



Writing Good Reflection Questions: Testing Brookfield's critical incident questionnaires effectiveness in improving student learning

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Introduction

Stephen Brookfield's Critical Incident Questionnaire (CIQ) is a formative assessment tool designed to help faculty better understand their students' behavioral responses to key factors affecting learning in a traditional (face-to-face) classroom. Grant and Trenor claim the CIQ holds potential for building grounded theory in engineering education [1, p. 13]. CIQs have also been identified by Phelan as being "particularly valuable in an asynchronous online learning context where students are typically geographically isolated from one another." [2, p. 1]. This paper describes how a construction management instructor used the CIQ to better understand and respond to her students' learning needs in an on-line engineering course. The CIQ allowed students to describe their levels of engagement when reading assignments, posting on an online discussion board, and conducting self-directed site evaluations of a Leadership in Energy and Environmental Design (LEED) certified building.

This paper contributes to the body of engineering education knowledge by describing how the CIQ was seamlessly incorporated into an on-line course providing the instructor with appropriate writing prompts, which allowed her students to express their genuine opinions about their learning experience. The instructor adopted the CIQ as a qualitative survey tool to collect preliminary data to inform her scholarship of teaching, after she read of its success in other disciplines. Review of preliminary data shows how her students' weekly CIQ responses informed the instructor and influenced changes to course content and delivery methods. Success for the instructor was measured by a significant increase in students' reported satisfaction at the end of the course. Success for the students included greater satisfaction on their second site evaluation visit to a LEED certified building than on their first visit where they reported frustration and angst.

Early career teaching faculty and others may wish to make use of the CIQ as a formative assessment tool when crafting questions to gain accurate responses that highlight students' degree of engagement and learning in their on-line engineering courses. This may result in boosting faculty teaching assessments at the end of the semester. Being responsive to students' learning needs throughout the semester is good for promotion and tenure. This is a work in progress.

There is a need for studying how the CIQ might be effectively implemented in undergraduate engineering education. When teaching online courses faculty often depend on discussion boards to track learner-centered dialogue. Discussion questions may or may not focus on students' preferences or perceptions of the learning environment. Unspoken frustration may lead to disgruntled students, a lack of active participation, and poor teacher evaluations at the end of the course. What this instructor wanted was an easy-to-use formative assessment tool, in the form of written comments, to better understand her students' learning experiences. Review of

pedagogical literature in engineering showed that “the CIQ was a significant tool in promoting active-learning practices among students and teachers” [3, p. 317].

The aim of this study was to show how the CIQ was used by this instructor to enhance the learning experience in an online engineering course. The researcher has recognized that tracking students’ perceptions of their learning experiences throughout the semester can be beneficial to early career faculty. Rather than waiting to receive summative evaluation scores through traditional student ratings systems, such as IDEA [4] the CIQ’s provide faculty with weekly feedback to improve their teaching performance. Keefer [3] recognized the benefit of the CIQ as a formative assessment tool that allows current students to provide feedback that may improve their learning experiences as they happen.

“Many educational events have a final evaluation of some sort. It is not always clear when or if the instructors receive them, nor is it clear whether the information contained is useful for improving future learning events. In many ways, it is too late to receive feedback at the end of a class if the needs of the current learners were not met or if ongoing and hidden problems exist”
[5, p. 179].

Purpose of this study

The purpose of this study was to test whether the instructor, issuing weekly CIQs to her online students, would be able to:

- 1) elicit authentic comments from her students which would allow her to gauge her students’ level of understanding regarding course content,
- 2) provide additional instruction as needed,
- 3) coach students through a self-directed site visit, and
- 4) assure a meaningful learning experience for all students.

In this way, gather data that would help her understand her engineering students’ perceptions of the virtual learning environment and be responsive to her students' needs [2].

Literature review

Early career faculty who are assigned online engineering courses may look for effective ways to practice learner-centered teaching [6]. Learner-centered teaching is known to promote professionalism in undergraduates [7, p. 213] by engaging them in deeper thinking and self-evaluation. A goal of learner-centered teaching is to train students to take an active role in reflecting on their educational experiences. One way to do this is through preparing effective writing exercises. Students’ written reflections may provide insights into their preferences regarding clarity of course content, effectiveness of pedagogical delivery methods, and perceptions of their learning environment. Benefits of reflective writing have been shown to improve student learning while training them to be life-long learners [8, p. 37] [9, p. 34]. However, for some faculty crafting robust analytical questions may be a daunting task; hence, their reliance on well-established Scholarship of Teaching and Learning (SoTL) methods [10].

These are qualitative research methods used to document significant classroom experiences in order to understand students and teachers' resulting behaviors.

For decades, faculty have tested teaching strategies to help students feel in control of their learning environment and to promote professionalism. Pedagogical methods shifting the burden of learning from professor to student have included learner-centered dialogues such as Socratic seminars and peer-review groups [7]. The theory of student engagement is “based on motivation and the idea that when students find the lesson meaningful and have a high level of interest in the tasks, they learn more effectively, tend to retain the information, and are able to transfer it to other contexts” [11, p. 1].

SoTL is scholarly thought and action that uses the reciprocal relationship between teaching and learning in post-secondary education contexts to improve student learning and enhance educational quality [10]. According to Hutchings and Shulman [12]:

SoTL invites teaching faculty to examine their own classroom practice, record their successes and failures, and ultimately share their experiences so that others may reflect on their findings and build upon teaching and learning processes. In this respect, SoTL serves as a conduit for disseminating contemporary research findings and making accessible practical applications of educational theories and practices related to teaching and learning for all stakeholders in education [13, p. 1].

Trigwell et al. agree. SoTL is disseminated through multiple channels, ranging from professional associations to the faculty member's institution to discipline-centered venues and disciplinary journals. According to Trigwell et al., the focus of scholarship may be “explicitly on teaching and learning within the discipline, or may include teaching and learning topics along with conventional topics to the international arena, which generally transcends disciplinary boundaries” [14, p. 157].

Research may include but is not limited to “reflection and analysis, interviews and focus groups, questionnaires and surveys, content analysis of text, secondary analysis of existing data, quasi-experiments (e.g., comparison of two sections of the same course), observational research, and case studies” [13]. In addition, Lee S. Shulman, president emeritus of the Carnegie Foundation for the Advancement of Teaching, has long encouraged teaching faculty to engage in scholarly systematic research in the practice of teaching and learning. He argues that it is “only when we step back and reflect systematically on the teaching we have done, in a form that can be publicly reviewed and built upon by our peers, that we have moved from scholarly teaching to the scholarship of teaching” [15, p. 1].

Active learning exercises emphasizing the design process as a systematic way of thinking have also been used – leading to student performance being measured by project results [7] [16]. This method of learning is beneficial in face-to-face situations where students may engage in group activities. But it becomes more challenging to replicate in online courses. There is evidence that the CIQ is widely used in various levels of education [5, p. 177], but there is only limited evidence of how the CIQ is used in engineering online teaching environments. Keefer describes the pedagogical value of this type of research:

“We want to better understand the experiences and perceptions of the student learners, for the more we can understand them, the more we can teach in ways that may meet their needs” [5, p. 178].

Since 1995, Stephen Brookfield’s CIQ has been used “as a post-class formative assessment tool” [5, p. 177] to gather open-ended written reflections from students. Through students’ open-ended reflections to five CIQ questions, faculty may discover the effects their teaching actions have on students’ learning. The CIQs allow students to reflect on moments when they felt especially engaged or disengaged from the learning experience, document helpful acts performed by others, report points in the design process where they are experiencing frustration and share things that surprised them. Normally, CIQs are administered anonymously; interventions are inclusive; and changes to content or delivery are implemented the following semester with a different student population [18]. Brookfield typically used the CIQ in face to face learning environments, this research used the CIQ in an online course.

Written reflections focus on learning moments when students feel especially engaged or disengaged, puzzled, or surprised. CIQs are useful when composing good reflection questions. They help faculty to better understand students’ opinions of key factors affecting their teaching and learning experience.

Current literature discusses the value of using the CIQ as a formative assessment tool to help faculty and students identify and discuss key factors affecting learning [17]. There are examples of ambitious SoTL projects in and outside the engineering disciplines that make use of the CIQ. In addition to their focus on rigor and equity, these projects share two working assumptions that assure their success:

- “(1) the quality of teaching is assessed by examining the participation and learning of all students in the classroom, rather than by the completion of a curriculum or by standardized test scores; and
- (2) widespread and sustainable improvements in teaching require a repertoire of practices that can influence student learning and be refined over time by both practitioners and researchers.

Such practices have been referred to as “core” to the work of teaching (Ball, Sleep, Boerst, & Bass, 2009; Franke & Chan, 2007; Hatch & Grossman, 2009)” [19, p. 1100].

Methodology

The Sustainable Building Systems course is an online course offered each summer as an elective course as part of a construction management undergraduate program. Students who take the class are upper class construction management students. A few architecture undergraduate students also take the class. Based on previous experience teaching the course, the instructor observed students being frustrated with the learning process, some of which is typical for online asynchronous environments. In online general discussions, students reported disengagement based on the lack of real-time interaction among students, time-management issues trying to juggle a full-time work schedule with studying and feeling physically disengaged from the

university community. To improve students' level of engagement in the learning process, the instructor decided in summer 2019 to embed weekly CIQs in the course. Her initial thought was, the CIQs would encourage students to reflect on their learning while informing the instructor about the students' learning experiences. The data collected by the instructor indicated students biggest frustration was with 1) the first site visit report (course assignment requiring that they apply sustainability evaluation on a real site), and 2) with the amount of new knowledge they acquired.

The CIQ was offered as an integrated part of a five-week long online course, offered to students from three majors: construction management, architecture, and agricultural engineering. Students completed the CIQ each Friday. Qualitative data were gathered online, and double-blind coded by the researcher and instructor using key words and phrases. The questions were modified (to include the words "online class") and were administered through QuestionPro Survey. The instructor selected the entire cohort of students enrolled in an on-line Construction Management course. Fourteen juniors and seniors were enrolled in the course. Thirteen completed the 5-week CIQ responses. To encourage participation, all students were assigned bonus points based on the percentage of the total class response rate for each week.

According to Brookfield, "Reflection is useful and necessary in the terms it sets itself; that is, to make a set of practices work more smoothly and achieve the consequences intended for them" [20, p. 293].

Research questions

The questions used in the survey were almost identical to Brookfield's original set of questions [21], but modified to fit the online setting of the course:

1. At what moment during this online class did you feel most **engaged** with what was happening?
2. At what moment during this online class were you most **distanced** from what was happening?
3. What action that anyone (instructor or student) took during this online class did you find most **helpful**?
4. What action that anyone took during this online class did you find most **puzzling**?
5. What about this online class this week **surprised** you the most? (This could be about your own reactions to what went on, something that someone did or anything else that occurred).

Data Results

Table 1: Data for 2019

CIQ Question Categories	Week 1: Beginning of Project		Weeks 2-4: Middle of Project		Week 5: End of Project	
	%	Respondents' comments	%	Respondents' comments	%	Respondents' comments
1.Engaged	64	Doing first assignment and exploring arch2030 web site				
			93	Group introductions and initial discussion		
			71	Group discussion based on reading the chapter(s)		
			57	Doing research and writing about indoor air quality		
					50	Writing the report for their 2 nd site visit
					50	Enjoying the 2 nd on-site visit
2.Distance	57	N/A				
			64	Never		
					57	Never
3.Helpful	29	Instructor prepared materials				
			64	Organization of course by instructor		
			36	N/A		
					50	Never
					43	Research on site 2 nd visit
4.Puzzling	71	N/A				
			71	1 st site visit and report		
					71	N/A
5.Surprised	43	New knowledge from sources beyond the textbook				
			57	New information		
			93	Time management		
					36	New knowledge based on readings, discussion board and two site visits

% = Percent of all students responded with similar open-ended answer to the question category.

N/A = Students provided no written response to the question category.

Never = Students responded they never experienced the feeling listed in the question category.

Discussion of data

Thirteen out of fourteen students responded to the CIQ. Comments provided the instructor with valuable insights into students' successes (engaged/helpful/surprised) and frustrations (distanced/puzzled). Students were able to express frustration or appreciation separate from the online discussion board. Students response rate was higher than anticipated. Ninety-three percent of the students reported feeling like they belonged to an online student learning community through discussion board posts. Sixty-four percent of students were positive about their learning experience based on their relationship with the instructor. New knowledge focused on sustainability issues and using LEED evaluation measures. Seventy-one percent of students were 'puzzled' by the requirement to visit and assess a LEED building during weeks two and three. These students reported weeks four and five being both 'engaged' and 'surprised' following their second visit to the building. Sixty-four percent of students were engaged with the course content and praised the instructor for her organization of course content and materials. During week two, ninety-three percent of the students reported being surprised by time management challenges. However, only one student continued to have time management issues throughout the semester.

The instructor reported she had a better understanding of her students' challenges based on the weekly CIQ responses. There was one problem with students' responses to question #2, 'Do you feel Distanced?' They were marked 'n/a' the first week, followed by 'never' in subsequent weeks. What did the students mean by these responses? In the future, the instructor would like to modify the CIQs to encourage more meaningful comments from her students, thereby avoiding ambiguity, or one-word answers.

Conclusions

The CIQ functioned as a comprehensive reflection instrument. It functioned as Phelan had suggested, allowing students' anonymous responses to be heard. Students, who were typically geographically isolated from one another, reported feeling a shared sense of community through the discussion board. "This is particularly valuable in an asynchronous online learning context." [2, p. Abstract]. This was a goal of the instructor. Using the CIQ, she prepared effective open-ended reflection questions. Students used the CIQ as a framework for deeper thinking and self-evaluation. One example was a student who used the CIQ as a place to work through time management issues. The instructor feels this unique learning experience is a beneficial skill for engineering students preparing to enter the profession.

This study has confirmed the efficacy of teaching by examining the participation and learning of all students. It demonstrated the successful use of CIQs to improve teaching practices during the duration of the course rather than waiting until the completion of the course. Written responses were open-ended, double-blind coding was required to achieve a non-biased set of data making coding time consuming. However, the instructor felt it was worth it to better understand what her students were feeling at the end of each week on instruction. Our use of the CIQ as a formative evaluation tool is still a work in progress; yet, we believe the CIQ is a reliable way to survey students regarding their perceptions of their own learning experiences. It is useful in online asynchronistic learning environments where students benefit from reflecting on their own learning behavior.

Limitations

Limitations included the fact that the class was only five weeks long. Class size was small.

Future research

Further testing needs to be done in engineering courses and slight modifications may be made to adapt the questions to reinforce the interaction among students and the instructor in this online course. Future research also needs to be conducted using full semester courses to better understand the range of opportunities the CIQ may offer as a formative assessment tool across engineering disciplines, both online and face-to-face.

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