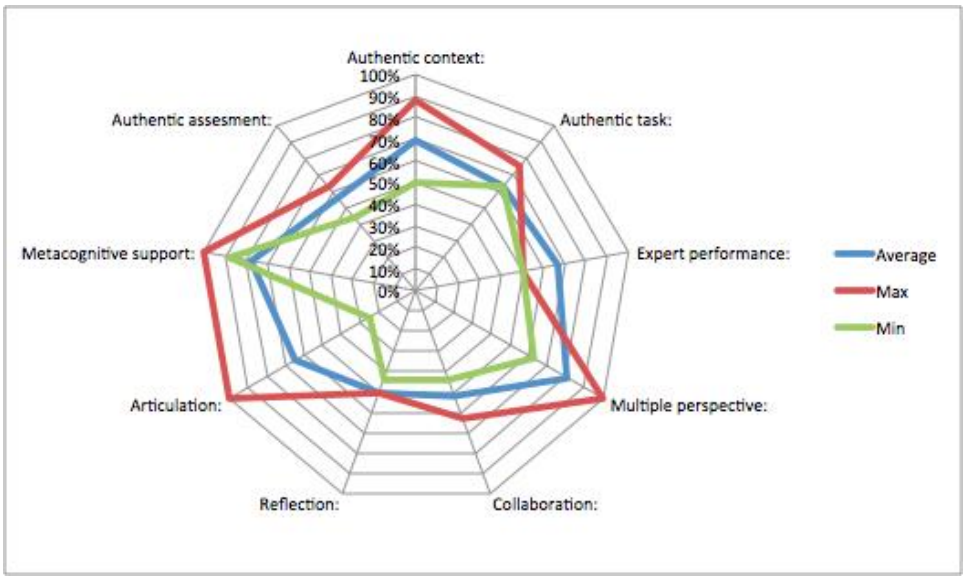


Figure 4. Minimum, maximum and average values of perceived authenticity per element obtained from the 13 different groups evaluated in the 2016 pilot study.

In the 2017 study, the dimension of more than one teacher being involved in the project was added. The data from the participating groups emerged with approximately similar values as in the pilot study, with a maximum value of mean perceived authenticity of 76%, minimum of 47%

and an average value for the 25 groups in 2017 at 65%. The maximum value was accomplished by two individual groups (Figure 5).

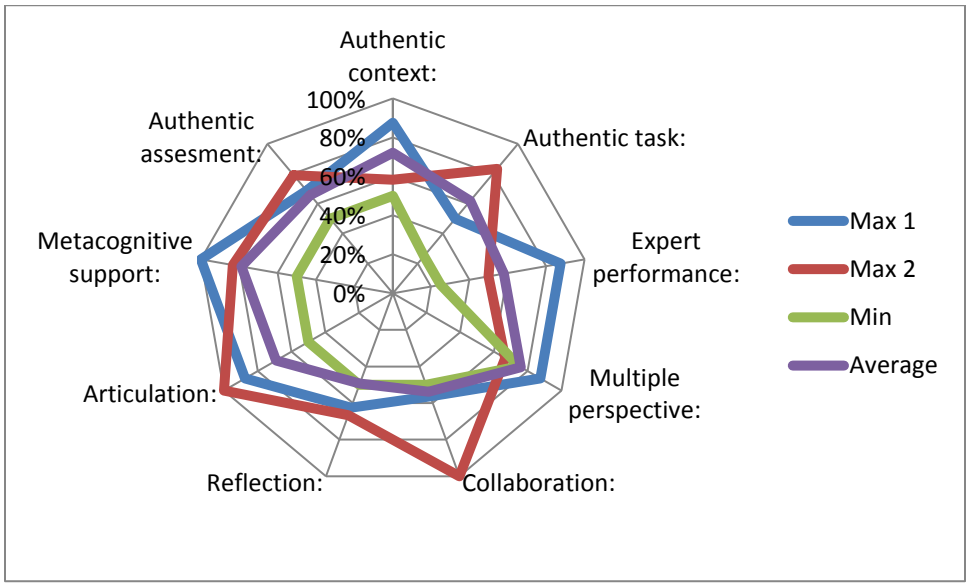


Figure 5. Data representing the most authentic groups (Max 1 and Max 2), the least authentic (Min), and average authenticity, as evaluated by the students themselves in the 2017 study.

The 2017 study also involved two teachers, which allowed for comparisons between different groups under different conditions. In line with Ciolan and Ciolan's (2014) findings regarding discrepancies in how authentic a task is perceived, we compared the views of different student groups with the teachers. Using a four-point Likert scale made it possible to compare data from these studies with the results of Ciolan and Ciolan (2014). As described in the methods, the teacher's evaluations were presented using all four points, instead of three as in the case of the students. The mean discrepancy between using a three or four-point scale was only 0,7%, but resulted in graphs that better represented teachers' views of the projects.

In Ciolan and Ciolan's (2014) work, the teacher evaluated the project as being more authentic than the students thought it was. This finding was replicated in the current study. On average, the teacher graded the projects as 12% more authentic then the students did with a range between –14% and +37% (Figures 6, 7 and 8).

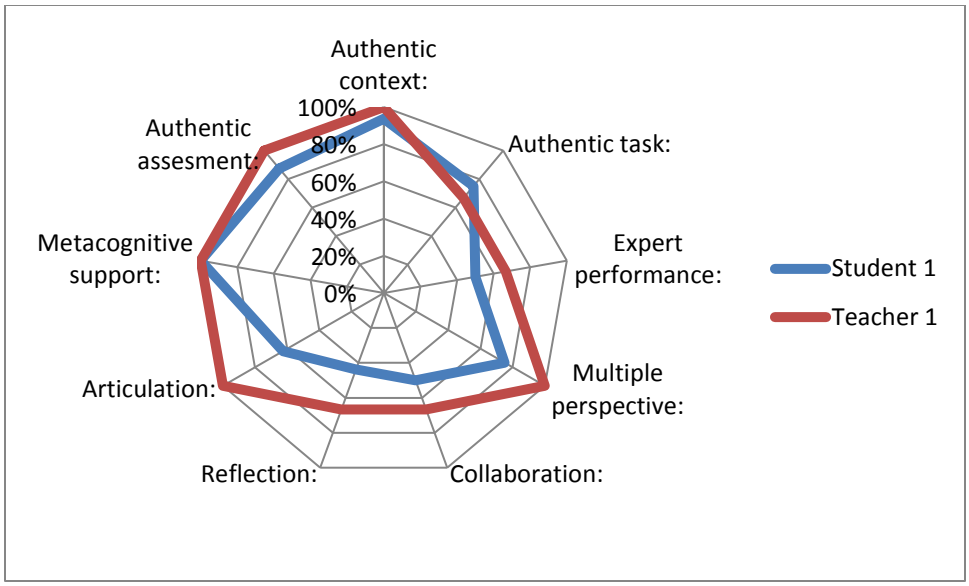


Figure 6. A typical result from the 2017 study for student group 1. The teacher evaluates the task as 85% authentic, and the students as 71% authentic.

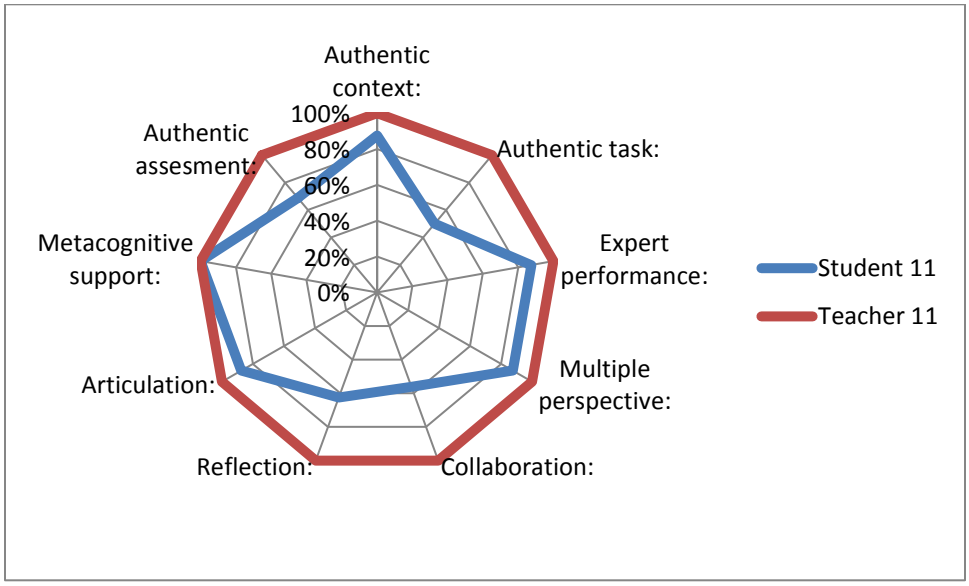


Figure 7. Authenticity of student group 11 as evaluated by the students and the teacher. This group, and three other groups, were identified as being 100% authentic by the teacher.

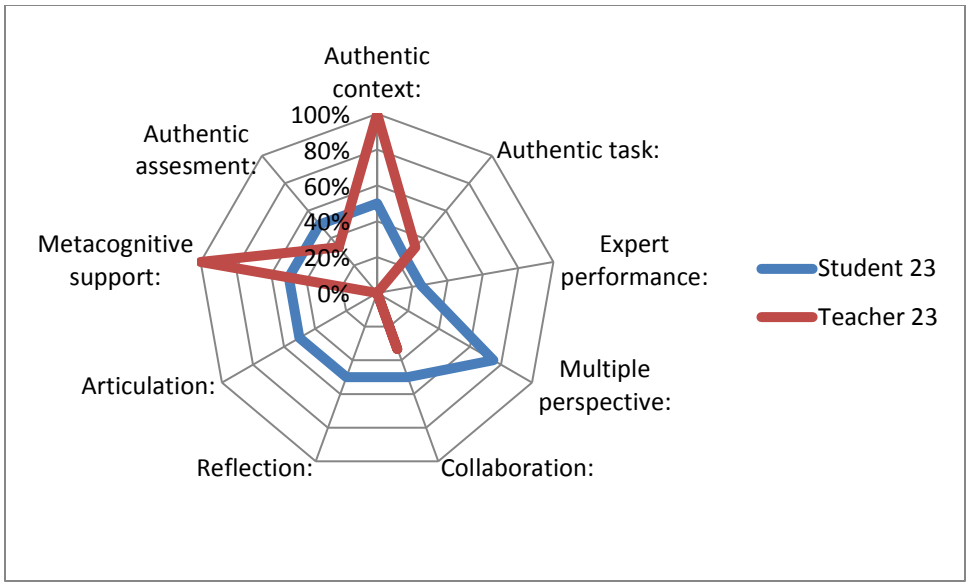


Figure 8. Five out of 25 student groups evaluated themselves as being more authentic than the teacher evaluated them as. Only two had a discrepancy of more than 10%. In this case, students evaluated the project as being 47% authentic and the teacher as 33%, respectively.

There is also a discrepancy between the two teachers in this study. Teacher 1, who was part of the 2016 pilot study, displayed a better conformity with the students' evaluations than Teacher 2, who joined the project a year later. This could possibly be due to previous experiences in evaluation according to Herrington *et al*.'s (2010) guidelines for authentic learning. Other differences are most likely due to different groups of students (see Figures 9 and 10).

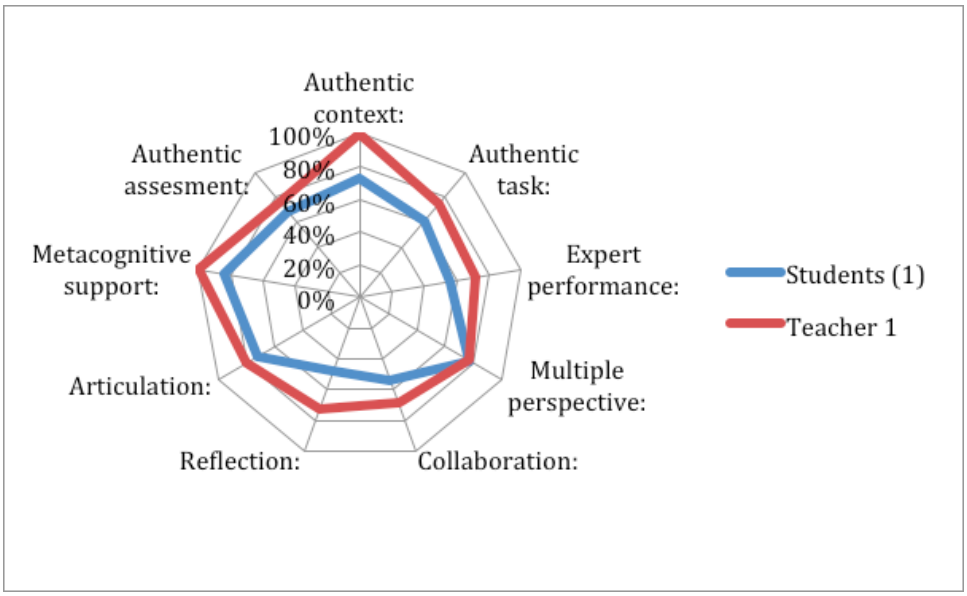


Figure 9. Authenticity as evaluated by Teacher 1 and corresponding students.

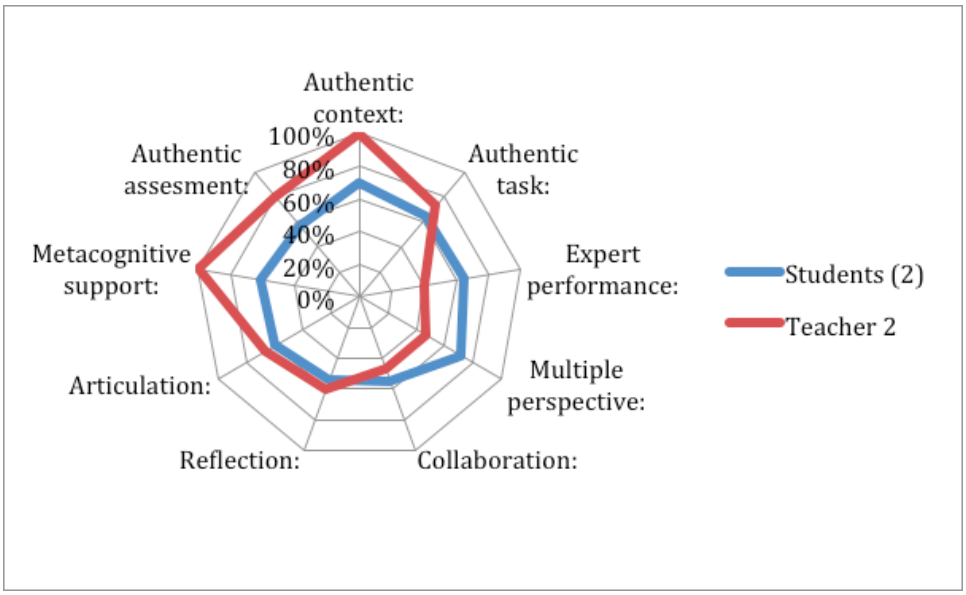


Figure 10. Authenticity as evaluated by Teacher 2 and corresponding students.

Discussion and Implications

The similarities between our 2016 and 2017 studies in Sweden, and the South African research context is an interesting platform from which to move the research agenda forward, at least when looking at the average evaluation of authenticity in which all studies scored approximately 65%. The fact that this score was obtained in all three studies is interesting bearing in mind that the evaluation was carried out very differently in the Swedish and South African studies respectively (students and teachers versus researchers). The contexts of the studies are also very different. While the Swedish studies were carried out in upper secondary schools, the South African study was conducted at university level. Further inspection of the results also reveals clear differences between the elements *Authentic task* and *Articulation*, for example. In this regard, authentic task received the highest score in Bozalek *et al.* (2013) while in our studies it was assigned the lowest scores. Regarding Articulation, in the Swedish context it emerged the other way around; a very high score in the Swedish studies but the lowest in the South African study. It is conceivable that the high score on Authentic task in the South African study was due to students being enrolled in higher education programmes in teacher education and health care where one can easily conceive an authentic link, whereas this was more difficult to achieve in the Swedish secondary school context. Conversely, the low score on Articulation in the South African study was probably due to traditional restrictions on presentation and assessment of student results, while in our studies we promoted a wide array of articulation techniques and authentic assessment. Also, the higher grades for *Collaboration* and *Reflection* in Bozalek *et al.* (2013) could be expected due to differences in age between upper secondary- and university students (also see Svärd *et al*., 2016).

The perceived authenticity of the IP module varied among the different groups of students, and it also varied among the teachers. However, on average, the teachers perceived the IP module as being more authentic than the students did. Concerning the differences in scores between the teachers and the students, our studies support the pattern of previous studies (e.g. Ciolan & Ciolan, 2014). At this stage in the research programme, we can only speculate about the reasons for this discrepancy. It is possible that the teachers, who initiated the IP module, were more positive at the start of the implementation. They also invested more time and energy in the project, and therefore they may have sought a positive outcome. In a few cases, the students evaluated their efforts as more authentic then the teachers did. One possible reason could be anxiety over receiving low grades by the teacher, even though students were assured that the study itself was not part of the grading process. This finding might call for group interviews with those groups that differed most from the teacher evaluation.

At the end of the study, after having analysed the various questionnaires and conducted interviews with some students, we hope to move closer to probing questions such as:

Does engagement during the IP module affect the outcome of the project? Do the students perceive a higher degree of satisfaction with the outcome? Is there any relationship between perceived authenticity and grades in Technology? Has the course changed students' ideas about their future prospects? And, do students see themselves as engineers or designers?

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