AC 2011-1275: LIFELONG LEARNING AND INFORMATION LITERACY SKILLS AND THE FIRST YEAR ENGINEERING UNDERGRADUATE: REPORT OF A SELF-ASSESSMENT

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Lifelong learning and information literacy skills and the first year engineering undergraduate: Report of a self-assessment

Introduction

ABET accreditation requires engineering students to attain "a recognition of the need for and an ability to engage in lifelong learning." (Outcome 3.i). [i] *Engineering Change*[ii], a report of the effect of ABET's EC2000 program found a fifty percent or greater increase in design projects, open-ended problems, applications, case studies, and computer simulations, all of which typically require supplementary information to complete assignments successfully. However, comparing self-reports of outcomes for graduates from 1994 and 2004, the authors found lifelong learning (3.i) languished at the bottom of the list, with a 3.49 average out of 5 (almost all other outcomes average 3.9 or above), with almost no improvement over ten years (3.40 to 3.49). During the same time, for example, "global and societal issues" went from 2.95 to 3.65 (the next lowest rating to lifelong learning).

Despite the articulated need for (and apparent lack of progress teaching) lifelong learning skills, fairly little has actually been written about what comprises those skills and how to assess them. Shuman et al suggest that students be able to

- Demonstrate Reading, Writing, Listening, and Speaking Skills
- Demonstrate an Awareness of What Needs to be Learned
- Follow a Learning Plan
- Identify, Retrieve, and Organize Information
- Demonstrate Critical Thinking Skills
- Reflect on One's Own Understanding[iii]

Shuman's outcomes correlate well[iv] with the ACRL Information Literacy standards for Science and Technology, which briefly are

- Determine the extent of information needed
- Access the needed information effectively and efficiently
- Evaluate information and its sources critically
- Incorporate selected information into one's knowledge base
- Use information effectively to accomplish a specific purpose
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally[v]

Shuman's analysis also reflects the thinking of the self-directed learning community,[vi] and Cervaro[vii], for example, found that engineers engage in 'informal learning' activities, i.e., self-directed learning, much more frequently than formal learning activities, such as seminars and workshops.

In an instructional setting, one would like to understand the skills and attitudes of students, so appropriate content can be provided. Assessing these skills and attitudes often is time consuming, time that librarians don't have in a curricular setting. At the authors' institution, with over 1600 first-year engineering students, instructors struggle with providing detailed, timely, and individual feedback to students on topics as complex as information literacy. Consequently, the authors wanted to develop an easy to administer and easy to grade self-assessment to generate quick feedback on student attitudes. Further, the authors wanted to investigate whether results from the instrument correlate to performance on more authentic activities (such as report writing or design projects).

Guglielmino [viii] developed the Self-Directed Learning Readiness Scale (SDLRS), a 58-question Likert scale self-assessment, which has been used by engineering educators[ix] to measure lifelong learning readiness. However, the SDLRS contains very little coverage of information gathering concepts, being limited to questions such as "I think libraries are boring places," and "if I discover a need for information that I don't have, I know where to go to get it." Recently, two research groups in nursing education created their own self-directed learning scales as well, which also provide little exploration of the informational component of lifelong learning.[x] Another instrument developed by Shinichi Monoi, Nancy O'Hanlon, and Karen R. Diaz[xi], on the other hand, uses a 12-question instrument that focuses on specific strategies, such as 'I can construct a search using a Boolean operator,' and 'I can use the thesaurus in a database to select subject terms for a search,' which the authors felt was a little too library-centric for their purposes.

The authors thus believe there is room (and need) for the development of a similar scale to the SDLRS, but one focused on information skills, and a scale focused on actual behaviors and strategies rather than just attitudes. The scale elicits students' self-perception of how often they employ those skills.

Method

The study was conducted in the context of a foundation course at a large Midwestern university, which all freshman engineering students take. Students were required to complete the survey as a part of the course and the survey was administered online. The sample size for the study presented in this paper is (N=*351*). The data analysis for this paper is only descriptive in nature. Subsequent papers will do a formal factor analysis on the entire dataset (N>*1600*).

The specific competencies probed were generated from an analysis of different models of information gathering behaviors. The main input was the Information Search Process (ISP) of Carol Kuhlthau.[xii] The ISP is a research-validated model of the stages an individual goes through when faced with a research task. It was developed in the context of typical 'research papers' that one might find in a humanities or social science course, so the authors modified and incorporated concepts extracted from engineering design process models and the authors' own analysis of previous student work.[xiii] From this analysis the authors decided to probe behaviors that include problem or task articulation, problem solving, information gathering, and the use, evaluation, and documentation of that information.

The authors narrowed down their original list of items to a compact instrument consisting of 26 questions probing nine difference concepts (see Table 1). Most concepts (6) have three associated questions, two concepts have two associated questions, and one concept has four. The questions were offered using a Likert Scale where 5 represented "Almost Always," and 1 – "Almost Never." There are no descriptors for 2-4, rather they suggested points on a continuum. All questions ask students to assess their own behaviors when faced with a research task (see Appendix), and were formulated by this team of researchers.

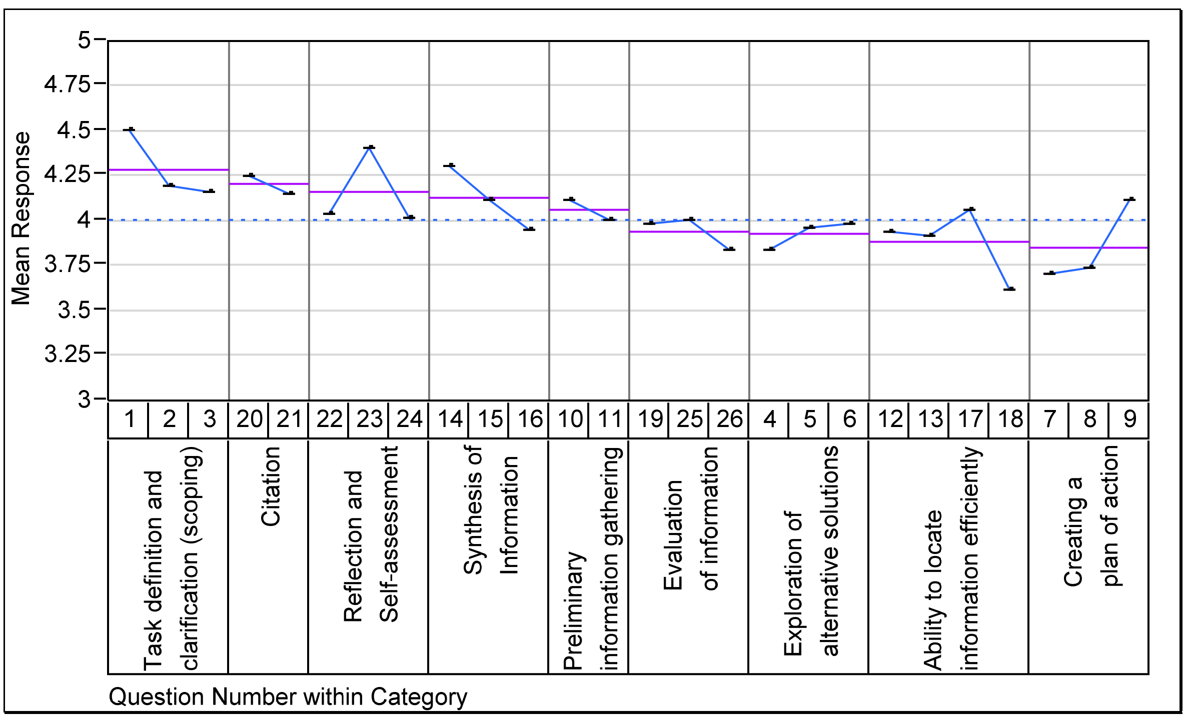
Table 1 Categories Probed and Alignment with ISP Stages

Assessment Categories	ISP Stages (Kuhlthau)
Task definition and clarification (scoping)	Task Initiation
Creating a plan of action	
Exploration of alternative solutions	Topic Selection
Preliminary information gathering	Prefocus Exploration
Ability to locate information efficiently	
Synthesis of Information	Information Selection
Evaluation of information	
Citation	Search Closure
Reflection and Self-assessment	

Analysis

The overall mean of the student response was 4.05, as indicated by the dotted blue line in Figure 1. This figure also shows each concept ranked from high to low (left to right) based on student responses. Each concept's mean is indicated by the horizontal purple lines. The blue lines connect the means for each individual question. Overall, students expressed high confidence levels in their information literacy skills, similar to the findings of Brown, et al.[xiv] The assessment had a reliability coefficient (Chronbach's alpha) of .98, and a preliminary factor analysis revealed a one-factor structure.

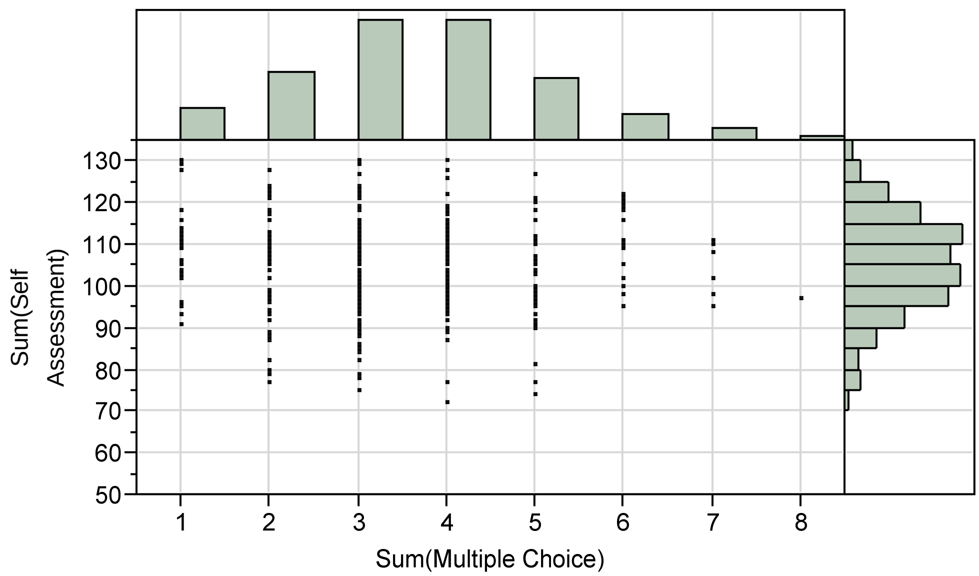
Figure 1: Means by Question, Concept, and Overall



Students expressed high levels of confidence in their ability to define tasks, write correct citations, reflect on their performance, and synthesize information. Students expressed less confidence in their behaviors related to evaluating information, exploring alternative solutions, locating information efficiently, and creating plans of action. The areas students felt least confident with correspond to the initial stages of Kuhlthau's Information Search Process, that is, preliminary information searching and focus formation activities (see Table 1), in line with Kuhlthau's own findings in other student populations.[xv] Holliday and Li[xvi] have found that millennial students potentially skip more steps in the Information Search Process due to the easy access to information on the Internet, which leads to lower overall student performance and higher levels of frustration on student projects.

In a preliminary attempt to determine validity of the instrument, results of the self-assessment were correlated with an eight question multiple choice assessment[xvii] students took that required students to read a memo and identify good and bad information usage. Figure 2 plots students' self-assessment scores (y-axis) against their grade on the multiple choice assessment (x-axis). The histograms show the density distribution of the plotted scores. The concentration of the scores does not show a significant correlation between the two assessments, although the highest self-assessments came from those who scored most poorly, and the students who scored the best on the multiple choice, rated themselves moderately in their overall self-assessment. This indicates, potentially, that students with greater knowledge of information literacy skills have more accurate self-perceptions of their abilities.

Figure 2: Correlation of Student Self Assessment and Multiple Choice Responses



Discussion

Overall, students expressed less confidence in their ability both to find and to evaluate information than in the other concepts probed, while they reported documenting and citing sources as one of their most highly rated skills. However, comparing self-assessments with more direct measures of student performance (for example, analyzing the information component of student projects) yields a substantial 'novice effect' of inflated self-perception of competency. The higher achieving students had a more accurate self-knowledge of their skill levels, which indicates this tool might be more effective if given to a population of more advanced students, for example, at the junior level.

This initial analysis of the self-assessment tool was meant to guide revisions of the final instrument, exploring the concepts probed against student response. The correlation with the multiple choice assessment shows that student self-perception of information literacy competency is higher than their actual skill level. Further development of the instrument will attempt to circumvent the novice effect.

The implications of this research suggest that a self-assessment Likert scale instrument, such as the one discussed in this paper, may not be adequate as a stand-alone assessment of information literacy due to the inflated self-perceptions of competency. However, future work by this research team to develop a correlating factor between multiple instruments may provide a recommended adjustment scale in scoring a quick self-assessment of information literacy. The results, however, do indicate that students report less confidence in their abilities related to the initial stages of the information gathering process, so care should be taken to include information literacy instruction which addresses that part of the information gathering cycle. The results indicate that students may need more assistance figuring out how to approach a problem and analyze competing solutions before diving into the research process. Since often information literacy instruction in engineering focuses on methods of locating resources (e.g., searching databases), this research indicates that a more holistic approach to information literacy is still warranted.

The authors will be conducting future studies to relate student self-perceptions to actual demonstrated behaviors (for example, student design projects) and to compare the results between first-year and upper-level undergraduates to determine how they change over the course of undergraduate study.

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Appendix

Information Literacy Core Skills Self-Assessment

5 4 3 2 1

5 = Always 1= Never

When faced with a new task (such as a design project) that I don't immediately know how to accomplish…

1. I analyze the task to determine what needs to be done
2. I analyze the constraints of the task and not just the final deliverable
3. I seek clarification of the task expectations from those who want the task accomplished
4. I investigate how others have tackled the same or similar tasks in the past
5. I think of a variety of ways to accomplish the task before actually trying one
6. I compare the advantages and disadvantages of different approaches to solving the task
7. I create a list of resources/materials needed to complete the task
8. I create an action plan for completing the task on time and within other constraints
9. I determine what I know and what I need to find out about the task to complete it successfully
10. I collect information to become familiar with the concepts needed to carry out the task
11. I talk to others to gather a variety of perspectives and advice about the task
12. I efficiently and effectively locate information relevant to the task
13. I use search strategies to help focus the results I get from search engines and databases
14. I relate information I find to my pre-existing knowledge
15. I work to resolve conflicts between information I find and my pre-existing knowledge
16. I integrate information from a variety of sources to achieve a deeper understanding of a topic
17. I use the general information I find to help focus my search for more information
18. I know when to use different kinds of information (e.g., patents, standards, handbooks)
19. When gathering information, I assess the accuracy of information I find
20. When I present information, I acknowledge the source
21. When presenting information from a source, I use correct and complete citations
22. I test my solution against the original expectations of the task and revise my work to improve the solution
23. After I finish the task, I determine whether I completed it successfully
24. After I finish the task, I analyze my work to improve my performance on future tasks
25. When I gather information, I identify and use high-quality sources
26. When I gather information, I evaluate the purpose of the source (for example, to persuade, inform, or entertain) when I decide whether and how to use it.

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