Combining information literacy development and teamwork through authentic assessment

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Structured abstract

CONTEXT

First year undergraduate students often lack demonstrable abilities to identify, locate, and critically assess information. For undergraduate engineering students a lack of competency in information literacy reduces the learning outcomes achieved when studying the often-complex social, political, economic and environmental factors that exist in the professional environment for contemporary engineering practice. There is general consensus in scholarship of teaching literature that information literacy needs increased attention in undergraduate course programs. This paper highlights a need to utilise formative assessment tasks designed to develop students' literacy skills and knowledge as demonstrably applied for making reasoned and justifiable decisions based on a critical assessment of valid information identified, obtained, and analysed by them in the context of the problem(s) being addressed. This task begins to develop student's abilities to negotiate consensus based on engineering principles and community values.

APPROACH

Students were required to work together in groups of five to collaboratively assess the validity of information and opinion published and freely accessible on the World Wide Web. The source of this information and opinion was an anti-wind turbine activist website by verifying the stated claims made on this website against peer-reviewed scientific and engineering research and information from by non-partisan experts. They were then asked to develop a team-based reasoned and justified written response to controversial and questionable claims published on the activist website. Although this task was primarily structured as formative assessment some marking weight was allocated to the assignment to motivate students to participate. This task was assessed and marks allocated equally on a per-group basis and in future it peer-based marking schemes will be considered to reduce equity issues common with a per-group marking basis. Further research is also planned as the participating students progress through their undergraduate course to assess the impact of this group-based information literacy development task on the ongoing development of students' individual information literacy competency.

OUTCOMES

Initial assessment of the results and outcomes indicated a demonstrated improvement in how students identified, obtained, and used information to not only fulfil the requirements of other assessment tasks but also in how they included information, especially digital-sourced information, into their undergraduate studies for the remainder of the trimester.

CONCLUSIONS

Designing and utilising formative assessment tasks for the primary purpose of achieving information literacy learning outcomes for students commencing their undergraduate studies is achievable and increasingly appropriate for undergraduate courses. Further research is planned to assess the benefits of improving the information literacy of commencing undergraduate engineering on achieving other learning and course outcomes as they progress through the course program.

KEYWORDS

Digital literacy; information literacy; authentic assessment; peer-based learning; formative assessment

Introduction

Engineering students and professionals benefit from competence in finding, assessing and using information to justify decisions. Engineers should be capable of making sound decisions based on the best quality information available to them. Assessing information in engineering requires an analysis of the accuracy and reliability of predicted effects of human intervention in physical environments.

Where decisions are likely to have perceived or demonstrable effects on a community, it is pertinent to also consider the social, political and economic conditions under which information is produced. Finally, for engineers to make sound engineering decisions, it is best practice for these decisions to be made in groups which attempt to find a consensus firmly based on engineering principles and community values.

The authors designed a formative assessment task which combined information literacy with teamwork through authentic assessment. The task was designed to give students the opportunity to develop and demonstrate competency in decision making based on expert information, their values and identity as engineers within a community.

Learning activity

Students formed groups of four to six people within two general cohorts: on-campus enrolled (normally attend classes at the campus) and off-campus enrolled (normally study in distance-based education mode and do not normally attend classes at the campus). Groups were required to critically evaluate an activist website (National Wind Watch, 2013) opposing the construction of wind turbines, arguing that "industrial-scale wind energy" presents many adverse impacts which are ignored or denied. Published on this website are a number of claims made about detrimental effects of wind turbines on society and on the environment.

Students were asked to analyse and evaluate these claims and from these select cite passages of text which they did or did not trust as being accurate in representing the facts about wind turbines. They were then asked to justify their evaluations by providing a critical assessment of the accuracy and reliability of the quoted text passages, in reference to high quality peer-reviewed information where groups identified the need to do so. Verification of statements formed an important part of group's collective responses. Groups were sometimes required to privilege one source of conflicting information over another during the process.

Groups were then required to construct short responses to a set of complex socio-political, economic, and environmental concerns raised by the website relating to the effects of wind turbines on local communities. The assignment deliverable was submitted on behalf of the group in the form of an online dedicated *MediaWiki* (one provided for each group) within Deakin University's learning management system.

Learning Outcomes

The learning activity was designed to give students the opportunity to develop and demonstrate a number of competencies within a structured peer-based learning environment. The targeted competencies primarily include elements associated with identifying and finding information; the critical evaluation of information; and critical thinking, assisted by the use of appropriate information, about a particular issue such as the impacts (social, economic, and environmental) of applied technology.

Assessment of the success of this learning activity was dependent on the evidence student groups provided pertaining to the following learning outcomes:

- Identifying the need for information
- An ability to search for and obtain information.
- Critically analysing information.
- Using information appropriately.
- Referencing information.

The targeted competencies for this learning activity were aligned to Walton & Clelend's (2013) three spheres of information literacy. They also draw from the information literacy standards for engineers and scientists outlined by the Australian and New Zealand Institute for Information Literacy (Australian and New Zealand Institute for Information Literacy, 2004). Engineers Australia (2011) also recognises the ability to "locate and utilise information" and to "critically assess the accuracy, reliability and authenticity of information" as essential professional engineer competencies.

Walton & Cleland (2013, p.22) recommend that these competencies are best introduced to students when "highly context-specific and ...woven into the fabric of the subject being taught". Furthermore there is an added imperative to do this in engineering undergraduate courses where students often have difficulty connecting the value and contribution of interdisciplinary skills, knowledge, and competencies within a perceived narrow 'engineering' focus (Richter & Paretti, 2009).

The need to develop students' information literacy within the context of specific professional disciplines has been discussed for some time (cf. Grafstein, 2002; Winterman, Donovan, & Slough, 2011). However the authors have had difficulty finding examples of undergraduate learning activities that develop and/or assess information literacy in an 'authentic' professional engineering context. Information literacy skills are often assessed in the form of standardised tests, quizzes and short answer questions (cf. Wertz, Ross, Purzer, Fosmire, & Cardella, 2011) or assessed in conjunction with an activity that has a non-literacy focus (cf. Jackson, Rumsey, Daragan, & Zelmanowitz, 2011).

The authors instead developed this learning activity with the goal to ensure that the information literacy skills students developed and demonstrated were contextualised within the discipline of professional engineering and were assessed authentically.

Assessment method

The task was assessed using a rubric aligned to the desired learning outcomes. The table below describes the criteria by which each learning outcome was assessed.

Table 1: Assessing learning outcomes

Learning Outcome	Assessment
Identify the need for and search for information.	Demonstrable ability to find and appropriately refer to relevant, credible sources of information.
Critically analyse information.	The reliability, accuracy and persuasiveness of each group's stated justifications for accepting or rejecting the trustworthiness of a passage of text on the website.
Use information appropriately.	The strength of reasoning and evidence provided by group's responses to complex social, political, economic and environmental considerations regarding the construction of wind turbines.
Use information appropriately.	Concision, coherence and clarity of the group's submission.
Reference information	Correctly acknowledge the work of others.

Authentic assessment of information literacy

Authentic assessment aims to "respond to human diversity and… cognitive flexibility" (Darling-Hammond & Snyder, 2000). It also acknowledges that students will take "different dispositions, prior experiences and knowledge..." (ibid). Authentic assessment allows students to construct knowledge through problem solving and searching and processing new

information and combine it with their prior knowledge (Brand-Gruwel, Wopereis, & Vermetten, 2005).

The learning activity required students, as members of a peer group, to consider technology-related issues that were socially, environmentally, economically complex and vulnerable to manipulation and bias according to the interests of particular stakeholders. The activity sought to encourage negotiated responses, developed amongst peers, by students on complex issues. Ideally these responses drew on the collective knowledge, prior experiences, and competencies of all group members. It was anticipated that the collaboratively developed written responses by the student groups addressing complex social, economic, and environmental issues would typically draw upon and implicitly reflect the underlying beliefs and values of the collective student groups.

The activity was designed to develop and assess student's competencies in critical analysis and information literacy in a peer-based learning environment, and in a way that obviates their value to engineering students. 'Critical analysis' refers in this paper to two interdependent competencies. The first competency is the ability to assess the "accuracy, reliability and authenticity of information" (Engineers Australia, 2011). The second competency is the ability to analyse the social (including political), environmental, and economic conditions under which information is produced and disseminated. In the second sense, critical analysis should be considered as a socio-political activity (Andersen, 2006).

An illustrative example of where a student group successfully demonstrated this competency in this assigned exercise is where the students' evaluated the following claim made on the activist website (National Wind Watch, 2013):

> *"A team in Portugal investigating heart, lung, and nerve damage from industrial low-frequency noise has found that the conditions for causing "vibroacoustic disease" exist inside houses near large wind turbines."*

The group not only sought to examine this claim by investigating the primary source cited by the website, with an emphasis on establishing the validity of the claim, they also researched the issue independently and identified what they considered a more authoritative source of information to cite in their collaborative critical analysis of this statement:

> *The claim that "conditions for causing "vibroacoustic disease" exist inside houses near large wind turbines" is negligible as the source does not state the direct cause of health effects experienced however it does state that "ILFN is prevalent in all urban areas" and "cases of VAD have been due to occupational exposures". Thus, the above claim is contradicted by a report on the review of evidence regarding wind turbines and health (National Health and Medical Research Council, 2010, p. 2-5.)*

Information literacy encompasses the ability to find, analyse and use information appropriately within a specific context (Eisenberg, 2010). An information literate engineer would competently identify, seek, evaluate and base their decisions on the best quality information available to them. This reflects the proposition of Dowling, Carew, & Hadgraft (2013, p.408) that engineering undergraduates students as well as graduate professional engineers need key skills in "finding, analysing, evaluating, integrating and using information."

However it cannot be assumed that students self-develop adequacy in these competencies without assistance. Rather, using information to solve problems should be considered as a complex cognitive skill and should be explicitly taught (Brand-Gruwel et al., 2005). The impacts and consequences of competency problems associated with inabilities to find information and to assess its accuracy and reliability are significantly magnified in the information age where most information resides and is accessed in digital format. Popular web-based search engines list search results with no indication of the validity of the source host or as to the merit of the information available. They typically present users with a large variety of information that differs in accuracy, reliability and trustworthiness. Furthermore the order of the search results may be determined by commercial motivations of the search

engine provider. Lack of information literacy can lend itself to a haphazard and fragmentary approach to literature searching, which in turns lends itself to an incomplete understanding of complex systems and environments (Harley, 2001).

Authentic competency in information literacy assists students to develop an informed understanding and perspective about complex problems and issues, which are accordingly reflected in their personal and professional values. While much literature on information literacy focuses on information seeking behaviour, integrating information literacy into the discipline of engineering requires more than just a basic ability to find information. An information-literate person can critically evaluate an issue to determine the facts, or at least assess the trustworthiness of claims about facts made by others, and can exploit information in a manner that is appropriate to their discipline of study and/or practice.

When presented with an unqualified statement (National Wind Watch, 2013) that, "Few studies have been done to determine the true effect of industrial wind turbines on birds and bats…" another student group made the following conclusive statement on its trustworthiness:

> *Untrustworthy. There have been many studies done on this topic as demonstrated by the National Wind Coordinating Collaborative (2010) who have compiled evidence from many researchers and peer-reviewed studies*

Information literacy as applied within the study of the discipline of professional engineering must be considered, as should be for the study of any discipline, as a "social activity and process of enculturation" in which students "think critically and communicate strongly" (Hargreaves, 1998). Information-literate students actively participate in an internal and interpersonal dialogue in order to develop and communicate responses that signify their beliefs and understanding about the true nature of the world. Those beliefs and understandings are both formed and reinforced by the information which students obtain and evaluate. As such, tasking students with critically assessing the trustworthiness of a source of information is fundamentally tasking students with becoming familiar and accomplished in performing an interpretative process intended to acculturate students to the discipline of professional engineering. In this learning activity the learning environment was structured as a peer group of fellow students in order to facilitate a socially enabled learning environment and in which fostered cultured, interpersonal dialogue through which shared values and discussed and debated form the basis of discourse (Gee, 1998).

Loui (2005) asked students to write an essay on their vision of an ideal engineer. The responses suggest that alongside technical knowledge and a strong work ethic, honesty, communication skills and integrity were identified by students as characteristics of ideal engineers. By placing students in peer groups and asking them to respond to the trustworthiness and integrity of information, the authors sought that the students would collectively respond within the groups by imagining their role as an engineer in the context of the profession's broader social responsibilities. This understanding reflects an individual or a group's negotiated identity as engineers. Universities are places "where students not only learn technical knowledge and engineering skills, but also develop a sense of belonging to the engineering profession" (Du, 2006). Although few students graduate with a fully formed sense of identity as an engineer, engineering students begin to develop an identity as professionals in their undergraduate years (Loui, 2005). Therefore by by having students undertake this learning activity at the commencement of their undergraduate engineering studies an explicit objective was to have students begin their individual development of their professional engineering identity from the commencement of their undergraduate studies or at the very least to be implicitly exposed to the social responsibilities of the engineering profession.

Outcomes

Most student groups were able to demonstrate an acceptable level of competency in finding, evaluating, and using information. Not unexpectedly for first year students, a few groups were observed to have unduly relied upon information that was assessed to be considered of a poor, and unacceptable, standard. However, providing an authentic learning activity that explicitly emphasised the necessity of quality information for engineering purposes it is believed had the effect of significantly improving a majority of student's corresponding competency to assess information in context, rather than passively accepting information regardless of its source, accuracy, reliability or relevance.

For this learning activity, group based assessment without individual acknowledgment (such as a peer-based marking scheme) was used. The simplicity of assessing the outcomes achieved of the group as a whole and according awarding a common mark to all student members of a particular group was selected for this activity since the activity was primarily designed to be formative rather than summative in terms of overall assessment and accordingly the relative weighting of this activity for a student's overall assessment in the course unit was minimal. An obvious limitation of not including any form of peer-based marking or individual assessment component for this activity is that variances in individual student effort contributing to the group collaboration was not explicitly determined in assessment. Therefore the internal group dynamics were not explicitly assessed for this activity. The main deliverable produced by the student groups consisted of an online *MediaWiki* produced by each group. The MediaWiki collaboration tool was selected for this activity since it is capable of facilitating asynchronous online electronic collaboration within a group and of tracking contributions made by individual students to the collaborative body of work. The tracking function provided an administrative tool to investigate and arbitrate equity complaints made by students about any members of their group who were considered to be under- or non- contributing.

The impact of this learning activity on individual students' information literacy competency was not directly assessed, as assessment was group-based, and it remains an area of further research by the authors to evaluate the information literacy competency of these students as they progress in their studies as well as to evaluate the impact of improved literacy competency on overall academic progress and learning outcome achievements.

Conclusions

The learning activity developed by the authors for commencing undergraduate engineering students provided the students with a structured peer-based learning environment to develop and demonstrate competency, on a collaborative group basis, in finding, critical analysing and using information. The activity required students to evaluate the accuracy, reliability and socio-political conditions under which stakeholders and interested parties often develop and publicly make available information and opinion on complex issues, and in particular where the application of technology has significant social, economic, and environmental impacts. The activity also required student to undertake this evaluation of such information and opinion with reference to trustworthy sources of information and facts.

By using a peer group structure for this activity it was an explicit objective to encourage open discourse between students as they compared and contrasted their individual beliefs and values on significant issues relevant to the professional discipline they are studying to expose students at the commencement of their studies to the social obligations of the engineering profession which implicitly demand the use of trustworthy information by student and graduate professional engineers.

An assessment task that helps students to develop and demonstrate these abilities and attributes are achievable and increasingly relevant to higher education for professional disciplines in the information age where most information is found, used, and communicated in digital format. Further research is required to assess the benefits of improving information

literacy on achieving other learning and course outcomes by students throughout the progress of their course.

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