

The Value of Interviews in the Longitudinal Assessment of a Course

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Abstract - Qualitative assessments, such as interviews and focus groups, are an important part of developing and improving classroom learning experiences for students. Often these tools are implemented at the end of a course for immediate feedback. We argue that a longitudinal approach in the use of interviews is necessary to fully capture the impacts of a course because students need time to reflect on their learning. Through an on-going project, we are investigating the question, “How can a series of interviews over time be used in longitudinal assessment to benefit the development and improvement of first year engineering courses?”. Situated in a self-regulated learning (SRL) conceptual framework proposed by Pintrich, we focus on preliminary results from a qualitative longitudinal assessment of students’ experiences in a large, first year engineering course. Data include a series of interviews collected annually with the same participants over a three year period. Results suggest three key themes. First, it is challenging for students to reflect on the course and what they have learned while still enrolled. Second, as students are called on to use skills they realize how much they have learned. Finally, two years removed from the course students reflected positively on the course for providing learning experiences that subsequent courses have not afforded. The implications of this work are a need for researchers and practitioners alike to consider longer-term qualitative assessments as they design and develop courses.

Index Terms – Interview, Longitudinal Assessment, First year engineering, Reflection

INTRODUCTION

As engineering educators we strive for continuous improvement of the courses we teach. We are concerned with both student learning outcomes and the experience in and perceived value of our courses. Interviews and focus group interviews are a common qualitative method used in the assessment of engineering courses. Generally such assessments are implemented a single time at the end of a course for immediate feedback. For example, Steward, Mickelson and Brumm [1] used end of semester focus group interviews as a summative assessment to investigate and compare formative and summative assessment tools in a study of students’ perceptions of their learning and teaching

methods in an engineering course. A few students in each of two offerings of the course participated in the focus group interviews. Each student participated in a single focus group. Courter, Millar and Lyons [2] used interviews in the evaluation of the pilot semester of a freshman introduction to engineering course in order to provide an understanding of the students’ experience in the course and identify aspects of this experience that could lead to improved student retention in engineering. Students in this study were interviewed twice during the semester they were enrolled in the course. Interviews are also used in program evaluation. For example, Lathem, Neumann and Hayden [3] used interviews to assess engineering students’ beliefs that their engineering program “positively influenced their attitudes and their self-reported understanding about the roles and responsibilities of engineers in today’s global society.” In the study, which extended over four years (2006-2009) students were surveyed once at the end of their senior year. A small number of students also participated in an interview or focus group, again once at the end of their senior year.

In contrast, Wise, Lee, Litzinger, Marra and Palmer [4] used a series of interviews with the same students over a three year time frame (1997-1999) in their study of the intellectual change in undergraduate engineering students and possible connections between curricular changes and intellectual changes. We argue that this longitudinal approach to assessment is necessary to fully capture the impacts of a course because students need time to reflect on their learning. This is a particularly true for first year engineering courses which are often intentionally introductory such that they form the foundation of later courses and the engineering curricula as a whole and are not intended to be “stand alone”. What we mean is that students may not fully understand how or what they have learned until that knowledge is called upon in subsequent courses. Through an on-going project, we are investigating the question, “How can a series of interviews over time be used in longitudinal assessment to benefit the development and improvement of first year engineering courses?”.

FRAMEWORK AND SITUATION IN CURRENT LITERATURE

To address our research question, we engage a self-regulated learning (SRL) conceptual framework proposed by Pintrich [5]. In Pintrich’s model, the learning process includes cognitive, motivational and affective, and contextual aspects. Like other SRL models, Pintrich’s

model is grounded in the central idea that the learner is in control of his/her learning process; Being in control means that the learner constructs his/her own meaning within the learning environment, sets his/her own goals, acts towards these goals, monitors progress towards these goals, and makes changes as appropriate [5].

Pintrich's SRL model [5] has four stages including: 1) planning and goal setting in which the learner considers, the task, context and self-beliefs, 2) monitoring in which the learner maintains awareness of the task, self and context and relationships among the three, 3) control in which the learner regulates aspects of the self, task or context, and 4) reaction in which the learner reflects on and reacts to perceptions of the self, task and/or context. Each of these four stages occurs across cognitive, motivation and behavioral aspects of the task in iterative and non-sequential ways. While much research has focused on relationships between motivation, cognition and learning [e.g., 6, 7, 8], little research has focused specifically on the role of reflection. Therefore, within this framework, we focus on reflection, and particularly reflection that extends over time after the course has ended, to address our research question.

Our study is both qualitative and exploratory to help us examine students' reflections on learning experiences and specifically how they change over time. Reflection is a way of processing and making meaning out of learning experiences. We believe that understanding this reflection process is critical to course assessment and improvement. Because we collected our first set of interviews as students were completing the course, we have their immediate response to the course. These interviews provide similar types of feedback to the bulk of the studies described in our introduction. By adding a longitudinal series of interviews that capture student reflection with time, we can consider the longer term impacts of the course and how such feedback could and should inform course design.

METHODS

Our data come from a larger, NSF-funded mixed methods research project that examines how different pedagogies impact student motivation and retention in engineering. Although the overall study includes surveys and classroom observations at two research sites, in this analysis we focus on a longitudinal series of qualitative interviews to assess students' experiences in a large, first year engineering course at one of the research sites. In particular, we examine how students' assessment of the value or usefulness of particular learning experiences change over time. We adopted a case study approach [9, 10] such that each participant and his or her complete set of interviews represents a case.

Research Site

Our research site is a land grant institution in the southeastern region of the United States. The course is a

required course taken in the second semester of the first year. The focus of the course is engineering design and the tools such as programing and algorithm development, graphics communication, and CAD, necessary for a successful design process. Students in the course completed a semester long team design project.

Participants

Participants in this portion of the study include those students for which we have an interview from at least Year 1 and Year 3. For participants other than Maya and Erin, we also have interviews from Year 2. Our sample includes 7 women and one man. Table I includes a listing of participants by gender. To protect participants' identities, we have assigned pseudonyms. Our study includes predominately students who have continued to persist in engineering studies although one participant, Harmony, changed majors in the second year.

TABLE I

Pseudonym	Gender
Harmony	F
Maya	F
Nicole	F
Cathy	F
Erin	F
Jena	F
Valerie	F
Doug	M

Our study is clearly skewed towards women participants. The context of the larger study is in understanding underrepresentation of women in engineering so to some extent having more women was intentional. However, with time, our study has become even more skewed towards women participants. We believe the findings are still important and relevant to all students, although, as discussed in our limitations section, additional research is needed. Even if a worst-case outcome in terms of generalizability is that these findings only apply to women, we believe they are still important and valid findings.

Data Collection and Analysis

Our data include interviews that were collected annually with the same participants over a three year period. The first interview was conducted in the final weeks of a second semester first year engineering course and the second two interviews were conducted one year and then two years later.

Interviews were semi-structured in format allowing the researcher to follow-up on participants' responses as appropriate to gain a better understanding [11]. In Year 1, the interview focused on eliciting information about student's perceptions of their learning experiences in their first-year course. Example interview questions that proved particularly fruitful for this analysis include:

- Tell me about your experience in [course name]. What do you like best? What do you like worst?
- Do you find this course interesting? Why or Why not?
- Is this course or the content of the course important to you? Why or Why not?
- How does this course fit or fail to fit your perception of what an engineering does?

In the Year 2 and Year 3 interviews, we asked participants to reflect back on their learning experiences and asked if the course prepared them for current courses and/or his/her career. We asked questions such as:

- Do you recall your experience in [course name]? What do you remember?"
- In what ways are your current engineering classes similar to or different from [course name]?
- Did your experience in [course name] prepare you for classes you are taking now? Why or Why not?
- Do you think your experience in [course name] is preparing you for your career? Why or Why not?
- What is the most significant thing you learned from participation in [course name]?

All interviews were audiorecorded and later transcribed verbatim. We used MAXQDA software to facilitate analysis. Our coding process used both a priori and inductive strategies [12]. Building on prior coding strategies, described in greater detail elsewhere [13], this analysis focuses on how students describe the useful aspects of the course.

RESULTS

Results from our study suggest three key themes. First, it is challenging for students to reflect on the course and what they have learned while still enrolled; they are often too focused on content and grades to use strategies (such as reflection) to process their learning experiences. Second, longitudinal data suggest that as students are called on to use skills they realize how much they have learned. Finally, years removed from the course students reflected positively on the course for providing learning experiences that subsequent courses have not afforded.

Focus on Content and Grades

During the first year, responses to questions of usefulness of the course were often very surface-level where participants listed software and activities. In previous analysis of data from the first year interviews, we found that students focused on grades [14] and content (e.g., the software Inventor and Matlab) [13]. They also talked about writing reports and learning the design process as useful outcomes with teamwork often only mentioned as a one-line statement with no expansion on what teamwork meant to them [13]. Students were often unsure of where or how they would use what they had learned in the course again in the future. By the second and third year, students still often gave content examples (e.g., Matlab and Labview) and activities (e.g., teamwork and report-writing) but they were more articulate

and able to provide greater detail about what they had learned with regard to that content or those activities.

As an example of change with time consider Doug's descriptions of learning teamwork. In Year 1 he said:

I think, like I mentioned earl[ier], the group work. Like, I, I feel like that's gonna be a lot of what a professional engineer does. It's – not necessarily working with other engineers, but working along with other experts in their field, so I think it's good, uh, to work in a group some and get used to that aspect.

Note that he describes working with others as important to professional practice but also in a very generic way. It is just people working together. Doug becomes more articulate by his second year. He describes learning how to work in a team as an important outcome of the course:

Basically there I feel like I learned how to be a member of a team, and how to, I guess take charge where no one else really would... To be able to get things done to meet our deadlines and everything. I learned I guess about team dynamics, about how everything works, in a work atmosphere.

In this quotation, Doug situates himself as a member of the team and gives an example behavior in which he engages during teamwork, e.g., "taking charge" when needed. In his second year, we get a better idea of what teamwork means to Doug and how he engages in it. His response in the third year is very similar to his response in the second year. We believe this response also relates to our second category of findings, i.e., experiences that draw on what they learned in the first year course contribute to their perceptions of what they learned.

Additional Experiences

As indicated when we described our research setting, the first year engineering course we studied attempts to engage students in learning a variety of basic engineering skills. Our analysis suggests that as students need to call on these skills in subsequent courses, internships or research experiences they realize just how much they learned in the first year course.

For example, when asked about skills learned in the first year Jena anticipated that learning the design process would be useful in future courses. In Year 3 she talks about not having many design projects in other courses but that when she does, she thinks about the first year course and what she learned about teamwork. Specifically, she talks about how to have an organized approach to the project (because her team in the first year was not organized) and to have more "patience" with other team members and how they approach the project.

Conversely, with time students sometimes also recognize deficiencies in first year experiences. Harmony has switched majors out of engineering. As she compares her first year course to non-engineering courses she is taking in her second year:

...like my other classes that I'm taking now, like [specific courses], they have a little bit more focus on, they're obviously focused on their subject matter, but then, they also integrate how their subject matter applies between people, this is hard to explain, I guess, it's kind of just a vibe! ((laughs)) But um, like for [specific course], they're saying like, 'Okay, well this is the [specific principle] that we're teaching you, and this is how it's going to affect you in your day-to-day life', whereas Engineering, it seemed like, 'These are the Engineering principles. Learn them. Here's the test.'

It is the connection of course content to real-life that Harmony enjoys most. She reflects back on the parts of the first year course that were most interesting to her saying:

I really thought learning programming was interesting, and it made me look at everything in a new way. Like, I was at the gym, and I was, um, I was like looking at the machine and it's like calculating my heart rate and stuff, and I was like, thinking about the programming it must have inside it, taking my heart rate and my weight and my age, and like calculating how many calories I've burned. And I was like, 'Inside this is a program that I could design!' So, I thought programming was really interesting, and it taught me how to look at a lot of things in a different way. Instead of just like, 'This is a computer, it's calculating things for me.' It was like, 'This is how it's calculating this for me!'

She specifically says that she had not really thought about the differences in courses until having some non-engineering courses for comparison. In her second year, Harmony realizes that an explicit connection between classroom content and life was missing for her. While she had been able to make some connections for herself, she could not make all such connections.

Providing Learning Experiences Not Found in Other Courses

Reflecting back on the first year course, students also mention that they had learning experiences in that course that they have not had in other courses. For example, Doug mentioned the series of small projects in workshops where he got to explore different topics in small groups each week. While it was at times frustrating to him to jump topics and not continue to build on prior knowledge, he remembers these workshops much more than lectures. Cathy specifically mentions having a design project that spanned the whole semester:

We don't, at least in my experience, I haven't had a design project that lasts the whole semester. I think I have had one other class that it lasted the whole semester but it was really small and easy. It was nothing compared to [course].

When asked if she thought it was good or bad that the project lasted the whole semester she said,

It's harder so if you want to take the easy way. It is nice that we don't have to but I am sure you learn more from semester long projects because it is more in depth and you really get to know your group.

Cathy has not had many full-semester design projects after the first year course. She recognizes that such projects are harder and appreciates not always doing them but also understand that they provide a different and meaningful learning experience.

Similarly, Nicole had been very excited about the hands on learning in the first year. In the second year she compares this to the courses she was then taking saying:

Ok, they're very different now this semester, just because this semester I don't really have any group projects or anything like that, it's mainly you're on your own doing your own work, 'cuz I'm in statics, or not statics, dynamics and deforms, and E theory, stuff like that. It's kind of traditional classes like in high school.

Nicole recognizes that there are aspects of her first year course that she no longer experiences.

DISCUSSION

Recall that the purpose of study was to address the research question, "How can a series of interviews over time be used in longitudinal assessment to benefit the development and improvement of first year engineering courses?". To address the question, we contextualize our findings in terms of our theoretical framework and in terms of implications and practical applications.

Our findings suggest that immediate course feedback may not be enough to inform course design because with time and reflection, students value their experiences in this first year differently. Whereas students are initially focused on content and grades with little understanding of eventual application, over time they develop an understanding of the course as providing foundational knowledge which they either later apply or can conceive of more ways in which the knowledge could be applied. This transformation takes time because additional experiences, or in Cathy's or Nicole's cases a lack of experiences, are needed to contextualize learning from the first year course.

Specifically situating these findings in Pintrich's SRL model [5], we believe that our findings span several stages but most directly highlight the importance of the reflective stage. The interviews conducted at the end of the course, represent as an assessment of the course against students' plans and goals for the course. (Stage 1). The students are focused on learning content and achieving high grades. They tend to focus more on the tasks in the class and struggle with the broader context for their learning. Through the interviews conducted in the second and third year, we find that through reflection the participants are better able to contextualize the learning. They can recall

specific tasks and course content but they are also able to situate the tasks and content in the broader picture of their overall experiences learning engineering. Upon reflection, content that may once have seemed less useful becomes meaningful. We note that reflection alone is not enough but rather time and additional experiences are needed.

Focusing on time and reflection does not mean we should ignore the immediate feedback that we can gather during or at the end of a course. This feedback tells us what the students experience while we are standing in front of them and while we are trying to work with them. For example, for the course described in this paper the outcomes of the first interviews suggest that finding a way to shift the focus from grades to deeper learning could be helpful. However, our study also shows that there are aspects of our course that have a positive longer term impact that we may not want to change because of the longer term benefits to students.

Since our study specifically advocates for the use of longitudinal interviews, answering our research question also means interpreting our findings in terms of our chosen methods. We argue that by using longitudinal interviews, we capture the students' experiences in their own words creating richer and deeper understanding. While we believe that surveys could also be meaningful in providing generalizable results, using them for this study would have been premature. If we had tried to construct surveys, based on data from the first year, we may not have known what to ask in subsequent years.

The implications of this work highlight the need for longitudinal assessment, reflection, and interviews or other sources of qualitative data such as focus groups. First, our research shows the need for researchers and practitioners alike to consider longer-term assessments as they design and develop courses. Longitudinal assessment could help researchers and practitioners remember to situate student feedback in the bigger picture. During or at the completion of the course, students may be tied up in the immediacy of the whole experience. For example, students may be bound up in the emotional experience of a difficult group member or the stress of just trying to learn content for a final exam to truly appreciate or understand what they have learned. While immediate feedback is important, the emotion fades with time and reflection.

Second, our findings suggest that reflection helps students value their first year course experience differently. What is not clear from our study is exactly when and how this reflection happens outside of the interview space. However, the first year course could be a place to help students develop reflective practices by increasing opportunities for reflection on course content. For example, perhaps sharing with students short video clips of advanced undergraduates talking about how they used content from the course and then asking the first year students to consider courses they intend to take and map how those course might relate to the first year course. Note that this activity is not directly supported by this current research but seems a

logical extension of the findings worthy of serving as an example and also worthy of further investigation and study.

Finally, implications from our research also include the value of interviews or other qualitative data in assessment. While our sample is smaller than if we had used a survey approach, we have rich meaningful insights from students regarding their experiences. Focus groups could be another way to garner similar data.

LIMITATIONS AND FUTURE WORK

Our study includes three limitations. The first is having a small sample size. While smaller samples are acceptable in qualitative research, we may not have reached saturation [11] and with a larger sample size may find additional benefits to longitudinal interviewing for course assessment. To expand our sample size we have initiated a second series of interviews with a group we call Cohort 2. In the interviews from the original cohort we observed significant changes in students' narratives between the first two years. To help us investigate these changes the second interview for students in Cohort 2 was conducted in the first semester of the second year with a follow-up one year later. The second limitation in our study is that our analysis is based on data from a single research site. Future research should examine the how well the findings from our study hold across different institutional settings. The third limitation is that our sample includes disproportionately more women than men. Our overall intention with this project was to oversample for women. However, our sample now severely underrepresents men. We saw no differences in our analysis by gender, and therefore, do not believe this limitation impacted the findings presented herein but further study with additional male participants is recommended. Cohort 2 described earlier in this paragraph has greater representation of men to help us address this gender imbalance.

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