AC 2010-849: EXPERIENCES OF GRADUATE TEACHING ASSISTANTS IN ENGINEERING LABORATORIES: CONTENT ANALYSIS USING THE “HOW PEOPLE LEARN” FRAMEWORK

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Experiences of Graduate Teaching Assistants in Engineering Laboratories: Content Analysis Using the “How People Learn” Framework

Abstract

In higher education, graduate teaching assistants (GTAs) have undertaken different instructional responsibilities, particularly in science and engineering laboratories. Herein, we utilized the How People Learn (HPL)¹ as an overarching framework to evaluate GTAs' instruction in engineering labs. Semi-structured interviews were conducted among five GTAs who were selected purposefully from an engineering lab, enrolling approximately 1800 students, to elicit GTAs' self-reflections regarding their teaching philosophies, practices, and experiences in instruction. Content analysis was conducted to examine how GTAs engaged with the four elements of the HPL framework (i.e., knowledge-, learner-, assessment- and community-centeredness) within their engineering laboratories. Findings from our analysis offer an overall view of GTAs' instructional practices in engineering labs and provide a general profile of GTAs' teaching related to the HPL framework. This profile may be used for the future training and evaluation of GTAs to improve in course organization and aid in pedagogical development.

Introduction

GTAs have taken an increasingly important role in higher education, especially in undergraduate teaching². Major responsibilities of GTAs include helping faculty members with class instructions³, leading classroom discussions, coordinating lab sessions, leading office hours, and grading exams, projects, or assignments. Since 1999, the percentage of graduate teaching assistantships granted in science and engineering has increased by over 10%⁴. This increase highlights the necessity of GTA training and an evaluation of their teaching practices.

To explore current teaching practices of five first-year engineering GTAs, researchers analyzed GTAs' pedagogical responses within the context of the How People Learn (HPL), a framework that categorizes classroom occurrences using four dimensions-knowledge-centeredness (KC), learner-centeredness (LC), assessment-centeredness (AC), and community-centeredness (CC). More specifically, researchers used the HPL framework to understand how GTAs' teaching is operationalized. The profile of GTAs' instruction under HPL framework provides a foundation for GTAs' training and development. The guiding research question for this study is, “What are the teaching profiles of GTAs as framed within the context of the How People Learn framework?”

Literature Review

Pedagogical feedback to GTAs provides positive influences to GTAs and increases their teaching efficacy. Such feedback to GTAs might be offered by supervisors or coordinators⁵. Novice GTAs prefer direct and structured supervision, whereas experienced GTAs prefer interpersonal-related supervision. GTAs' self-reflections offer opportunities for them to rate their confidence level before and after teaching^{6,7}. Evaluations from undergraduate students are provided via

surveys, group discussions, and written course evaluations in terms of GTAs communication skills, accessibility, organizations, etc⁸.

Although different sources are available to provide feedback to GTAs in higher education, learning and teaching theories are needed to guide effective evaluation and training for these GTAs. The HPL framework provides new learning and instruction principles of an effective learning environment¹. The four dimensions of an effective learning environment include learner-centeredness, knowledge-centeredness, assessment-centeredness, and community-centeredness. Teachers who are learner-centered pay attention to the unique backgrounds and experiences that students bring to the classroom. A knowledge-centered environment emphasizes students' understanding of course content and their abilities to transfer this knowledge accurately in other environments. The key aspects of assessment-centeredness are the opportunities for feedback and revision by both instructors and students. A community-centered environment encourages all members of the classroom community to learn from each other within the learning environment.

The HPL framework has been demonstrated as a useful tool for the establishment of educational modules that promote student learning^{9, 10} as well as the evaluation of these educational modules¹¹. Founded on the principles discussed in the HPL framework, some instructional modules has been designed to optimized instruction and learning^{12, 13}. In these instructional modules, learning activities and resources are organized so that the learning modules are pedagogically sound and well integrated with other modules. Herein, we use the HPL framework to evaluate GTAs' instructions in the context of first-year engineering laboratories.

Methods

This study was conducted among five GTAs within a first-year engineering problem solving and computer tools course at a Midwestern public university in fall 2007. During the semester in which they participated in the study, each GTA supervised approximately ninety students in traditional and innovative labs. In the ten traditionally-taught computer labs, GTAs provided content expertise about course concepts to their students, whereas in the four open-ended problem solving labs, GTAs primarily coached their students. Other GTA roles included grading undergraduate students' homework, laboratory reports, quizzes, and exams. Despite these role definitions, most GTAs teaching the course self-identified themselves as mentors or facilitators for their students¹⁴.

Participants

Purposeful sampling was used to identify five GTAs to discuss their GTA experiences. Four of the five GTAs were international students, and the experience of the GTAs ranged from no experience to vast experience. Mary and Peter were enrolled in a pedagogically-focused graduate course designed to help GTAs to improve their effective teaching practices. They were interviewed after they took the course¹⁵. Eve and Joe were recruited because of their similar profile and experiences to Mary and Peter (i.e., gender and experience level within the course), respectively. Mark was recruited to participate because he was an experienced TA within the course.

Data Collection

Semi-structured interviews were conducted among the sample of GTA described above. Each GTA was asked nine protocol questions that explore their roles, responsibilities, and expectations as GTAs. Each GTA was interviewed for 30-45 min each, and the interviews were transcribed and verified by researchers.

Data Analysis

Before analyzing the data, researchers read and re-read the transcripts. Then researchers created a codebook representing the definition and the operationalization of the four lenses of the HPL framework. An additional aspect, class organization, emerged in our transcripts. After presenting excerpts of the interviews to the research team, the codebook was revised as needed. Content analysis¹⁶ was then used to map GTAs' responses to the four aspects of the HPL framework (i.e., knowledge-, learner-, assessment- and community-centeredness) within their engineering laboratories. The coding procedure was performed by two researchers and the coding was verified by two experts to obtain the inter-coder reliability. Final inter-coder reliability was above 80%.

Results

Findings from our analysis offer an overall view of GTAs' instructional trends in engineering labs and provide a general profile of GTAs' teaching related to the HPL framework. We compiled the frequency of each code and summarized the counts for each GTA in each category (Table 1). As shown in Table 1, GTAs varied in their references to knowledge-centeredness with 9 for Mark and 0 for Peter. This variation of the demonstration of knowledge-centeredness implies the GTAs' different abilities in explaining major concepts and linking key concepts with the big picture of the field.

Table 1 Content analysis frequency counts

GTA Name	How-People-Learn Lenses						GTAs' Prior Experience
	Knowledge	Assessment	Community	Learner	Organization	Total	
Mary	4	4	15	15	16	54	No prior experience
Eve	10	6	14	10	15	55	No prior experience
Peter	0	5	7	8	7	27	Some experience
Joe	6	9	9	8	4	36	Some experience
Mark	9	5	10	12	5	41	Vast experience
Total	29	29	55	53	47	213	

Meanwhile, this profile shows that most of the GTAs demonstrate varying instances of each dimension. The analyses show that in an engineering lab, the GTAs paid great attention to differences in students' backgrounds, knowledge, learning styles, preconceptions, and needs (i.e., learner-centered). They were involved actively in formatively and summatively assessing students' learning and in creating learning environments for students to get engaged (assessment-centered), and they also engaged students in the community of the classroom (community-centered).

Finally, our results raise a concern about GTAs' competencies regarding course organization, especially for new GTAs. New GTAs without prior teaching experiences talked more about classroom organization. The large frequency of organizational incidence suggests that GTAs often discuss their concerns towards classroom organization.

Discussion

Our findings demonstrate that the levels of GTAs' knowledge-centeredness and classroom-organization are closely related with their experiences. GTAs with more teaching experiences demonstrate a higher level of knowledge-centeredness and lower level of classroom organization. This profile offers insights for designing GTAs' training and professional development program by emphasizing knowledge-centeredness for new GTAs and deemphasizing organizational aspects for more experienced GTAs.

As pointed out by Jolly¹⁷, practitioners develop from lower level to higher level of proficiency in the continuum of becoming an engineering educator (i.e., novice, advanced beginner, competent, proficient, and expert). This development requires active reflections of the trainee guided by proper strategies at each stage. Combined with our profile of GTAs' instruction under the HPL framework, we suggest that clear rules and specific guidance about class organizational issues be laid out for novice GTAs to decrease their confusion about these matters. Meanwhile, other explicit rules about teaching, for example, "explain XX concepts", can be used to help GTAs' instructions. As the GTAs obtain some teaching experiences, guiding questions like "What kind of personal characteristics will limit your teaching practice" and "How do you like your interactions with students" are designed to assist the self-reflections of GTAs so that they will identify their own strengths in teaching and develop their own teaching style.

Conclusions

In this report, we demonstrate an overall teaching profile of GTAs within the context of the HPL framework. Our findings highlight the importance of GTAs' prior teaching experiences in helping the GTAs to explain key concepts and situate concepts into a big picture. Meanwhile, new GTAs tend to show frustrations in class organizational issues. These results provide potential implications for the training and professional development of GTAs. Combined with professional development models, specific suggestions (guidelines or reflective questions) are proposed here to help with the improvement of GTAs' instructions.

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