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Pop Rocks! Engaging first-year geology students by deconstructing and correcting scientific misconceptions in popular culture. A Practice Report

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Abstract

Popular culture abounds with ill-conceived notions about Earth's processes. Movies, books, music, television and even video games frequently misrepresent fundamental scientific principles, warping viewers' perceptions of the world around them. First year geoscience students are not immune to pop culture's portrayal of earth science and the misconceptions they bring to Geology 101 cloud their ability to differentiate between fact and fiction. Working within an action research context, a semester-long assessment was designed with the intent to highlight and subsequently challenge students' misconceptions using examples of "bad geoscience" from pop culture. Students were required to practice and refine generic skills within this context. This project succeeded in engaging students, but requires refinement to become more effective in enhancing their geoscience literacy.

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Introduction

Numerous challenges plague first year education in the geosciences. Foremost is that the majority of students entering university lack an appreciable geoscience background (Moore, 2010). High schools, if they offer any geoscience at all, typically pitch geology at such a low level that it is stuck with the pejorative moniker "rocks for jocks" (Holbrook, 1997; van Norden, 2002). Thus, the general populace perceives geology as an "easy" science and a waste of time for the exceptional students. Most schools also cite the lack of qualified staff as a major barrier to offering earth science programs (Tompkins, Dawson & Moore, 2010). Australian school leavers commonly have no idea what a geologist actually *does* and are motivated to study geology purely by the lure of big money from the mining sector (personal communication, Jo Watkins, Executive Officer, Earth Science Western Australia, February 18, 2011).

The weak earth science foundation of school leavers means we must start from the most elementary principles in first year geology programs. Hence, this broad and dynamic subject is commonly taught with an emphasis on memorization and "regurgitation" of principles and "facts," rather than as a scientific process and a way of understanding dynamic systems to solve complex problems (Buchwald, 1997). It is the exceptional program that engages students from day one with level-appropriate authentic learning activities (Buchwald).

Traditional first-year geology curriculum provides students few opportunities to exercise creative problem solving skills and develop generic skills in a supportive and formative environment (Buchwald, 1997). Teaching and assessment in the first year rewards memorization, yet students are plunged into authentic, open-ended, independent field studies in their second year and beyond. Not surprisingly, even the best and brightest students appear to flounder under these conditions because they are not prepared for poorly defined problem solving experiences. Professional skills are likewise expected to materialize organically by the time a student graduates. Unfortunately, they do not always appear and many students seem to struggle with general communication, information literacy and technology skills.

An example of poorly scaffolded first-year writing assignment in Geology 101 asked students to write a three to four page speech, not to be presented, defending the proposition that "ice is a mineral, glaciers are rocks." Students were instructed to produce an original, well-written essay with evidence of wide reading from reputable sources. Not surprisingly, instructors were routinely disappointed with students' products and students complained bitterly about the lack of feedback on this assignment they perceived as a "complete waste of time." It failed to meet the criteria Biggs (1999) indicates make students *want* to learn: one, it had no value or connection to the learners; and two, success was not expected because the target was perceived by students as ambiguous. The lack of feedback during and after the assessment period further intensified students' anticipation of failure.

This paper describes a recently implemented innovative approach to first year geology assessment designed in an effort to overcome the obstacles outlined above. The first section outlines how the initiative was implemented followed by the impacts. The second section discusses changes implemented in an attempt to ameliorate the negative impacts from the trial round. The paper closes with two questions raised by implementation of this initiative for further discussion.

Innovative assessment design

A replacement assessment needed to encourage a deep approach to learning, not just for the assessment task itself, but also throughout the unit and course. It needed to engage students early on, identify major issues with core skills or misinterpretations of the project concept and highlight students' misunderstandings of fundamental earth science concepts. The assessment needed to promote the development of generic skills in addition to interaction with the fundamental geologic knowledge.

The resulting new assessment was a three-part project drawing on the frequent egregious misrepresentations of earth processes in pop culture. Part one was a low-stakes formative assessment within the first two weeks of instruction to alert students and instructors to potential problems and areas needing work before their major writing assignment. Students were to write a one- to two-paragraph project proposal indicating the piece of pop culture they would like to critique for its misrepresentation of earth science, why they selected that piece, and citing/referencing the film/book/song/etc. correctly.

Students were then to build their proposal into a ≤700 word letter to *Science*. This provided them with a clearly defined audience while allowing them some freedom in their voice and requiring a high degree of professionalism. In their letters, they were to first summarise the plot or theme of their piece then highlight one or more violations of geologic principles within it. The body of the letter was dedicated to explaining *why* these items were incorrect, citing appropriate literature to support the arguments, and finally suggesting a "fix" that would be geologically correct, but not render the entire film/book/song/videogame moot.

The final stage of the project pushed students further beyond conventional assessments and drove generic skills development. Groups of five to seven students needed to select one paper from within their group for further expansion into a final multimedia project and presentation. Thus, students had to practice good communication both within their group and to an audience of their peers and instructors. Groups had complete freedom to choose how to present their work, but the suggested ideas ranged from relatively simple (e.g. video clips imbedded in a formal slide show) to complex and very involved (e.g. refilming erroneous movie scenes or recording new lyrics to a song), giving them an opportunity to develop their technology skills. Students understood that scientific accuracy was of utmost import, requiring them to utilize good information literacy skills, however creativity and originality were desirable.

Results

The assessment described above incorporates myriad facets that receive extensive accolades in the teaching and learning literature. Taylor (2008) clearly outlines the measurable benefits of scaffolding first-year learning experiences from an early transition phase on to development of learning skills and finally demonstration of achievement. The three sections of this project lead students naturally through this process, helping them to see where they are headed while they learn how to get there. While many students struggled to start their proposals, nearly all students showed significant improvements in their writing, creative voice, interaction with the subject and involvement in the unit as they moved through the three parts of the project, thus demonstrating the effectiveness of this model.

The topic immediately created a sense of interest and connection for most students, evidenced by the tone and frequency of emails and one-on-one conversations with instructors and other students about their project ideas. The activities provided students with a degree of choice in their learning and promoted a deep sense of belonging for many students. The learning environment was strongly learner-centred and kindled close teacher-student relationships, which promoted the development of important generic skills such as communication, technology application, information literacy, critical thinking and cultural understanding. Many studies find these aspects of curriculum design and learning environment critical for promoting deep approaches to student learning and engaging cooperative learning (Biggs, 1999; Kember, 2009; Kember & Gow, 1989; Kember, Ho & Hong, 2010; Kember & Kwan, 2000; Kember & Leung, 2005).

Student engagement outside of the classroom was also positively influenced, as predicted by previous studies (Yan & Kember, 2003, 2004). Groups of Geology 101 students met routinely outside of class for both academic and social endeavours. Demonstrators reported cohorts of these students collectively preparing for exams and enhancing the overall group knowledge in both first and second semester, long after this assessment was completed. Several students from the class informally described the strong friendships and working relationships that developed and the ways in which they shared work and understanding. One student commented that he really struggled with reading because he is dyslexic, however, he was much better at understanding many of the concepts than his well-read partners. Thus, they developed a study pattern whereby students who did the reading would summarize it for the group and then the whole group would discuss this within the broader context of the lectures and practical exercises, ultimately enriching everyone's understanding.

The results were not, however, entirely positive. The most negative impact was the unwieldy workload it created for staff. More than 100 hours of marking was required for the first two parts of the assignment. This was split between just two individuals, one of whom was also responsible for all of the lecture and lab instruction and unit coordination. This assessment was worth 30 percent of the overall marks, leaving three practical exams, a field trip and a final exam for 200 students to be marked as well with little additional help available.

Another issue was highlighted by students in their formal anonymous feedback on the unit and informal conversations specifically about the project. There was a consistent view that the groups needed to be formed much earlier to allow more time to work together and solve problems. While many groups worked incredibly well to produce exemplary final projects, several completely malfunctioned, usually to the detriment of the strongest student.

Finally, a few complaints were raised about the marking and timing of feedback. Some students felt that they were being assessed too harshly on their writing skills for a science class. Others complained about "unprofessional" comments on their papers, even while acknowledging that they had submitted poor quality work. Many students felt that the "slow" turn-around time on their assignments (two to three weeks) hindered their ability to complete the sequential parts in the time allotted.

Conclusions

Good curriculum design requires reflection on teaching and learning experiences to inform the assessment redesign. From informal conversations with students, anonymous voluntary feedback, and my own personal experiences, I identified four key changes needed to make the project more valuable to students and more manageable for instructors. First, marking criteria had to be more transparent to students; second, feedback had to be more timely, easier to provide and more personalized; third, in-class time was required to guide students into an unfamiliar learning activity; and fourth, exemplars had to be provided to demonstrate that success is achievable. These changes were incorporated in the second iteration.

In the second iteration of this assessment, students received an introductory lecture and activity to prepare them for the project itself, independent research, group work, blended learning (using complementary online technologies and face-to-face learning) and e-portfolio usage. Students initially used their e-portfolios to work through guided questions to prepare their writing assignments and solicit feedback from peers and instructors. Marking rubrics and exemplars allowed students to better assess and improve their own and other's work before submission, decreasing instructor fatigue. Instructors also had the option to provide recorded oral feedback, which was faster and more personalized than succinct, standard written comments.

Students from 2010 were invited to participate in short interviews about their personal perceptions of the project and its impacts. Students in 2011 can participate in ongoing, online questionnaires about their perceptions that will inform further project modifications where necessary.

Overview of conference session outcomes

The aim of the presentation at the 14th Annual Pacific Rim First Year in Higher Education Conference (2011) was to solicit input from the participants to increase the sustainability of this assessment and how to share it viably with others across disciplines. I asked participants to engage first with each other in small groups to brainstorm possible solutions and suggestions and then share their ideas with the whole group. Their recommendations provide valuable insight into overcoming the obstacles of the new Geology 101 project.

Participants at the conference presentation suggested two potential strategies for how to reduce the marking overload and instructor burnout that have plagued this assessment. The first idea was to give students two options for marking and feedback, with the default set as the usual full feedback with explanations and suggestions for improvement. The alternative or "low-cost carrier" option allows students to elect to have their work quickly marked and returned with little to no feedback. The participant who suggested this model stated that typically 30-35% of his student cohort selects the "no frills" option as they simply want their marks and are uninterested in extensive feedback.

The second suggestion, upon which several participants expanded, was to create peer-to-peer marking meetings, which could be either face-to-face or online. One participant recommended creating a well-constrained environment for this to occur, including detailed and unambiguous marking guides, examples of both excellent and poor quality work from previous years, and close instructor guidance. The participants emphasized the importance for students to justify *why* they gave a particular mark.

In response to the question of how to package and "export" this piece of assessment viably to other lecturers, participants made a few brief suggestions. The first was to record and share both the best and worst examples of what students created as part of the package. The second suggestion was to follow the guidelines for online assessment sharing from the University of Buffalo.

References

Biggs, J. B. (1999). *Teaching for quality learning at university: What the student does*. Buckingham, UK: Open University Press.

Buchwald, C. E. (1997). Undergraduate geology education - The Carleton College experience. *Journal of College Science Teaching, 26*(5), 325-328.

Holbrook, J. (1997). Career potential in the sciences, geology in the high schools, and why would anyone major in geology anyway? *PALAIOS, 12*(6). No page numbers. Online only journal available at http://palaios.geoscienceworld.org/

Kember, D. (2009). Nurturing generic capabilities through a teaching and learning environment which provides practise in their use. *Higher Education, 57*, 37-55.

Kember, D., & Gow, L. (1989). A model of student approaches to learning encompassing ways to influence and change approaches. *Instructional Science, 18*, 263-288.

Kember, D., & Kwan, K-P. (2000). Lecturers' approaches to teaching and their relationship to conceptions of good teaching. *Instructional Science, 28*, 469-490.

Kember, D., & Leung, D. (2005). The influence of the teaching and learning environment on the development of generic capabilities needed for a knowledge-based society. *Learning Environments Research, 8*, 245-266.

Kember, D., Ho, A., & Hong, C. (2010). Characterising a teaching and learning environment capable of motivating student learning. *Learning Environments Research, 13*, 43-57.

Moore, L. (2010, July). *Valuing earth and environmental science education in*

Australia: Where to from here? Keynote presentation at the Geological Society of Australia, 2010 Australian Earth Sciences Convention, "Earth Systems: Change, Sustainability, Vulnerability." Canberra, Australia.

Taylor, J. A. (2008). Assessment in first year university: A model to manage transition. *Journal of University Teaching and Learning Practice, 5*(1), 20-33.

Tompkins, D., Dawson, V., & Moore, L. (2010, July). *Exploring the challenges of implementing a new earth and environmental science course in high schools: Preliminary findings from Western Australia*. Paper presented at the Geological Society of Australia, 2010 Australian Earth Sciences Convention, "Earth Systems: Change, Sustainability, Vulnerability." Canberra, Australia.

van Norden, W. (2002). Problems in geology education: Our high schools are the weakest link. *PALAIOS, 17*(1). Online only journal available at http://palaios.geoscienceworld.org/

Yan, L., & Kember, D. (2003). Influence of the curriculum and learning environment on group learning approaches outside the classroom. *Learning Environments Research, 6*, 285-307.

Yan, L., & Kember, D. (2004). Engager and avoider behaviour in types of activities performed by out-of-class learning groups. *Higher Education, 48*, 419-438.