LEARNER ENGAGEMENT IN OPTIONAL DISCUSSION FORUMS: A REFLECTION ON AN ONLINE STATISTICS COURSE

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ABSTRACT

When teaching pre-loaded and ready-to-use online courses, online instructors can integrate some optional discussion forums to tailor their instructions and to redirect teaching to meet instructional objectives. My teaching experiences, however, have revealed a lack of learner engagement in such optional discussion forums. Keeping this problem in mind, I explored possible ways to design and incorporate optional discussion forums in a pre-loaded online statistics course. Learners in this course were non-traditional doctoral learners, and they demonstrated satisfying engagement in these optional discussion forums. Therefore, in this reflection paper, I describe the process to design these optional discussion topics, evaluate learner engagement in optional discussion forums through three dimensions, and share major instructional strategies I used during this course to cultivate student engagement to work on these optional discussion topics.

Keywords: Cognitive engagement, behavioral engagement, emotional engagement, deep learning, expectancy-value motivation theory, classroom assessment techniques

Implementing pre-loaded and ready-to-use online courses has become a popular practice in higher education institutions. While it has its advantages, there are concerns of developing "academic monocultures through standardization" (Ostenson, Clegg, & Wiggins, 2017, p. 513) and limiting instructor autonomy (Carl, 2014). It is, therefore, important to encourage online instructors to tailor standardized curricula to fit student needs.

As a methodologist at Grand Canyon University's (GCU) College of Doctoral Studies, I taught pre-loaded doctoral level online research methodology courses in the past three years. In each course, I felt a strong need to adjust instruction by adding one or two optional online discussion topics in each module per week. My goal of integrating optional discussion forums was to better guide learners to achieve instructional objectives and promote deep learning in each module. Learners, however, demonstrated a low engagement in these optional discussion forums. On average, only 14.96% (SD = 14.37%) of my learners responded to optional discussion topics in the courses I taught between 2017 and 2018 (see Table 1).

Working on optional discussion topics was not mandatory, but a lack of efforts invested by learners in these optional discussion forums could jeopardize my goal as an instructor to adjust standardized courses based on learners' needs. Therefore, I was eager to work on a design project to (1) understand how to design quality optional online discussion topics that could engage learners, and to (2) explore possible instructional strategies to support learner engagement in optional online discussion forums. In May of 2018, I was assigned to teach a doctoral level statistics course, RES 845, and I decided to explore this design project in the context of teaching this online statistics course. In the following sections, I will (1) present relevant theories which have shaped my decisions during

Table 1. The Percentages of Learners That Responded to Optional Discussion Forum by Course and Week.

Week	Online Course						
	RES 880 Formalizing the research prospectus				RES 866 Approaches to research design and data analysis		
	03/30/17[a]	09/14/17	11/09/17	03/15/18	05/25/17	07/20/17	01/18/18
1	21.43[b]	0	0	26.67	53.85	25	0
2	0	0	0	13.33	46.15	41.67	13.33
3	0	0	18.18	6.67	38.46	16.67	20
4	0	7.14	9.09	20	15.38	33.33	0
5	14.29	0	9.09	20	30.77	16.67	6.67
6	0	14.29	0	6.67	15.38	33.33	20
7	0	0	36.36	30	15.38	41.67	6.67
8	7.14	0	9.09	30	23.08	25	0

[a] Course starting date (each course lasted eight weeks)

[b] i.e., 21.43 percent of the learners in the RES 880 course (started on March 30th, 2017) responded to the optional discussion topic posted in week 1.

this project, (2) evaluate cognitive, behavioral, and emotional engagement demonstrated in the optional discussion topics of this course, and (3) discuss potential factors contributing to learner engagement in these optional discussion topics based on the unique strategies I adopted when designing and implementing optional discussion forums in this course.

THEORETICAL FOUNDATIONS AND RELEVANT LITERATURE

A general instructional design procedure follows four steps: diagnose, design, implement, and evaluate (Astleitner, 2018). In the first section, I have diagnosed the problem based on observing courses I taught in the past—a lack of learner engagement in optional discussion forums. In this section, I articulate relevant theories and connect to relevant literature to support my decisions on designing, implementing, and evaluating the design project.

Design Optional Discussion Topics Based on Expectancy-Value Motivation Theory

When working on designing optional discussion topics, I used Eccles et al.'s (1983) expectancy-value motivation theory (for a detailed introduction of this theory, see Wigfield, Tonks, and Klauda's [2009] work). This theory has been widely used and discussed in different settings (e.g., Burcher, Serido, Danes, Rudi, & Shim, 2018; Galla, Amemiya, & Wang, 2018; Wigfield, 1994). Based on this theory, learners engage in a learning task if (1) they believe they can succeed in the task (i.e., expectancy) and (2) they can see the value of working on the task (i.e., value).

Applying the expectancy dimension in designing optional discussion topics in this course, my learners need to perceive their competence (i.e., feel confident to solve the problems presented in the designed optional discussion topics). If the optional discussion topics are too difficult, learners may not work on them due to their perceived incompetence. Yet if discussion topics only contain easy learning tasks, learners may not work on them either. Learners would be most likely to invest effort in a learning task if the task is moderately difficult (Atkinson, 1958). A quality discussion topic should provide cognitive challenges to learners and should also allow learners to see the possibilities to solve the problems if sufficient efforts are invested with appropriate strategies.

Applying the value dimension in designing optional discussion topics—how useful learners perceive each optional discussion topic—is the key standard for me to develop these discussion topics. It requires the designed optional discussion topics to have clear utility value and relevancy to students (i.e., how working on these optional discussion topics can fit into their future plans). For more information regarding task values, see Wigfield and Cambria's (2010) review. Learners who take this course are doctoral learners who will ultimately complete an empirically-based dissertation to receive their degrees. Therefore, to demonstrate utility and relevancy in the designed optional

discussion topics, beyond the need to connect optional discussion topics with the instructional objectives in each module, I should also focus on connecting the tasks in these optional discussion topics with the knowledge and skills learners need to acquire to accomplish their dissertations.

In short, if both expectancy and value dimensions are well reflected in the designed optional discussion topics, and both dimensions can be well maintained and facilitated during the course, I may see a significantly higher learner engagement in the designed optional discussion topics.

Classroom Assessment Techniques (CATs) for Designing and Implementing Optional Discussion Topics

Instructors need to evaluate instructional discrepancies between instructional objectives and expectations and learners' actual knowledge acquisition. It is very common for instructors to develop on-going strategies to minimize these instructional discrepancies. Classroom Assessment Techniques (CATs) (Angelo & Cross, 1993) have been widely used as a strategy to identify instructional discrepancies (Bergquist & Holbeck, 2014) and have been used extensively in online learning environments (e.g., Hogan & Daw, 2014; Holbeck, Bergquist, & Lees, 2014; Li & van Lieu, 2018). Bergquist and Holbeck (2014) has suggested the following five steps to implement CATs for online classrooms:

1. Identify learning objectives and conduct a summative assessment for each online module.
2. Design or select appropriate CATs to assess student understanding of the objectives.
3. Implement CATs in online discussion forums.
4. Analyze student responses to CATs in online discussion forums.
5. Reteach or redirect teaching to address learning objectives.

At GCU, online instructors were instructed to post one optional discussion topic each week as a CAT. However, I still prefer to use "optional discussion topics" (rather than Classroom Assessment Techniques) in this design project. First, I do not want to limit my optional discussion topics merely to the assessment purpose. I believe assessment should start at the beginning of each module by observing questions and concerns emerging from learners' responses to the pre-loaded mandatory discussion topics. As optional discussion topics in this design project could assess student knowledge acquisition, I would also want to use them as an opportunity for me to redirect learners so that they can have a higher chance to achieve or even exceed instructional expectations. However, the literature in CATs and Bergquist and Holbeck's (2014) steps provide some valuable information when implementing designed optional discussion topics each week.

CATs were initially developed as an instructional strategy to evaluate instructional discrepancies (Angelo & Cross, 1993). Following this idea, I carefully reviewed each module's objectives with their corresponding pre-loaded learning materials, assignments, and mandatory online discussion topics. In addition, I reflected on my own experiences as a methodologist guiding learners to design and complete their dissertations and listed additional important and relevant research and statistical skills and knowledge that should be incorporated in each module. Next, I designed the first version of optional discussion topics in all modules.

Different from the primary intention of CATs to be used as a formative evaluation strategy to measure knowledge acquisition, the designed optional discussion topics in this course included new instructional materials to expand and/or redirect student learning. Specifically, I used the first three days of the week to observe students' responses to the two mandatory discussion topics in order to understand students' actual learning. Then I revised the initial optional discussion topic designed for that week. In the morning of day four, I posted the revised optional discussion forum. From days four to six, I observed student responses and provided corresponding guidance if learners demonstrated questions or concerns. In the morning of day seven, I posted an end-of-the-week summary comment to (1) reveal solutions to the questions in the optional discussion topic, (2) summarize the problems and obstacles demonstrated online when learners responded to the optional discussion topic, and (3) provide guidance, suggestions, and/or additional reading materials to redirect their future knowledge exploration.

Evaluate Project Outcomes based on Cognitive-Behavioral-Emotional Dimensions of Engagement

In traditional school settings, prior studies have focused on school engagement, and they define school engagement through at least three dimensions—cognitive, behavioral, and emotional (e.g., Astleitner, 2018; Fredricks, Blumenfeld, & Paris, 2004; Furlong et al., 2003; Kahu, 2013; Reeve, 2012). The cognitive dimension refers to student engagement in deep learning and self-regulation strategies demonstrated at school or during the learning process (Fredricks et al., 2004; Kahu, 2013). The behavioral dimension refers to student attendance in school and participation in learning tasks (Fredricks et al., 2004). The emotional dimension refers to learners' enthusiasm, enjoyment and interest in learning, and their sense of belonging to the learning community (Furlong et al., 2003; Kahu, 2013; Libbey, 2004).

These three dimensions have been widely used in a wide variety of empirical studies as a conceptual foundation of learner engagement (e.g., Han & Hyland, 2015; Yu, Zhang, Zheng, Yuan & Zhang, 2019). The three-dimensional engagement framework provides a way to evaluate how engaged my learners were in the designed optional discussion topics. But these three dimensions of school engagement were revised to fit the context of this design project.

Cognitive engagement. When considering learners' cognitive engagement through instructional designers' perspectives, Astleitner (2018) suggested assessing student cognitive complexity levels demonstrated in their learning outcomes. Since learning outcomes in this project were learners' solutions and answers generated to the questions in each optional discussion forum, if learners correctly addressed these questions, it demonstrated their cognitive engagement with the complexity levels required by the questions in the optional discussion topic. Therefore, to evaluate learners' cognitive engagement, I decided to (1) analyze complexity levels of each designed discussion topic and (2) report the percentage of learners who had correctly completed all questions in each optional discussion topic (i.e., full correctness rate).

In addition, as discussed above, learners are optimally engaged if the learning task is challenging but also achievable (i.e., moderately difficult). To interpret the difficulty level of a designed optional discussion topic that was too easy or too difficult, there could be several possibilities:

1. If all learners or the majority of the learners who worked on an optional discussion topic could correctly answer all questions (i.e., the full correctness rate is between 50%-100%), it might indicate that the discussion topic was too easy.
2. If a discussion topic was too difficult, it would be very hard for respondents (i.e., learners who responded to the discussion topic) to correctly answer all questions (i.e., the full correctness rate should be very low and could even be under 20%). Meanwhile, if a discussion topic was too difficult, most respondents could also have trouble correctly answering the majority of its questions. Thus, to evaluate learners' cognitive engagement, I also need to assess the percentage of those respondents who could correctly address at least half, but not all, of the questions (i.e., partial correctness rate). If the partial correctness rate for a discussion topic was lower than 50% and the full correctness rate for the same discussion topic was also very low, then most respondents seemed to have trouble correctly answering its questions. Therefore, this could indicate that the discussion topic was too difficult.

The evaluation plan of the cognitive engagement dimension is summarized in Table 2.

Although there are multiple systems to classify educational objectives (e.g., Anderson & Krathwohl, 2001; Bloom, et al., 1956; Marzano & Kendall, 2008), the taxonomy of cognitive complexity levels required in each designed optional discussion topic was evaluated based on Astleitner's (2018) cognitive engagement classifications: knowledge, comprehension, convergent thinking, evaluation, and synthesis. (Check Astleitner's [2018] work for detailed explanations on each level). Even though Astleitner (2018) believed that the structure of these five levels should be hierarchical (i.e., the complexity levels progress from knowledge to synthesis), each designed optional discussion topic might cover multiple levels.

Behavioral engagement. Behavioral engagement in school settings refers to school attendance

Table 2. Rubrics for Evaluating Project Outcomes—Student Engagement in Each Designed Optional Discussion Topic

Cognitive Engagement	Behavioral Engagement	Emotional Engagement
1. Task Analysis: Analyze and report complexity levels of each designed discussion topic based on Astleitner's (2018) cognitive engagement classifications	1. Partial Participation Rate: Report the percentage of students who participated in each optional discussion topic (with, addressed at least one question (but not all questions)	1. Open-Ended Information for Emotional Engagement and Disengagement
2. Full Correctness Rate: Report the percentage of learners who correctly completed all questions in each optional discussion topic	2. Full Participation Rate: Report the percentage of students who addressed all questions included in each optional discussion topic.	2. Question and Clarification Rate: Report the percentage of students who asked questions or posted clarifications when they worked on the optional discussion topic
3. Partial Correctness Rate: Report the percentage of learners who worked on the optional discussion topic and correctly addressed at least half (but not all) of the questions in each optional discussion topic		

and participation in classroom activities. To apply this dimension in this design project, the percentage of students who addressed at least one question in each discussion topic (i.e., partial participation) and who addressed all questions included in each participation discussion topic (i.e., full participation) were reported. It is important to differentiate between partial and full participation, since all optional discussion topics (except week eight) contained multiple questions with varying difficulty levels. Working on more difficult questions would demonstrate higher behavioral engagement than working on simple questions only. The evaluation plan of this dimension is summarized in Table 2.

Emotional engagement. Emotional engagement in school refers to learners' enthusiasm, enjoyment, and interest in learning. When evaluating this dimension in my project, I read and re-read student postings in all discussion forums of this course and the end-of-course evaluation survey. I would present open-ended information indicating emotional engagement or disengagement. I would also report the percentage of learners who asked questions and requested clarification when working on optional discussion topics, because such actions indicate their interests in learning (in some previous studies, asking questions belongs to the fourth engagement dimension—agentic engagement. (For detailed information about this dimension, read Reeve and Tseng's [2011] and Veiga's [2016] studies). The evaluation plan of this dimension is summarized in Table 2.

Finally, the three conceptual dimensions of learner engagement should be evaluated based on learners' socio-cultural contexts (Kahu, 2013). Schools and dynamic interactions between students and their learning environments can affect student cognitive engagement (Pietarinen, Soini, & Pyhältö, 2014). Applying this important message in this design project, student engagement in optional discussion topics can be influenced by any contextual factors during this statistics course (e.g., my interactions with learners, learner-learner interactions, guidance I provided during the course, pre-loaded course materials and assignments, and even the factors coming from student families and employment). Therefore, in the process of evaluating student engagement, I need to be cognizant of the influence from these environmental factors and take a holistic approach to integrate these factors in my evaluation.

EVALUATION OF PROJECT OUTCOMES

There were 13 adult learners in this course, and they were in their first two years of doctoral-level coursework. Most learners had a full-time job and a family. There were nine optional discussion topics designed and posted in the course. Week four had two optional discussion topics. Week eight's optional discussion topic did not include any specific questions requiring learners' solutions. Instead, I made a PowerPoint presentation in week eight pulling together all statistical analyses and concepts we had covered in the course. I simply asked learners to post their last-minute questions after reviewing my presentation. Since

Table 3. Analyzing Complexity Levels of Designed Optional Discussion Topics

Optional Discussion Topic	Knowledge	Comprehension	Convergent Thinking	Evaluation	Synthesis
Week 1	Y	Y	Y	Y	N
Week 2	Y	Y	Y	Y	N
Week 3	Y	Y	Y	Y	N
Week 4-1	Y	Y	Y	Y	Y
Week 4-2	Y	Y	Y	Y	Y
Week 5	Y	Y	Y	Y	Y
Week 6	Y	Y	Y	Y	Y
Week 7	Y	Y	Y	Y	Y

Note. Y = the corresponding complexity level was presented in the optional discussion topic. N = the corresponding complexity level was not presented in the optional discussion topic.

this optional discussion topic did not present any specific questions, this discussion topic was not used when evaluating learners' cognitive or behavioral engagement. Results of student engagement in optional discussion topics based on cognitive, behavioral, and emotional dimensions are organized and presented below.

Cognitive Engagement

Complexity levels of each designed optional discussion topic based on Astleiner's (2018) five-levels classifications are presented in Table 3. Results demonstrate that all designed optional discussion topics require complex and deep learning. When a learner correctly addressed all questions in each optional discussion topic, it implied learner's cognitive engagement with corresponding complexity levels.

Table 4 includes the percentage of respondents who correctly addressed all questions in each optional discussion forum (i.e., full correctness rate) and the percentage of respondents who correctly addressed at least half, but not all, of the questions in each optional discussion forum (i.e., partial correctness rate). Based on my initial plan to design these optional discussion topics with moderate difficulty (i.e., not too difficult or too easy), it is ideal to have:

1. higher percentage values for the partial correctness rate (e.g., over 50%), because it means most learners who worked on the optional discussion topic could get the majority of questions (but not all) correct; and
2. lower percentage values for the full correctness rate, because if most learners who responded could solve all questions, it indicates that the optional discussion topic might have been too easy.

Based on the two columns of cognitive engagement in Table 4, the optional discussion topic in week two, the first optional discussion topic in week four, and the optional discussion topic in week six seemed to be too easy, since over 50% of the learners who participated in these discussion topics had correctly address all questions. The second optional discussion topic in week four seemed to be too difficult—although 28.5% of the respondents generated correct answers, over 70% of the respondents failed to answer the majority of the questions correctly. Scaffolding strategy should be considered for this optional discussion topic in the future. Difficulty levels of other optional discussion topics were designed appropriately.

Behavioral Engagement

Student behavioral engagement was evaluated through two dimensions: the percentage of students who participated in the optional discussion forum and addressed at least one question (i.e., Partial Participation Rate), and the percentage of students who participated in the optional discussion forum and addressed all questions (i.e., Full Participation Rate). As shown in Table 4, except the low participation rate in week seven's optional discussion topic, students of this course demonstrated much higher participation rates in the designed optional discussion topics of this statistics course than the participation rates in my prior courses. The average partial participation rate for prior courses I taught between 2017 and 2018 was only 14.96% (SD = 14.37%). Please see

Table 4. Evaluating Cognitive Engagement and Behavioral Engagement in Designed Optional Discussion Topics

Optional Discussion Topic	Cognitive Engagement		Behavioral Engagement	
	Full Correctness Rate	Partial Correctness Rate	Full Participation Rate	Partial Participation Rate
Week 1	0%	85.71%	53.85%	53.85%
Week 2	62.5%	25%	46.15%	61.54%
Week 3	11.11%	88.89%	69.23%	69.23%
Week 4-1	71.43%	14.29%	53.85%	53.85%
Week 4-2	28.57%	0%	46.15%	53.85%
Week 5	14.29%	57.14%	53.85%	53.85%
Week 6	71.43%	28.57%	53.85%	53.85%
Week 7	20%	80%	15.38%	38.46%

Note. Full correctness rate = the number of learners who correctly completed all questions included in the optional discussion topic ÷ the number of learners who responded to the optional discussion topic. Partial correctness rate = the number of learners who correctly addressed at least half of the questions (but not all questions) included in the optional discussion topic ÷ the number of learners who responded to the optional discussion topic. Full participation rate = the number of learners who completed all questions included in the optional discussion topic ÷ the number of learners who took the course. Partial participation rate = the number of learners who completed at least one question included in the optional discussion topic ÷ the number of learners who took the course.

detailed information in Table 1. More interestingly, there may be a few learners who did not respond to the optional discussion topic of a certain week, but had actually worked on it. For example, one learner wrote in week four (optional discussion topic two):

> *Thank you for posting these optional DQs [discussion topics] and the detailed answers. I admit due to my travel schedule these past two weeks I did not have time to do the [optional] DQs prior to you posting the answers, but I am still running the data through SPSS to help get a better understanding of what I am doing in the system.*

Emotional Engagement

Learner emotional engagement in designed optional discussion topics was evaluated through two dimensions: (1) the open-ended information indicating learners' emotional engagement (e.g., interest, enthusiasm, and enjoyment) or learners' emotional disengagement in the optional discussion topics; and (2) the percentage of students who asked questions or posted clarifications when they worked on optional discussion topics (i.e., Question and Clarification Rate).

Open-ended information indicating emotional engagement or disengagement.

When learners responded to questions during the first seven weeks of optional discussion topics, they focused on providing answers. Thus, to look for the information indicating emotional engagement or disengagement, I also reviewed their responses to week eight's optional discussion topic as well as the end-of-course evaluation survey.

All learners completed the end-of-course evaluation survey, and one learner provided an open-ended comment about the optional discussion topics of this course: "The optional questions provided in the forum were a tremendous help (and fun!)."

In week eight's optional discussion forum, I uploaded a PowerPoint presentation integrating all concepts and different statistical analyses we covered in this course. I hoped the presentation could help the learners understand connections between concepts and statistical analyses and help learners to select appropriate statistical analysis for a specific research study. There were no specific questions included in this optional discussion topic, and I only asked learners to check out the presentation and post their last-minute questions. Out of 13 learners, 11 learners posted a comment appreciating the optional discussion topics I developed in the course. For example, a learner said, "I especially appreciated the optional discussion topics taking us further than the basic materials." Among a few learners, I was also grateful to see that at the end of this course, learners became more confident and more modest about how much they knew—they realized that their understandings were limited, yet they were motivated and felt confident to learn in the future. Like one learner shared in week eight:

> *Thank you, not only for this PowerPoint presentation, but also for a very challenging and informational course. I definitely had*

to work hard to wrap my head around each of the concepts and test presented. However, the interaction and feedback I received from you was more than helpful and insightful. Again, while I am planning to go down the path of a qualitative study I now have a better understanding of why that choice fits my study best. I will not claim, by any means to be an expert or subject matter expert on what I learned in this course, but I do know where to find many important references and having a better understanding of the content now.

Avoiding overestimating knowledge acquisition is important. Prior research has demonstrated interesting findings: Compared with learners who believe knowledge is contextually-based and is not black-or-white (i.e., complex views of knowledge), learners who believe learning is quick and knowledge is simple and easy-to-learn (i.e., simplistic views of knowledge) are the ones who hold lower internal standards of learning (e.g., Agosto, 2002; Mansourian & Ford, 2007). More interestingly, Schommer (1990) found that the participants with simplistic views of knowledge in her study demonstrated lower test scores, yet they felt more confident about their test scores than the participants with complex views of knowledge. That means, learners with simplistic views of knowledge are more likely to overestimate how much they have learned and feel satisfied about what they have learned, but these type of learners are low performers indeed. Based on these prior studies, I was grateful that my learners completed the course with enough confidence to continue learning statistics while also recognizing the limits of their current knowledge system.

Regarding disengagement, I checked all online discussion transcripts and the end-of-course evaluation survey (conducted anonymously). The open-ended information indicating learner disengagement in optional discussion topics was not found. But there was one learner (out of 13 learners) who had never responded to any of the optional discussion topics, indicating her disengagement in the designed optional discussion topics.

Question and clarification rate. The percentages of learners who included content-based questions when they responded to the optional online discussion topics are displayed in Table 5. Most learners focused on posting solutions to the questions included in each optional discussion topic, but three learners (two learners in week five and one learner in week seven) had posted one or two questions when reading and interpreting additional resources I provided in the optional discussion topics. These learners proactively reached out to address their points of confusion, and thus, demonstrated their emotional engagement in learning.

Clarification was mainly reflected in learners' responses to the end-of-the-week summary post. On day seven of each week, I uploaded a summary post in which I provided answers to all the questions in the optional discussion topic of the week, summarized problems or obstacles I observed based on learner responses, explained rationales and the process of developing answers, and offered additional readings that I believed were needed based on my assessment of their answers. Learners responded to my summary post in two ways: First, some learners reflected on why they did not get all questions correct and this self-reflection led several learners to additional learning efforts. For example, after I provided the summary post for week three's optional discussion topic, one learner responded:

Thank you for your thorough responses to our discussions. Apparently, I was confused by questions 3C and 4C; which goes back to my general misunderstanding within this module. However, after re-reading the textbook, doing some additional reading,

Table 5. The Percentages of Learners Who Proposed Questions and Uploaded Clarification Posts in Optional Discussion Forums

	Week 1	Week 2	Week 3	Week 4-1	Week 4-2	Week 5	Week 6	Week 7
Question Rate	0%	0%	0%	0%	0%	28.57%	0%	20%
Clarification Rate	42.86%	0%	12.5%	0%	57.14%	28.57%	0%	0%

Note. Question rate was calculated by the number of learners who included content-based questions when they responded to the optional online discussion topic ÷ the number of learners who responded to the optional discussion topic. Clarification rate was calculated by the number of learners who responded to the end-of-week summary comment I uploaded on Day 7 ÷ the number of learners who responded to the optional discussion topic.

and finishing the Mod 3 [i.e., Module 3] problem set [i.e., the assignment of this week], I believe that my confusion has lessened.

Second, some learners provided me with their feedback regarding how well the summary post had helped them. For example, a learner responded in week one:

Thank you very much not only for this exercise but for the detailed explanation of each scenario. It definitely helped me gain a better understanding of the logic and design of the quantitative methods.

Another learner commented in week four:

Having the answers helps me know where I am going wrong and how to get back on track.

Knowing that the instructor was not only asking questions but would also provide detailed explanations on how to solve these problems, learners were more likely to recognize the worthiness of working on these optional discussion topics, and thus, it triggered their effort investment in optional discussion topics.

These two types of responses demonstrate that developing a well-designed optional discussion topic is critical to engage learners. But it is even more crucial to provide an end-of-the-week summary post to encourage learners to reflect on the problems, to confront and correct mistakes and misconceptions when teaching statistics (Garfield, 1995), and to re-direct learners for future knowledge exploration. Interestingly, learners only responded to my summary post in weeks one, three, four (the second optional discussion topic), and five (see Table 5). Perhaps it was due to the fact that these four weeks' optional discussion topics were more difficult to learners than other optional discussion topics. As shown in Table 4, the optional discussion topic in weeks one, three, four-two, and five yielded lower full correction rates (i.e., 0%, 11.11%, 28.57%, and 14.29% respectively) than the optional topics in weeks two, four (the first optional discussion topic), and six (i.e., 62.5%, 71.43%, and 71.43% respectively). Although the full correction rate in week seven was low (i.e., 20%), all respondents correctly answered most of the questions. Thus, week seven's optional discussion topic might not be too challenging to learners. In week four's second optional discussion forum, 71.43% of the respondents had trouble figuring out even half of the questions, and thus, this discussion topic could be too challenging to learners. But interestingly, this discussion forum triggered the highest clarification rate; 57.14% of the learners who worked on this discussion topic responded to my end-of-the-week summary post. When facing a more challenging discussion topic, it seemed that learners in this course not only worked on it, but also checked answers, reflected on their problems, and communicated with the instructor about their insights and reflections. Such positive learning behaviors indicate that learners in this course were more learning-oriented and had really enjoyed optional discussion topics that were challenging to them.

DISCUSSION AND REFLECTIONS

Based on the evaluation results presented in the last section, learners of this statistics course generally seemed to be engaged in these designed optional discussion topics. In this section, I would like to reflect on my experiences of designing optional discussion topics in this course as well as in previous courses I taught between 2017 and 2018, and present some insights on why learners were more engaged in the optional discussion topics I designed in this statistics course.

First, I anchored my design process in this statistics course upon the two motivation dimensions—expectancy and value. But in previous courses, I did not consider both dimensions. Instead, I only focused on the value dimension to design the optional discussion topics with the skills and the knowledge that learners could use in their dissertations. The discussion topics in previous courses, therefore, could have been less challenging (so learners might have felt bored working on them) or too challenging (so learners could have not perceived their competence to handle it). In addition, since all doctoral level courses (except dissertation credits) are provided during the first two years for learners before they formally start a dissertation, if only the value dimension is used to design optional discussion forums (i.e., to demonstrate how working on the optional discussion topics can help

their dissertations), learners may not recognize the immediate benefits of working on these optional discussion topics. Therefore, my experiences in this statistics course may suggest using both dimensions in expectancy-value motivation theory (Eccles et al., 1983) as a viable approach for instructional designers or online instructors when designing online discussion forums that could trigger more engagement in discussions. It is also important to notice that expectancy-value framework is contextually-based (Bong, 2001; Wigfield, Tonks, & Klauda, 2009). The positive outcomes of this design project can be partially due to the nature of the course, which will be discussed in this section later.

Second, when designing optional discussion topics in this statistics course, I tried to break down the complex and difficult concepts and address each of them systematically in different modules. This strategy was not used when I designed optional discussion topics in previous courses. Breaking complex and difficult concepts down into multiple smaller and easier components, into different levels of knowledge acquisition (e.g., knowing, comprehending, convergent thinking, evaluating, and synthesizing based on Astleitner's [2018] classifications), and/or into multiple examples could have helped my learners in this statistics course gradually understand these complex and difficult concepts as well as understand their implications in multiple contexts. Such design could cultivate learner motivation because each learning task was more manageable, and learners were more likely to perceive their competency and progress. I want to share a concrete example since I believe this is an important idea. Based on my teaching experiences, learners usually have hard time understanding the relationship between sample size and statistical power. In this course, I break it down into five optional discussion topics:

1. I decided to let my learners explore basic concepts of Type I error, Type II error, and power in week two's optional discussion topic (so this requires knowing and comprehending). Learning these concepts was the first step in order to understand the influence of sample size on statistical power.
2. In week three, since the instructional objectives focused on sampling distribution and hypothesis testing, I designed a scenario in the optional discussion topic comparing two sampling distributions with different sample sizes, and asked learners to calculate sampling mean and sampling error based on each sample size and checked their differences in the conclusions after hypothesis testing (so this requires knowing, comprehending, convergent thinking, and evaluating). My goal was to develop an initial awareness of the impact of sample size on hypothesis testing.
3. In week four, the course focused on three types of t-test. In the first optional discussion topics, I created a scenario and asked the learner to run an a priori power analysis based on independent samples t-test (so this requires knowing, comprehending, and convergent thinking). My goal was to help learners connect different concepts (i.e., Type I, Type II, power, sample size) that they had learned in week two and three and use these different concepts with one example.
4. In week five, I asked the students to practice another a priori power analysis based on the repeated-measures design with one between-subject factor and one within-subject factor. By practicing the a priori power analysis based on different statistical analyses, my goal was to help learners realize that sample size requirements varied upon selected statistical analyses.
5. Finally, in week six, I used the pre-loaded example and asked learners to run three post hoc power analyses based on different sample sizes (keeping other parameters the same). My goal was to help the learners truly understand how sample size could affect the power of a statistical test.

As demonstrated in this example, breaking a complex concept into five modules and addressing them systematically have produced a better outcome among my learners. Over 70% of the learners who worked on week six's optional discussion topic addressed all questions correctly, and most learners had indicated in week six's optional discussion forum that they truly understood the impact of

sample size on statistical power, and why it is important to report effect size for the result that is statistically significant

Third, compared with other courses I taught previously, what I did differently in this statistics course was to incorporate a very large number of examples and hands-on experiences. In this statistics course, I noticed that the pre-loaded course materials focused too much on discussing concepts at abstract levels. Yet the course lacked specific examples and hands-on experiences, which has been widely considered as an important and effective strategy to teach statistics (Garfield, 1995). To improve it, I built my optional discussion topics based on scenarios, and made up datasets so that learners could run statistical analyses. Learners appreciated these examples and were able to see specific mistakes they made when they worked on these examples. For instance, one learner in week four (optional discussion topic two) said:

> *I didn't think to create a column that indicated the difference between the pre- and post-test. While in retrospect it seems obvious, I just didn't think out of the box and realize that I needed to expand upon the given data.*

Without practicing the statistical analysis based on the example, this learner would not have noticed this mistake.

Meanwhile, it is also important to consider the nature of the course itself. Since prior research has shown that providing learners with hands-on activities is an effective way to teach statistics (Garfield, 1995), it is a common instructional practice for statistics instructors to expose their learners to specific examples and datasets. When teaching this statistics course, it was easy for me to find examples or to make up datasets to be used along with the examples. However, in other courses I taught previously, good examples can be hard to find. In RES866 Approaches to Research Design and Data Analysis, for instance, there was one week focusing on the differences between varying qualitative designs. It was certainly an easy task for me if I just asked learners to read important readings (such as Creswell's work), followed by sharing their take-home messages or questions in the optional discussion forum. But I wanted my learners to truly understand the differences between major qualitative designs and apply their understandings when making decisions in their dissertations. I remembered that I spent so much time trying to find different dissertations or publications that could present as perfect examples to discuss underlying rationales of using a specific qualitative design. This was extremely time-consuming for just one week's instruction, so it was quite impossible as an individual instructor doing such work each week. Therefore, I think it is critical for the university to have a team looking for appropriate instances and incorporating them in each pre-loaded course.

Fourth, compared to previous courses, what I did differently in this statistics course was to build a strong connection between the two mandatory pre-loaded discussion topics and the optional discussion topic I uploaded each week. On the one hand, I posted the optional discussion forum in the morning of day four each week, which allowed the first three days for me to observe and respond to students' online discussions in the two mandatory discussion forums. When I interacted with my learners in mandatory discussion forums, I tried to bridge the ideas and questions that emerged from students' posts in mandatory discussion forums to the optional discussion topic of that week. I believe this strategy has successfully aroused their attentions to the optional discussion topic. For example, in week four's second mandatory discussion forum, I joined their discussions on the issue of why homogeneity assumption should be checked for independent samples t-test. I, then, mentioned in the mandatory discussion forum that since we had discussed the importance of this assumption, in the optional discussion forum of that week, learners would be able to use a dataset I provided to run this assumption test. I believe referring to the optional discussion topic in mandatory discussion forums and being specific about how the optional discussion topic could help them with the issues discussed in mandatory discussion forums are important strategies for learners to be engaged in optional discussion forums.

On the other hand, when composing the instruction of the optional discussion topic, I also deliberately connected to the mandatory discussion topics of that week. For instance, the first mandatory discussion forum in week two stated:

- How is sample size related to statistical tests and outcomes? Give a specific example.
- Why is it important to plan the sample size before collecting data?

Therefore, I started my week two optional discussion topic, like:

> *In the first discussion forum of this week, we get into the relationship between sample sizes, type II error, and statistical power. To extend this discussion….*

In short, I believe strengthening connections between the pre-loaded course materials and the designed optional discussion forums could have helped the learner in this statistics course recognize the value of these optional discussion topics, and thus, could have encouraged them to work on these optional tasks.

Next, it is essential for instructors to put forth their efforts to create a learning-oriented environment. When learners focus on learning and mastery, they are more likely to invest effort in challenging tasks and demonstrate sustained engagement during the learning process (Grant & Dweck, 2003). I have used two approaches to cultivate students' learning-oriented goal during this statistics course. First, when I responded to my learners with additional reading materials, I intentionally ended my response with learning-oriented comments, such as, "Enjoy reading this article!" and "Keep learning and keep thinking." I believe such comments have at least stressed my view (as an instructor)—I wanted my learners to focus on learning.

The second approach is to make each end-of-the-week summary post as a starting point for new knowledge exploration. Although the end-of-the-week summary post revealed solutions and explanations for the optional discussion topic, I took it as an opportunity to re-direct learning. Specifically, I summarized students' problems and misconceptions based on assessing their responses to the optional discussion forum, explained why they made mistakes, connected their mistakes to other concepts, and provided additional reading materials for them to explore in the future. By doing it, I conveyed an important message to my learners—the end of each week should not be an ending point to bring their learning to a closure. Instead, it helped open their eyes to recognize what else they don't know, to understand the complex nature of each topic, and to realize how the concepts in the week could connect to other concepts. I hope the end-of-the-week summary post could drive my learners to keep learning in the future as well as provide guidance on how they could learn in the future.

With the above-mentioned two approaches to lead my learners to focus on learning, I was grateful to see its effect—my learners seemed not to worry about making mistakes in their posts, or they were not concerned about how smart and capable they looked in their posts. Instead, they focused more on knowledge mastery. As one learner said in week eight:

> *I felt comfortable enough to share ideas and questions without fear of being incorrect or not taken seriously. You truly created an environment where all students could share, and if we were incorrect, you pointed us in the right direction without making anyone feel foolish. Thank you for seeing potential in each of us and encouraging us to learn as much as we could in the little time we had in this course.*

Meanwhile, it is also important to realize that the nature of the course may affect the easiness or effectiveness of instructors' attempts to create a learning-oriented environment. For example, one of the courses I taught in the past, RES880, aims for guiding learners to develop a prospectus. Since the entire course was established for an outcome goal, if optional discussion forums require learners' intensive efforts to explore new knowledge, learners could feel reluctant to work on such optional discussion topics because the course requires them to develop a product within only eight weeks, so they may not be able to immediately benefit from working on optional discussion topics. This can be a reason explaining why the participation rates in optional discussion forums were low in RES880 (see Table 1 please). Therefore, the factors I have discussed in this section may be dependent upon the course itself.

The context-dependent nature of this project is also reflected within each class. Even in the same course, the climate of different classes can vary. For instance, the course of RES880 (see Table

1) started from March 15, 2018, seemed to have higher participation rates in optional discussion forums than the same courses started from March, September, and November of 2017 (even though I always revised optional discussion topics for the same course based on different groups of students, the majority of the optional discussion topics in the same course remained the same across different classes). Thus, there is a need to verify this design project outcomes and the above-mentioned strategies based on the same statistics course I will teach in the future.

I want to end up this reflection paper by stressing Kahu's (2003) idea that understanding learner engagement should be embedded in learner's social-cultural contexts. I have discussed some possible reasons in this section to reflect on why the optional discussion topics designed in this statistics course triggered more engagement than the optional discussion topics I designed in previous courses. I believe these factors have worked together as a coherent system in this particular course that have encouraged my learners to be more engaged in these optional learning tasks. I invite readers' insights and communications with me.

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