Tools to Facilitate Teacher and Student Collaboration in Assessment

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Abstract: This paper reports on an ongoing design based research project in which researchers and teachers collaborate to design, teach and assess STEAM units of work. Drawing on research on project based learning and interdisciplinary collaboration, we investigate two computer-supported tools that mediated between: students in groups reaching consensus on disciplines included in their project, and students and teachers engaging in self- and teacher-assessment using a rubric. We make recommendations for future iterations of the research.

Introduction and background

STEM education is a priority nationally and internationally, as countries identify areas of investment for future workforce planning. STEAM education includes the Arts (e.g. Herro & Quigley, 2017). STEM/STEAM education can include units of work that require students to make connections between discipline areas (e.g. Costin, Thompson & Chapman, 2018). STEM/STEAM learning environments provide challenges both for researchers to understand the interplay of teacher and learner activity, as well as for the design of assessment by teachers (Costin et al., 2018). Computer supported collaborative learning (CSCL) "refers to situations in which computer technology plays a significant role in shaping the collaboration" (Goodyear, Jones & Thompson, 2014, p. 440). Research that explores how individuals learn to work in interdisciplinary teams in graduate or professional settings (e.g. Pennington et al., 2015) focuses on the integration of disciplinary perspectives to create a shared model of a given system to then represent and mediate conversations about the phenomenon in study. Goodyear et al. (2014) argue that the computer component of CSCL can play different roles in the support of collaboration, including providing a visual representation of the task or scaffolding particular epistemic processes, such as knowledge building. In project based learning (PBL) students work in small groups where a question or problem organizes or drives activities, and these activities produce artefacts, products or solutions which address the driving question. (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991). Jonassen (2000) provides a description of eleven problem types: logical, algorithmic, story, rule-using, decision making, trouble-shooting, diagnosis-solution, strategic performance, case analysis, design, and dilemmas. For students to become intentional, constructive learners they need to assume some authority and take responsibility for their learning. Black and Wiliam (2009) identify the core role of peers in formative assessment (through peer teaching and collaborative learning) and the learner themselves (providing opportunities to develop metacognition, motivation, interest, attribution, and self-assessment). Boud and Falchikov (1989) state that "Self-assessment refers to the involvement of learners in making judgements about their own learning, particularly about their achievements and the outcomes of their learning" (p. 529). There have been several studies indicating a discrepancy between teacher or tutor evaluation of student work, and self-evaluation, even using criteria co-developed with students (Orsmond, Merry & Reiling, 2000). We present a STEAM unit of work developed over several years, as part of ongoing design-based research project in which researchers and school teachers work closely to collaboratively design, teach and assess STEAM units. We examine two computer-supported tools that mediated the collaboration between: students in groups reaching consensus on disciplines included in their project, and students and teachers engaging in self- and teacher-assessment using a rubric, and provide recommendations for the next iteration of the research.

Methods

Design-based research methods connect theory to the design of a particular activity, which is then implemented and evaluated (Sandoval and Bell, 2004). The combined design approach applied to the development of this project is explained in full elsewhere (Thompson et al., 2016). This study was conducted in an Australian high school, with eight girls and 14 boys in years 7 and 8. The curriculum for Government schools until Year 10 is mandated by a national body, the Australian Curriculum and Assessment Authority (ACARA). Given the different expectations of working for students in the STEAM areas, designing integrated assessment is challenging. Students participated in an 8-week program devised to scaffold independent STEAM inquiries in preparation for a local, regional science fair. The student STEAM projects were classified by the researchers according to Jonassen's (2000) typology of problem-solving. Data was collected using the students' portfolios. The assessment

rubrics were based upon standardised criteria sheets currently in use in the school. To encourage reflection and assessment literacy on the part of the student, a self-assessment rubric was included. In the results section we compare the overall score allocated by students and the teacher and investigate the elements of the rubric in which there was the greatest discrepancy in assessment.

Results and discussion
Applying Jonassen's (2000) typology of problem-solving, of the nine projects, six were classified as decision-making, one as trouble-shooting and two were classified as design projects. Students tended to over-estimate the number of disciplines included in their project, although most groups did identify a focus discipline aligned with the researcher's. The strongest similarity was the importance placed on Science, which was generally a heavily weighted component in the projects. Arts received the least weighting by students. The STEAM projects provided clarity in learning, experience in developing stages of inquiry, the integration of skills from different disciplines, and an opportunity to synthesise past learning with emerging learning. The rubric was not used effectively as a tool to negotiate project scope or expectations with these students.

Conclusions
The examination of the role of two tools to support collaboration and self-assessment has revealed the potential of enabling further student agency in STEAM units of work, and in subsequent iterations, the learning goals of the students will be more closely aligned with the rubric, negotiated with the teacher, and re-negotiated at key points during the Technology projects. By more closely scaffolding the different Science and Technology (design) processes, the rubric could be used to facilitate learning associated with metacognition, motivation and self-assessment. The effectiveness of project based learning, and in STEAM units of work is dependent on the willingness of educators to allow students to regulate and control their own learning, and the willingness of students to accept this responsibility.

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