

Problem-Based Learning: Designing Online Courses Using A Constructivist Framework

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Abstract— A case study was undertaken to understand how a problem-based learning environment can be designed for undergraduates such that collaborative behaviors between and among peers and instructor are maximized, face to face as well as online. Using constructivist learning theory we examined where students gain their confidence when solving problems, what role peers and instructors had in facilitating problem solving, and to what extent students use technology in accomplishing course work related to problem solving. These factors were first examined using a face to face course in order to better understand how to design an online course that would facilitate problem-based learning. This paper reports these data, how they were used, and also reports the qualitative findings from the pilot online offering of the course. In total, the results provide a holistic picture of the course development life-cycle and how it can be realistically informed by constructivist learning theory such that collaboration can be facilitated in order to create a problem-based learning environment. Faculty and administrators considering online course development as well as those examining the efficacy of traditionally delivered courses in regard to student learning in a problem-based environment can utilize the results.

Index Terms— Online Courses, Thermodynamics, Problem Based Learning.

I. INTRODUCTION

Various factors influence course design and these factors can be compounded further when considering online course delivery, especially those that rely on asynchronous methods. Faculty preparedness and motivation as well as the pedagogy being used to deliver course content play an integral role in shaping the learning environment [1, 2]. Other considerations include learning objectives and the developmental level of the student population enrolled in a given course [3,4]. These elements influence course quality and ultimately the degree to which students meet the desired learning outcomes associated with a given course [3]. Addressing these factors becomes especially important in courses that are designed to facilitate problem-based learning [5]. Recent statistics reveal that delivering course content to students online is of continuing interest to university faculty. Over one-third of public university faculty have taught an electronically delivered class while more than one-half have encouraged students to enroll in an online

course [6]. At the same time, impediments to online course delivery have been readily identified by faculty, including acknowledgement that teaching an online course can take more effort than delivering content through traditional face to face venues [6]. In addition, support opportunities that would assist faculty in delivering quality courses online often fall short of faculty expectations; leaving them feeling unprepared to design and implement an electronic version of courses they may teach [6].

In addition to faculty motivation, considering the pedagogy that is used in online course delivery is also important. Research indicates that if course design and delivery are grounded in learner centered theory then students can effectively engage with and master course content [2]. Online pedagogy requires thinking in detail about how to facilitate interactions between students as well as getting students to engage with the course content through electronic mediums [1]. Learning experiences that are designed to promote purposeful collaboration between students and those that utilize multiple methods to deliver content as well as assess the transfer of knowledge are more likely to see increased gains in student learning [3].

More explicitly, when considering how to design a course that facilitates problem based learning (PBL), collaboration between and among peers and instructors becomes of critical importance, regardless of delivery mode [7]. PBL uses real world situations as way to encourage learning [8] as the problems presented to students do not have a clear right or wrong answer. PBL is based on social constructivism, a learning paradigm that suggests collaboration between and among students and instructor actively engages students in the learning process as conceptual knowledge is created and shared [7]. Engaged in the problem-solving activity, students work in teams to consider the veracity of diverse ideas and multiple perspectives, plan and monitor their steps, and regulate their progress based on feedback from different sources such as peers, teacher, or instructional materials [9,10]. Feedback is an important consideration because it requires transfer of knowledge and therefore represents students' gain in problem solving. In particular, feedback from peers may push students to perform higher level cognitive functions [11].

Environmental variables such as feedback from both peers and instructor and the mode of course delivery can influence student confidence in the acquisition of problem solving skills [12].

Technology can be used to enhance collaboration and feedback through active engagement with materials and collaboration with peers and instructors [2, 5]. For instance, online resources such as the chat, discussion forum, blog, and wiki can play an active role in facilitating teamwork and feedback.

Additional considerations in a PBL environment are students' epistemic beliefs; views on the nature of knowledge and knowing play a role in students' confidence as it relates to problem solving. Research has shown that epistemic beliefs affect how students approach learning tasks [13], monitor comprehension [14], and plan for solving problems and carry out those plans [14]. These beliefs also play a role in how students use their peers and the instructor in relation to course assignments and activities, including how often students ask questions from their instructor, how much instruction students expect in relation to certain tasks and whether students use their peers during course based activities and in accomplishing learning goals [15].

Examining how engineering undergraduates gain confidence in problem-solving as well as what instructional technologies can be used to encourage those skills is of increasing interest [16]. Studies have found that proper design of courses and using effective pedagogy can be used to promote problem-solving skills among students as well as encourage student interest and engagement [17]. However, expecting students at earlier stages of development to learn from courses based on principles of negotiation, shared construction, and peer-to-peer learning could be problematic. If tools employed in teaching and learning or instructional design run contrary to students' epistemic beliefs, it could lead to frustration and disengagement [15].

While PBL has been cited as an important pedagogical strategy, less is known about how to effectively employ this strategy in an online environment [18]. Previous studies that have examined the efficacy of PBL learning have been inconclusive with regard to the efficacy of the online learning environment and have provided less information that can be used by practitioners to develop effective online PBL courses [5].

Given these challenges, a case study of a traditionally delivered undergraduate Thermodynamics course was undertaken to better understand how to design online aspects of this same problem-based course. The study sought to examine how students approach problem solving and determine the efficacy of the pedagogical strategies used to facilitate an online problem-based learning environment. This case study reports the qualitative and quantitative baseline data collected from the control group learning problem solving in thermodynamics in the traditional learning environment and discusses how the data were used to design the online problem-based version of the same thermodynamics course using various learning technologies. In addition,

the qualitative data from the pilot online course delivery is shared. Findings in relation to the efficacy of the online design and delivery are discussed.

II. METHODOLOGY

This case study followed a mixed method research design and involved one section of a traditionally delivered (i.e., face to face through lecture) and one section of an online Thermodynamics undergraduate engineering course delivered using synchronous and asynchronous technologies [19]. Both courses were offered in the Department of Mechanical Engineering at a Research I university and have the following objectives: introduce students to problem solving and have them integrate prior knowledge in differential equations and statics with new information to solve engineering problems in thermodynamics. The data consisted of survey results, field notes, student interviews, and class observations.

The traditional course provided the initial basis for this study. The survey data provided a means to examine the student population enrolling in the Thermodynamics course in relation to the areas of interest for this study. Survey data focused on how students approached problem solving, the role of instructor and peers in facilitating problem solving, and students' use of technology as it relates to accomplishing course work. Following collection and analysis of the survey results, a protocol was developed for the classroom observations and subsequently for the interviews with students. Following analysis of the data collected, an online course was designed and then observations of students' problem-based learning behaviors using a similar protocol were undertaken to determine the efficacy of the learning environment.

A. Data Collection

Following approval by the Institutional Review Board, the online survey was administered to the 45 students enrolled in the traditional course. During the first week of class students enrolled in the course received an email explaining the aims and purposes of the study and were asked to complete the survey by following a link included in the email. The survey solicited demographic data and measured three areas of interest related to this study. Students' self-reported confidence as it relates to problem-solving was measured using five items asking participants how confident they were solving different equations and their confidence as it relates to stating what is known or what is to be determined after reading an engineering problem. Response options were on a five-point Likert scale ranging from 1 "no confidence" to 5 "a great deal of confidence." Students' perceptions of instruction were measured with twelve questions that examined students' epistemic beliefs. Items asked respondents whether they thought good instructors often bring up questions that have more than one correct answer and whether instructors should present various ideas on an issue. Questions also asked students whether they like it when an instructor asks questions that have more than one answer or brings up questions that the instructor does not know the answer to. Participants could choose from a five-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree." The final area that was measured was

students' use of technology as it relates to accomplishing course work using three items on the survey. Respondents were asked how they used technology to collaborate with peers to accomplish course work. Questions asked whether they met in-person, whether they used text messaging or email to accomplish course work, or if they completed work individually. Participants could choose from a five-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree".

Observations of students and instructor during class also served as a method of data collection. Observations focused on examining instructor behavior in facilitating problem-solving as well as the epistemic beliefs of students in relation to the role of peers and instructor in this course focused on problem solving. The course was observed once a week and interactions between and among the instructor and the students were recorded with field notes. To answer the first question, the instructor's use of student-centered pedagogy to teach problem-solving skills were recorded including lecturing and questioning practices. For example, the number of times the instructor lectured, gave instruction, asked an open ended question, asked a closed-ended question, required a response, called for an activity, or introduced a simulation, or Web-based application requiring a response were recorded. We also recorded whether the instructor turned students' questions back to students for answering and tried to engage the class in problem solving processes. Lastly, we documented what questions students brought to class with them and how students used peers when presented with a problem set in class.

Interviews with students focused on gathering specific student experiences in relation to the areas of interest for this study, asking students to describe how they approach problem solving, what role peers and instructors played when presented with a problem set for class, how technology facilitated problem solving and where students derived their confidence from when approaching problem solving. Interviews with students took place in the classroom during the established class time and were conducted by the two researchers. Approximately 10 students attended each group. The instructor was not present during the interviews.

B. Data Analysis

For data analysis, descriptive analyses were conducted using the survey data. Mean scores were computed for each item on the survey. In terms of the qualitative data collected from classroom observations and interviews, a priori knowledge was achieved using the survey data and the three areas measured by the survey served as the initial coding scheme for the transcripts and field notes. In total, findings from the data collected were synchronized with the review of literature to reach conclusions regarding the research questions of the case study and provide the framework for the design of online thermodynamic course.

III. FINDINGS

Of the 45 students enrolled in the traditional course, 35 (29 men, 6 women) students completed the survey. The mean age for the 35 students was 20.5 (SD=.92), identifying them as traditional-aged college undergraduates. The class met twice a week and the first

half of the term, the attendance was high, with more than 35 students being present.

A. Summary of Findings

Confidence in Problem Solving. Respondents were generally confident about their problem solving skills as it relates to engineering, revealing a high degree of self-efficacy (refer to Table 1).

TABLE I.
CONFIDENCE IN PROBLEM SOLVING

Question	Mean	SD
1. How confident are you with solving engineering problems?	4.09	.658
2. How confident are you with stating what is known after reading an engineering problem?	4.49	.742
3. How confident are you with stating what is to be determined after reading an engineering problem?	4.51	.658
4. How confident are you with listing all simplifying assumptions to solve an engineering problem?	3.83	.785
5. How confident are you with drawing a diagram to solve a problem?	4.23	.690

During interviews students explained that their approach to problem solving and therefore their confidence as it relates to problem solving comes from the belief that they have mastered the problem solving approach that is utilized in most of their engineering courses.

One student mentioned, "Nearly all engineering classes have the exact same method for solving problems, almost a prescribed method. One just needs to apply it correctly. I just take it slow...and repeat it until I get it." Almost overwhelmingly among respondents this method was described commonly as "plug and chug." One student provided more detail in relation to this: "Write the problem statement, the givens, any diagrams and assumptions. Then what the problem is asking for and any applicable formulas and constants. Then solve the problem." Students identified repeated practice of this approach and "...having worked similar problems before, usually when an example worked directly from the instructor, or from the book" as giving them confidence. In addition, students explained that they imitated exactly what the instructor did to gain confidence in relation to problem solving:

I have always mirrored exactly what the professor does pretty much on you know problems just like this alright I'm gonna do this the way he does it cause he's the teacher who knows better than him and that's how I've always done every problem solving type thing just whatever he thinks is best...I dunno...I'm just guessing otherwise.

Epistemic Beliefs: Role of Instructor and Peers. On average students were uncertain about the role of the peers in knowledge construction and also did not see themselves as having a direct role in constructing knowledge. Respondents to the survey showed a preference for the instructor passing knowledge directly to individual students (refer to Table 2)

TABLE II.
PERCEPTIONS OF INSTRUCTION AS IT RELATES TO
PROBLEM SOLVING

Question	Mean	SD
1. A good college instructor often brings up questions that have more than one correct answer.	3.43	.884
2. College instructors should present various ideas on an issue.	4.11	.583
3. It 's not necessary for the instructor to answer all of my questions I post in class; fellow students can often do it instead.	3.00	1.213
4. I like it when an instructor brings up a question that he or she doesn't know the answer to.	2.91	.981
5. In a course I would learn as much from fellow students as I would from the instructor.	3.26	1.010
6. I usually like it when my instructor answers a question with "it depends" and follows this by a discussion of the topic.	3.31	1.105
7. In the class, I would want the instructor to answer the questions I ask instead of other students answering my questions.	3.46	.817
8. Working with students on solving problems should be an important part of a class.	4.20	.677
9. If I heard an instructor say "we don't know the answer to that" I would worry about taking a class from him/her.	2.63	1.003
10. An instructor who says "nobody really knows the answer to that" is probably a bad instructor.	2.11	.900
11. There is one right answer for most questions and a good instructor knows it.	2.91	.981

Students explained that the instructor's role is confirmatory, providing the "final answer" and serving as the "primary source for help/recommendations." In terms of the role of the instructor in problem-solving, students saw the instructor as there to provide information, including guiding them through the initial steps of critical thinking. As explained by one participant,

...if you understand what your asking for then its easier but if your lost on the problem I mean and your professor like your trying to ask him a question he's like well you know ... what are you asking what do you want to know, I'm like I don't know like I need help working this problem I don't know what I'm having trouble with I'm, just not understanding the concept so its really hard to pick out one certain thing to ask about.

Students may show this preference because it allowed the students to memorize and repeat the procedures or content that the instructor was looking for students to acquire but this did not mean that students actively processed this information, as one student illustrated, "I could just do a bunch of examples and get what my professor wants me to get out of it but do I actually understand it, no."

Survey results also reveal students were uncertain about the role of peers and what they can learn through collaboration. For instance, the mean on item 3 was 3.00, indicating that students were uncertain about peers

answering their questions instead of the instructor. However, student respondents did indicate that they thought collaboration with peers and being presented with alternative viewpoints by the instructor was an important part of a class. Interviews with students provided further detail about students' beliefs about the role of peers in problem solving, as illustrated by one student indicating that, "Peers are there to help each other out if another needs help." Students did not see peers as a potential source to engage in collaborative problem-solving with and did not indicate that collaboration could result in new meaning making and knowledge. Another student explained how they use peers to confirm findings reached individually rather than reach conclusions collaboratively:

Well I think the most common one I have seen is that I have done is like hey I was having issues on this problem this is what I got did you get the same thing and then if it matches up then you are pretty confident that's the answer if not its like okay so this is what I did what did you do kinda of just like just trying to get a feel for the method they used and maybe they messed up maybe you messed up just seeing where its not reconciled.

When students were confused or dealing with abstract information they revealed a strong preference for having the instructor guide them. As illustrated by one student:

I mean I don't mind helping but sometimes I don't know how to get across this abstract idea which is new to me too so I know the professor has years or experience they know how to I mean some are better than others but most are better than me.

In the traditional class that was observed for this case study, the instructor assigned homework but did not collect assignments. Usually, each class would start with students seated in the front row asking questions about those assignments. The instructor would use these occasions to revisit the concepts being covered in class. This activity was designed to encourage problem solving and class discussion. However, homework questions rarely created peer interactions. The interactions were between the instructor and the individual students who had homework questions. While the instructor attempted to improve collaboration during problem solving, the homework problems usually had a clear right or wrong answer rather than being ill-structured problems. This led students to try to solve the problem sets on their own. In addition to the homework, the instructor would bring problems to some of the classes and would distribute those problem sets to the students after his lecturing, asking students to gather in groups to solve them. It was not clear, however, if the instructor would require the groups to post the answer later on the forum in the online course management system (i.e, Blackboard, Scholar) that the instructor used to post quizzes, notes, and course materials. While the problem sets were designed to actively engage students in knowledge generation, lack of accountability resulted in the students waiting for the instructor to post the answer to the problems rather than having the students generate and propose different solutions.

Role of Technology. We also asked students how they used technology as it relates to accomplishing course work. Students' survey responses for the use of technology for doing homework, class projects, and

studying indicated they prefer to complete their work on their own (refer to Table 3).

TABLE III.
TECHNOLOGY

Question	Mean	SD
13. I usually use text messaging or email to do homework, work on projects, and/or review class material with classmates.	3.17	1.32
14. I usually meet classmates face-to-face to do homework, work on projects, and/or review class materials.	2.83	1.27
15. I usually complete homework, class projects, and/or study on my own.	3.46	.95

In spite of prevalent use of technology for day to day communication, during interviews students indicated that they prefer to meet with students face-to-face. Scheduling was prohibitive and this may be one reason students did not make use of peers when completing coursework related to problem-solving, as one student explained:

...people don't have the same schedules so I know I have its really hard for me to work on thermal dynamics before like Wednesday because I have other classes where everything is due Tuesday or Wednesday so its hard for me to really get on and I'm sure you probably notice the amount of people that really come to class and he doesn't assign homework that's due.

In total, the information gathered through this study was used in considering how to design the online aspects of this same course. Examining how students derive their confidence in relation to problem-solving, students' epistemic beliefs, and how they used technology to accomplish problem-solving provided the course designers and the instructor responsible for teaching the course with the information needed to consider how to encourage problem-solving skills using various electronic mediums.

B. Application of Findings to Course Design

In terms of student confidence in problem-solving, our findings showed that students were generally confident about their problem solving skills in engineering courses. However, their self-efficacy rating did not match the behavior we observed in class because typically few students engaged with the instructor on questions about homework. In the interviews, students indicated that they were not motivated to contribute to online course forums and had difficulty verbalizing their difficulties in relation to comprehension of course material during class. With this information, the online design employed a more constructivist method and allowed students to give and receive feedback from peers and the instructor on the steps of problem solving using online technologies. The technologies were also employed so that learners could monitor steps in problem solving, as self-explanations have proven to be an effective way to increase the co-construction of knowledge. We expected the use of questions prompts and timely feedback would help resolve students' misconceptions of the materials early on and allow for more effective communication with the instructor and each other. The greater accountability, visibility, and opportunities for reflection afforded by

written asynchronous online discussions given the deeper patterns of communication that can take place were also expected to facilitate collaboration [11]. In order to help students see themselves as effective contributors in relation to problem-solving we started the online course with worked out examples and had students demonstrate the seven steps of problem solving. For each problem students were presented with, we identified the skills and sub-skills students were supposed to learn and provided them with opportunities to perform and practice all of those skills.

To alter this epistemic belief that only the teacher has all the answers, expectations made it clear to students that a good grade on homework requires active participation in group work in addition to self-monitoring of their progress. Furthermore, the online design allowed a portion of the grade for participation in group problem solving. Students' participation grade for weekly problem solving activity consisted of three components of relevance, engagement, and clarity. We provided students with rubrics that combine the three components of relevance, engagement, and clarity with the seven steps of problem solving.

According to social cognitive theory, students monitor their steps and errors, note their progress toward the solution, and use progress indicators to confirm that they are capable of solving thermodynamics problems. This reciprocal process enhances self-efficacy for continued learning and impacts students' motivation positively [4,20]. The baseline data collected from students showed that that students were hesitant to collaborate and were more likely to use peers when required by the instructor. In terms of designing course materials for online delivery, the results from our study confirmed data [21] that real world examples or project-based problem sets that do not have a clear right or wrong answer could benefit student development.

C. Efficacy of the Pilot Online Course

Based on the findings synchronous and asynchronous technologies were used in the online course design to promote students' collaboration during problem solving. Of particular focus was designing the online course forums. The questions on the forum were conceptual in design compared to quantitative, close-ended questions that would have needed a right or wrong response and were used to promote collaborations among students. Students received grades for their activities on these forums. CentraTM was used to provide for synchronous meetings and allowed students and the instructor real-time interactions to discuss steps to thermodynamics problems and analyze students' misconceptions of the key concepts. The recordings of these sessions were available to students for future viewing. Students were provided rubrics that outlined the expectations of their postings and feedback to peers in these forums. The three elements of the rubrics were relevance, engagement, and clarity of students' feedback in regard to problems and topics. The instructors guided these forum activities through posing questions that challenged students to search for multiple ways to demonstrate their conceptual understanding of very fundamental conceptual notions that are part of the Thermodynamics course content. These exercises were intended to (a) move students in their approach to learning from a passive, faculty dependent stance to an active,

constructivist stance [10], and (b) to embrace ambiguity and make thoughtful judgments from incomplete data [22].

Observational data of student performance and engagement with course content formed the basis of this case study. This preliminary research activity allowed us to further define and develop a research question that will be used in future studies [19].

Field notes were taken among the primary researchers who served as the course instructors and compared with one another. Students were observed in the following contexts: providing definitions, applying concepts to solve homework, processing concepts by applying them to other physical cases and problem sets provided by the instructor, and making decisions in the context of solving problems with incomplete data. Observational data collected by course instructors also allowed us to examine if there were any difference in forum contributions online versus students' contributions in a face-to-face class. In terms of analysis we looked at the type of question delivered, the kind of feedback from instructors (question posing vs. traditional comments) and the quality of students' responses and their impact on students' participation in forums.

In total the observational data from the pilot offering reveals that only a few students participated in the live (synchronous) class lecture. These few were regular attendees, rarely missing a live (online) lecture. These students were also the ones that received the highest score and grade in the course. Students who regularly logged into the live lecture did avail themselves of the instructor and asked questions during the lecture, although usually only after prompting by the instructor, or when previous forum questions were discussed by the instructor at the beginning of the session. It was extremely rare to receive a question via email or otherwise from those students who viewed the lectures asynchronously. Participation in the forums was erratic with approximately 2/3 of the students actually responding in any way at all to the forum questions. The intention of these forum questions was to reinforce very fundamental concepts that will be applied repeatedly in a variety of subsequent homework problems. Although the students responses were generally correct it is unclear whether they have a strong grasp of these concepts; their replies were brief and did not incorporate examples that were pulled from real-world experiences. Examples used in forum responses typically came from the textbook.

IV. DISCUSSION

In total, the data collected from the initial face to face traditional offering of the Thermodynamics course provided key building blocks for the online offering. Appropriate application of interactive technology associated with online learning was implemented in the online course to allow students to practice the problem-solving skills identified as important for this course. By examining where students derive confidence in relation to problem solving as well as how they formulate their ideas we hoped to design a course that can engage students more readily in the course content, creating a dynamic learning environment and meaningful interaction and collaboration among students and with the teacher.

Realistically, the online problem-based version of the course proved challenging to deliver effectively. This could be due to both the students' motivation as well as the instructor preparation and comfort with teaching this type of course online.

Interestingly enough, students that might have benefited the most from the online synchronous sessions rarely used this technology. This could be that students enrolled in the online version due to other demands which prevented them from logging in to the synchronous sessions with peers and instructor. Conflicting schedules may have also prevented the students from collaborating and exchanging ideas with one another. This trend could be studied more through open-ended questions or a survey that asks students about their motivation for enrolling in an online course and how the online environment assisted in developing their confidence in relation to problem-solving. This type of information could assist in determining whether students in the online course would be likely to seek out the instructor for clarification rather than peers or whether the online students felt they needed to solve problems autonomously since they would not be able to seek clarification due to scheduling conflicts or discomfort with the technology being used in synchronous help sessions.

Although the online student enrollment was small compared to the traditional in-classroom offering, the instructors observed that student participation in "forum-type" conceptual questions in the traditional classroom setting are difficult to sustain and are driven by the instructor. Students in a live classroom setting, when dealing with conceptual questions related to technical material, are reluctant to volunteer their ideas, active open discussion is difficult to achieve and maintain except with frequent prompting by the instructor. Students in the online course are less inhibited in expressing their ideas or understanding of the material and can inspire other students to respond. The design of well-prepared and thought-provoking forum questions is crucial to the spontaneous interaction between the students, as is motivation for participation (e.g., rewarding students for participation or attaching value to participation through grading procedures).

Among students that did participate in forum discussions, requiring the students to cite examples would have been appropriate and one or two additional questions in response to their replies that would have forced the students to apply the concepts to their own common experiences. Doing this may also have induced the students to consider the concepts more deeply and encouraged more problem-solving behaviors.

Findings from this study did point to the need to consider faculty training in online course delivery as well as problem-based pedagogical strategies in tandem. Instructors observed teaching this course were comfortable with new technologies but did not receive any formal training on how to create a problem-based learning environment. Faculty training, comfort, and continued support in relation to technologies but also pedagogical strategies are key areas that need to be

incorporated when delivering different aspects of a course online. The pedagogy being employed through the electronic mediums is considerably different than that used by the instructor in the traditional face to face delivery. Faculty members need to be prepared for the changes in the medium through which interactions with students take place as well as how the content is delivered so that the course is designed, delivered, and carried out in an effective manner.

In total the data collected from this case study shows that in terms of the interaction that is needed between and among students and instructors to advance problem-based learning, there needs to be much more intensive use of the forums and some strategy to enhance/require regular and consistent interaction between the students and the instructor. Synchronous elements embedded in the course seem to be the best way to achieve this type of interaction. However, students themselves are not necessarily motivated to engage in such types of learning environments or may not have the flexibility to meet during synchronous offerings given other personal demands.

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