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ASYNCHRONOUS LECTURER-SUPPORTED DISCUSSION FORUM IN TEACHING QUANTITATIVE METHODS TO BUSINESS STUDENTS

FORO DE DEBATE ASINCRÓNICO APOYADO POR PROFESORADO EN LA ENSEÑANZA DE MÉTODOS CUANTITATIVOS A ESTUDIANTES DE NEGOCIOS

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Shellyanne Wilson
https://orcid.org/0000-0001-8639-7616 (ORCID iD)
The University of the West Indies, Trinidad & Tobago

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ABSTRACT

While asynchronous discussion forums have been widely implemented across different learning environments, there have been mixed findings in terms of their impact on student performance. This study aims to investigate the impact of an asynchronous lecturer-supported discussion forum used to augment traditional Face-to-Face course delivery, on student performance in a Quantitative Methods course taught to business students in the Caribbean. An asynchronous support discussion forum was set up for a group project designed for students to apply quantitative techniques to solve real-world problems. The quantity and quality of student participation and lecturer participation in the discussion forum, represented by student questions and lecturer questions, were investigated to determine their impact on student performance, measured by group project

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*Corresponding author: shellyanne.wilson@sta.uwi.edu
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marks for 109 student groups over three academic years. The results showed that neither student participation nor lecturer participation in the asynchronous support discussion forum led to significantly better student performance by way of group project mark. Possible reasons for this finding that is inconsistent with the literature include issues such as voluntary student participation in the forum, multiple other avenues to obtain lecturer support, and the use of questions to represent participation. The study's conceptual framework points to the importance of specifying the learning environment, learning objective, discussion forum type and engagement type in examining the impact of a discussion forum.

KEYWORDS
asynchronous lecturer-supported discussion forum, augmented learning, quantitative methods

RESUMEN
Si bien los foros de discusión asincrónicos se han implementado ampliamente en diferentes entornos de aprendizaje, ha habido hallazgos mixtos en términos de su impacto en el desempeño de los estudiantes. Este estudio tiene como objetivo investigar el impacto de un foro de discusión asincrónico, impartido por un profesor, que se utiliza para aumentar el rendimiento de los estudiantes en cursos presenciales tradicionales en un curso de Métodos Cuantitativos, impartido a estudiantes de negocios en el Caribe. Se creó un foro de discusión de soporte asíncrono para un proyecto grupal, diseñado para que los estudiantes aplicaran técnicas cuantitativas para resolver problemas del mundo real. Se investigó la cantidad y calidad de la participación de los estudiantes y la participación del profesor en el foro de discusión, representada por las preguntas de los estudiantes y las preguntas del profesor, para determinar su impacto en el desempeño de los estudiantes, medido por las calificaciones de proyectos grupales para 109 grupos de estudiantes durante tres años académicos. Los resultados mostraron que ni la participación de los estudiantes ni la participación de los profesores en el foro de discusión de apoyo asincrónico condujo a un rendimiento significativamente mejor de los estudiantes por medio de la calificación del proyecto grupal. Las posibles razones de este hallazgo que es inconsistente con la literatura incluyen cuestiones como la participación voluntaria de los estudiantes en el foro, muchas otras vías para obtener el apoyo de los profesores y el uso de preguntas para representar la participación. El marco conceptual del estudio señala la importancia de especificar el entorno de aprendizaje, el objetivo de aprendizaje, el tipo de foro de discusión y el tipo de participación al examinar el impacto de un foro de discusión.

PALABRAS CLAVE
foro de discusión asincrónico apoyado por un profesor, aprendizaje aumentado, métodos cuantitativos

INTRODUCTION

Quantitative courses are mandatory in business degrees as business graduates are expected to have quantitative reasoning, problem solving and analytical skills (Ramos Salazar, 2018). A number of business students, however, cope with 'quantitative anxiety,' defined as anxiety experienced when dealing with any quantitative subject matter (Swart & Wuensch, 2016). In addition to this anxiety, there is also a negative attitude towards these types of courses in the business curriculum, where these courses are often viewed as being the most challenging and difficult courses in their degree programmes (Yousef, 2017). Even more troubling, is the view that these courses are separate and not relevant to their substantive programme of study (Buckley et al, 2015).

Research shows that business students actively strategise to delay taking quantitative courses, switch majors to avoid these courses, and even drop out of college or university (Swart & Wuensch, 2016). Despite the unpopularity of these quantitative courses among students, the quantitative processing skills that are developed by these courses are highly sought after by employers as problem solving and numeracy skills are seen as critical for growing and sustaining businesses (Lee-Post, 2019).

As a result, there has been much interest in understanding business student performance in quantitative courses, as well as the efficacy of the teaching and learning methods used in these courses. In terms of the former, researchers such as Yousef (2011) and Yousef (2013) studied the impact of variables such as age, gender, nationality, high school type and field of study, on academic performance in quantitative courses among undergraduate students. In terms of the latter, researchers such as Nilsson and Hauff (2018) identified strategies such as integration of quantitative methods within the substantive business subject area and practical application of quantitative methods to teach business students. Winch and Cahn (2015) considered the use of supplemental tutorial videos in teaching management science to business students, and similarly, Laugerman and Saunders (2019) examined the relationship between using supplemental videos and academic performance in the teaching of statistics to business students. Cook, Watson and Vougas (2019) investigated the impact of flexible e-learning materials in the teaching of quantitative methods.

This paper falls into the second category of examining the efficacy of asynchronous online discussion forums used in quantitative courses taught to business students. Because the asynchronous online discussion forum allows for discussions between students and lecturers, and among students, beyond the boundaries of the physical classroom (Hew, Cheung, & Ng, 2010), it presents an attractive teaching and learning vehicle not only during regular semester engagement, but also for periods when Face-to-Face engagement is not possible, such as during the COVID-19 pandemic.

While many other researchers have investigated the efficacy of asynchronous online discussion forums, such as the Duncan et al. (2012) study of accounting students, much of this work has focused on participative discussion forums in online teaching environments. This paper adds to the literature by considering asynchronous support discussion forums used to augment Face-to-Face delivery, by providing lecturer support to students when they undertake a group project, designed for students to apply quantitative methods to a real-life scenario. The paper firstly examines students' participation, by way of student questions, in an asynchronous online discussion and their performance and secondly, the paper examines the relationship between the lecturer's

participation, by way of lecturer questions, in an asynchronous lecturer-supported online discussion forum and the students' performance.

The paper proceeds as follows. Section Two presents the literature review on asynchronous online discussion forums and how they contribute to knowledge. Section Three outlines the research method used to meet the research aims. Section Four presents the research results, while Section Five discusses the findings and concludes the paper.

LITERATURE REVIEW

Students across various disciplines are required to develop knowledge, skills and understanding of quantitative methods. In the short term, while these students are in college or university, quantitative techniques prepare students with a foundation to tackle many academic tasks. In the longer term, these techniques are needed in wider society, in the world of work and in multiple research settings (Nilsson & Hauff, 2018). In the world of work, employers seek out business graduates who are able to display 'evidence-based decision-making abilities' (p.68), which require quantitative skills (Hijazi & Zoubeidi, 2017). Business students are exposed to tools and techniques that could be applied to business decision-making scenarios. These scenarios often require the decision-makers to have quantitative numeracy, defined as the skills, knowledge, attitudes and problem-solving skills to process and engage in quantitative situations (McClure & Sircar, 2008).

Because there is often a reported mismatch between supply and demand for skills in the job market, there has been great interest in how student acquire the requisite skills and the integration of these skills for the job market (OECD, 2016). For example, Goldfinch (1996) examined the methods used to teach quantitative methods to business students, where the effectiveness of 'school-type classes' was compared to 'traditional lecture / tutorial method', and concluded that the 'school-type classes' led to higher examination results. Lin (2018) considered whether the use of game play in teaching microeconomics increased comprehension, attendance and examination performance among business students, and concluded that game play led to increased examination performance. Lawrence and Singhania (2004) considered student performance when statistics course is taught to undergraduate business students via traditional delivery versus distance-learning, where the finding was performance was higher when students were in the traditional format versus the distance-learning format. Similarly, Verhoeven and Wakeling (2011) considered student performance when quantitative methods was taught to business students via online delivery versus face-to-face delivery, and concluded that students taught using face-to-face delivery enjoyed a higher success rate than students taught via online delivery.

Despite the findings of researchers such as Verhoeven and Wakeling (2011), online delivery has increased in popularity over the last few decades. This increase in popularity reflects the view that virtual or online learning has expanded the bounds of time, place and space that characterise the traditional learning environment, based on technology that not only delivers learning resources but also enables communication among the learners (Tan, 2017).

One common tool used in virtual or online learning that enables communication among learners is the online discussion forum, where users can

obtain feedback on problems, share ideas and interact with other students (Romero et al., 2013). These forums can be used via the various delivery modes: fully online delivery, blended delivery, and to augment courses that use Face-to-Face delivery. Whilst there has been the recognised dichotomy of synchronous and asynchronous online discussion forum, the focus of this paper is on the asynchronous discussion forum, which Hew et al. (2010) defined as "a text-based computer-mediated communication environment that allows individuals to interact with one another without the constraint of time and place" (p.572). The removal of time and space constraints (Gao et al., 2013) allows for the asynchronous online discussion forum to be used in any of the delivery modes outlined above: fully online delivery, blended delivery, and to augment courses that use Face-to-Face delivery. In particular, the advantages of the asynchronous online forum, identified as data retention, accessibility to data, flexibility for users with respect to time and opportunities for deeper reflection and discussions (Hew, Cheung, & Ng, 2010), present attractive opportunities for lecturers to incorporate into their suite of teaching and learning strategies. Notwithstanding these advantages, researchers have also reported on disadvantages of the asynchronous online forum, such as poor student participation and student engagement, feelings of disconnect in the online environment, lack of emotional cues, and surface-level discussions (Aloni & Harrington, 2018).

Aside from the categories of synchronous and asynchronous online discussion forums, these forums can also be classified based on the objective. As shown in Table 1, Gill (2006) outlined five types of online discussion forums: Support, Participative Discussion, Task Collaboration, Workflow Management, and Administrative. These types of discussion forums reflect the way in which lecturers use forums. For example, Coppola et al. (2002) identified three roles played by lecturers in asynchronous learning networks: cognitive roles, affective roles, and managerial roles. The cognitive role concerns the learning and thinking processes, the affective role focuses on relationships among the participants and the classroom atmosphere, and the managerial role centres on class and course management.

Table 1. Types of Online Discussion Forums

Discussion Type	Description
Support	Designed to provide answers to general or focused questions
Participative Discussion	Used to host discussion, typically on a focused topic
Task Collaboration	Designed for group collaboration
Workflow Management	Used to track workflows
Administrative	Used for general administrative tasks

Source: Gill (2006)

Because simply implementing asynchronous online discussion forums is not enough to improve student learning (Parks-Stamm, Zafonte, & Palenque, 2017), different approaches have been utilised to examine how these online discussion forums contribute to learning.

One approach taken in examining online discussion forums is the categorisation of the message types where, for example, Chen and Chiu (2008) proposed a framework for characterising these messages using five dimensions: Evaluation, Knowledge Content, Social Cues, Personal Information and

Elicitation. Within the Knowledge Content dimension, Chen and Chiu (2008) specified three categories: Contribution, Repetition and Null Content.

In this same vein of studying the nature of the postings, Mazzolini and Maddison (2003) classified instructor postings into one of four groups: 'posing questions'; 'answering questions'; 'combination of answer and follow-up question' and 'other types of posts such as administrative housekeeping'. Similarly, Blignauta and Trollip (2003) developed a taxonomy of six categories of instructor postings, which are classified into either 'Messages with no academic content' and 'Messages with academic content' on asynchronous online discussion forum, as shown in Table 2.

Table 2. Taxonomy of Instructor / Lecturer Postings on Asynchronous Online Discussion Forums

Classification	Criteria	Description
Messages with no academic content	Administrative	General administrative topics that provide support and give directions
	Affective	Acknowledgment of learner participation
	Other	No academic content and off-task related
Messages with academic content	Corrective	Remedial and redirecting messages
	Informative	Supportive feedback
	Socratic	Reflective questions about learner's posting

Source: Blignauta and Trollip (2003)

Another approach to studying learning in online discussion forums is by analysing the interaction on the forum. Interaction is viewed as one of the most important elements of learning in both face-to-face and online environments (Jung et al., 2002). A common typology of the types of interactions on online discussion forums comprises learner – learner interaction, learner – instructor interaction and learner – content interaction (Lin, Zheng, & Zhang, 2017), and these three types of interactions have often been studied to investigate learner satisfaction. Similarly, Jung et al. (2002) considered academic, collaborative and social interactions on online forums on learner satisfaction and learning.

In keeping with this theme of interaction, the Interaction Analysis Model considers the quality of the interactions and the quality of the learning experience in online discussion forums. The model which specifies five phases of knowledge construction (Gunawardena et al., 1997; Hew & Cheung, 2011) and is summarised in Table 3.

Table 3. The Interaction Analysis Model

Phase	Description
Phase 1	Shares and compares information
Phase 2	Discovers inconsistency of ideas, concepts, or statements
Phase 3	Negotiates ideas, suggests new construction on issues where conflict exists
Phase 4	Tests proposed synthesis or co-construction against existing cognitive schema, personal experiences, or literature
Phase 5	Summarises agreement or application of newly constructed meaning or ideas

Source: Gunawardena et al. (1997)

Researchers have also examined interaction from the perspective of patterns and content. Zhu (2006) used the Analytical Framework for Cognitive Engagement in Discussion, summarised in Table 4, to perform content analysis of asynchronous discussion forums, where five categories were used for coding: Question, Statement, Reflection, Mentoring, and Scaffolding.

Table 4. Analytical Framework for Cognitive Engagement in Discussion

Category of Engagement	Type	Characteristics
Question	Type 1	Seeking information through question with a direct and correct answer
	Type 2	Inquiring or starting discussion which there is no direct or correct answer
Statement	Type 1	Responding to previous message
	Type 2	Informative through statement that provide information
	Type 3	Explanatory through statement that presents factual information
	Type 4	Analytical through statement that offers analytical opinion
	Type 5	Synthesizing through statement that summarises messages
	Type 6	Evaluative through statement that presents evaluative judgment
Reflection	Type 1	Reflective of changes
	Type 2	Reflective of using cognitive strategies
Mentoring	Type 1	Mentoring which explains concept
Scaffolding	Type 1	Scaffolding which guides by offering suggestions

Source: Zhu (2006)

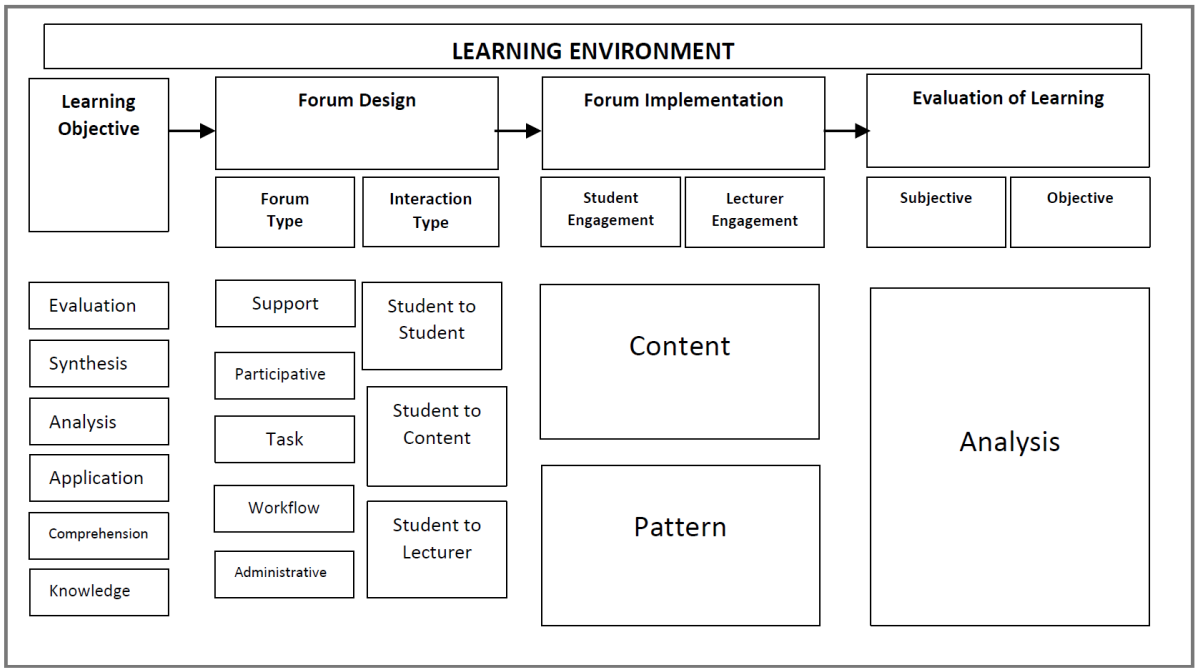
Of these five categories of engagement, the Question category features in research investigating how characteristics of discussion forums impact learning outcomes (Liu, Cheng, & Lin, 2013). Noce et al. (2014) pointed out that instructor questions are the 'driving force' in student engagement and learning on online asynchronous discussion forums, and distinguished between authentic questions, which are questions that the instructor does not know the answer, versus test or display questions, which are questions that the instructor already knows the answer. Similarly, Paoletti et al. (2018) classified four types of questions: factual, probing, generative and orienting, where factual questions ask students about facts, rules and procedures; probing questions ask students to explain concepts; generative questions ask students to provide additional information that is not factual; and orienting questions direct students to possible solution strategies. King (1994) specified three types of questions used by students in knowledge construction: integration questions, comprehension questions and factual questions. According to King (1994), the Integration Question connects ideas or requests explanation; the Comprehension Question requests descriptions or definitions; and the Factual Question requests recall of facts. Further, as a result of this questioning, integration questions lead to knowledge integration, comprehension questions lead to knowledge assimilation, and factual questions result in knowledge restating (King, 1994).

Ultimately, the evaluation of the efficacy of the asynchronous discussion forum is not an easy undertaking, and while various measures have been utilised, they are viewed as only approximations in terms of understanding if the use of technology in this manner benefits the educational process (Gill, 2006). Students can provide self-reported learning reports through the use of surveys (Benbunan-Fich, 1999). Lecturers can evaluate the actual content of the online discussion,

through tools such as content analysis rubrics (Gao et al., 2009) or taxonomies such as Bloom's taxonomy (Bloom, 1956) applied to the asynchronous discussion transcript (Abawajy, 2012) or through data mining to identify relationships and patterns of the posts on the forum (Andresen, 2009). Another approach lecturers can take towards evaluating the efficacy of asynchronous discussion forum is measuring student performance in a specific course section or in the overall course (Duncan, Kenworthy, & McNamara, 2012).

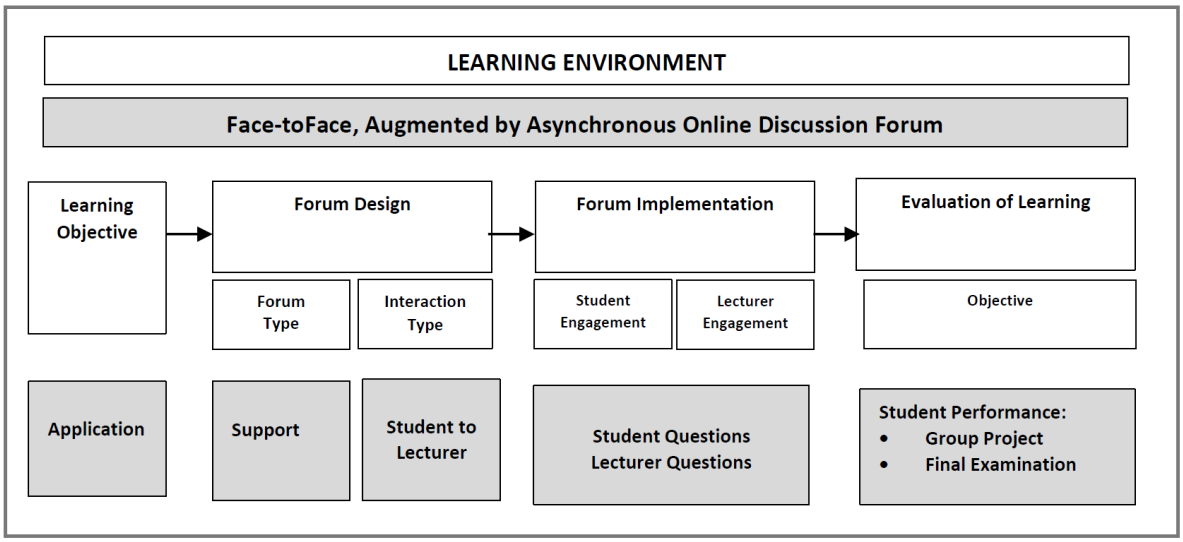
The type of delivery environment, along with the type of discussion forum would dictate the suitability of the approach taken for coding the forum interactions and analysing if and how the online discussion contributed to meeting the learning objective (Liu, Cheng, & Lin, 2013). Figure 1 shows the conceptual research framework used to guide this research undertaking, which was developed via synthesis of the existing literature.

Figure 1. Conceptual Framework for Analysing the Efficacy of Asynchronous Online Discussion Forums



Based on the conceptual framework, the research context for this paper is outlined in Figure 2, where the learning environment, learning objective, forum design, forum implementation and evaluation of learning are presented.

Figure 2. Framework Outlining Research Context for Research



METHODOLOGY

The study was conducted in a Department of Management Studies (DOMS) at The University of the West Indies, St. Augustine Campus. The course in the study is titled Quantitative Methods and it is a compulsory course for all students pursuing any of the nine undergraduate degree programmes offered by the DOMS. The course is also read by students from other departments since Quantitative Methods is a pre-requisite for a number of courses, including Production and Operations Management and Operations Planning and Control.

The class uses the traditional Face-to-Face delivery mode over 13 weeks, with three weekly contact hours. Topics covered over the semester include forecasting, decision theory, linear programming, queuing theory, game theory and simulation modelling. The course is taught using PowerPoint Presentations, videos and worked problems on the smart board or white board. Additionally, students are given exercises during the Face-to-Face sessions, and homework problems to work through to reinforce learning. The course is assessed via 40% coursework and 60% final examination. The coursework comprises two individual quizzes, worth 10% each, and one group project, which accounts for 20% of a student's final grade. All members of the group receive the same mark for the group project.

The group project officially starts in Week 4 of the course and is due in Week 12. An asynchronous support forum discussion page is set up on Moodle, the Learning Management System (LMS) at the university, which is designed to provide additional support to the students as they work through the group project.

The project outline is provided below.

> *Quantitative Methods (QM)) focuses on the tools and techniques that may be applied in problem solving and decision-making scenarios. The objective of this QM Group Project is to engage students in the scientific approach to problem solving, where you will identify and analyse a real-world problem or decision-making scenario and make recommendations to solve the problem or arrive at an optimal solution. The real-world scenario could be based on a campus issue (eg: student parking on campus, student shuttle service), or an off-campus issue (eg: gas-station service waiting time). The project will*

employ the quantitative analysis approach, using the following four steps:

I. Definition of Problem
II. Development of Model
III. Data Collection
IV. Development of Solution

Using the tools and techniques covered in QM, you will present an analysis of the identified problem. Based on your analysis, you will present solutions, which would be practical proposals that are based on sound quantitative analysis principles.

Groups are self-selected and comprise between two – six students. Further, each group is encouraged to submit a project proposal, indicating the real-world problem or decision-making scenario and the planned approach towards problem solving. The Lecturer then provides feedback on each proposal received and responds to each post made on the discussion forum.

This paper reports on three years. In Year 1, there were 36 groups, comprising 193 students: 61 male students and 132 female students. In Year 2, there were 31 groups, comprising 166 students: 58 male students and 108 female students. In Year 3, there were 42 groups, comprising 207 students: 64 male students and 143 female students. In total, there were 109 groups.

In terms of student participation in the asynchronous discussion forum, the following hypotheses are tested:

Hypothesis 1*: The quantity of student participation in the form of questions in the asynchronous lecturer-supported discussion forum will influence the student performance in the group project.*

Hypothesis 2*: The quality of student participation in the form of questions in the asynchronous lecturer-supported discussion forum will influence the student performance in the group project.*

Zhu (2006) identified questions as one type of major interaction on discussion forums. Further, as per King (1994), student questions are used in knowledge construction, and the different types of questions serve different purposes. As such, student questions is used to examine student participation.

In Hypothesis 1, the independent variable 'quantity of student participation' (StuQuan) is the aggregate number of student questions made on the group discussion forum. In Hypothesis 2, the independent variable 'quality of student participation' (StuQual) is the rating of student questions, where factual questions are classified as level 1, given a score of 1; comprehension questions are classified as level 2, given a score of 2; and integration questions are classified as level 3, given a score of 3. An example of each type of student questions is provided below:

- Student Factual Question: Is this a multi-phase system?
- Student Comprehension Question: What is meant by configuration of the queuing system?
- Student Integration Question: Can the average time spent in line be used as a reflection of the efficiency of the workers catering to the line?

Student questions that had no academic content, such as questions seeking administrative answers, such as 'What time is the project due?' are classified as Level 0 and given a score of 0.

The dependent variable for both hypotheses is student performance, which is measured by the group project mark (GroProj). The group project is scored out of a total of 20 marks. Based on the grading scheme used by the university, the marks are categorised into the following grade bands: A Grade: 16 – 20 marks; B Grade: 13 – 15 marks; C Grade: 10 – 12 marks; F Grade: 0 – 9 marks.

Noce et al. (2014) highlighted the critical nature of lecturer questions in driving engagement on discussion forums. Further, Paoletti et al. (2018) specified the different types of lecturer questions in stimulating different student responses and outcomes. As such, lecturer questions is used to examine lecturer participation.

In terms of lecturer participation in the asynchronous discussion forum, the following hypotheses are tested:

Hypothesis 3: *The quantity of lecturer questions in the asynchronous lecturer-supported discussion forum will influence the student performance in the group project.*

Hypothesis 4: *The quality of lecturer questions in the asynchronous lecturer-supported discussion forum will influence the student performance in the group project.*

In Hypothesis 3, the independent variable 'quantity of lecturer questions' (LecQuan) is the aggregate number of lecturer questions made on the group discussion forum. In Hypothesis 4, the independent variable 'quality of lecturer questions' (LecQual) is the rating of lecturer postings, where factual questions are classified as level 1, given a score of 1; probing questions are classified as level 2, given a score of 2; generative questions are classified as level 3, given a score of 3; and orienting questions were classified as level 4, given a score of 4. An example of each type of lecturer question is provided below:

- Lecturer Factual Question: What are your decision variables, and your constraints?
- Lecturer Probing Question: Why are you using decision analysis in this scenario?
- Lecturer Generative Question: How did you determine that the southern carpark is underutilised?
- Lecturer Orienting Question: Are you confident that you have collected sufficient data for your analysis?

Lecturer questions that had no academic content, such as questions seeking administrative answers, such as 'What time do you want to meet?' are classified as level 0 and given a score of 0.

Again, the dependent variable for both hypotheses is student performance, which is measured by the student final mark in the group project.

The coding of the questions was done by the lecturer and two research assistants collaboratively. In cases where there was disagreement with the coding level, discussion was used to come to agreement.

Data analysis was done using inferential tests using PSPP software (Version 1.4.1).

RESULTS

Student Participation and Student Performance

Of the 109 student groups, 50 participated in the lecturer-supported asynchronous discussion forum by way of factual, comprehension and integration questions. As shown in Table 5, the 50 participating student groups (M=13.87, SD=2.33) compared to the 59 student groups which did not participate in the forum (M=14.74, SD=2.51) demonstrated statistically significant lower group marks, t(107) = -1.85, p = 0.03.

Table 5. Summary Statistics for Participating Student-Groups versus Non-Participating Student-Groups

	Participating Student Groups	Non-Participating Student Groups
Number of Groups	50	59
Mean Group Mark	13.87	14.74
Standard Deviation	2.33	2.51

For the 50 student groups which participated in the forum, Student Question Quantity had a range of 1 – 8. Low Student Question Quantity was categorised as groups that posed 1 – 3 questions, medium Student Question Quantity was categorised as groups that posed 4 – 6 questions, and high Student Question Quantity was categorised as groups that posed 7 – 8 questions. For these 50 student groups, the Student Performance by way of Group Mark had a range of 8 – 18 marks, which were categorised via the grading scheme of A: 16-20 marks, B: 13-15 marks, C: 10-12 marks, and F: 0-9 marks. Table 6a summarises this data.

Table 6a. Participating Student Groups: Student Performance and Student Question Quantity

	Student Performance				
Student Question Quantity	**Grade A**	**Grade B**	**Grade C**	**Grade F**	**ROW TOTAL**
Low	11	17	10	1	39
Medium	1	3	4		8
High	2	1			3
COLUMN TOTAL	14	21	14	1	50

A chi-square test of independence was performed to examine the relationship between student question quantity and student performance. The relationship was not significant, X^2 (6, N = 50) = 4.99, p = .545.

For the 50 student groups which participated in the forum, the Student Question Quality had a range of 1 – 22. Low Student Question Quality was categorised as student question quality aggregate score of 1 – 7, medium Student Question Quality was categorised as student question quality aggregate score of 8 - 14, and high Student Question Quality was categorised as student question quality aggregate score of 15 - 22. Table 6b summarises the data.

Table 6b. Student Performance and Student Question Quality

	Student Performance				
Student Question Quality	**Grade A**	**Grade B**	**Grade C**	**Grade F**	**ROW TOTAL**
Low	10	17	9	1	37
Medium	2	3	4		9
High	2	1	1		4
COLUMN TOTAL	14	21	14	1	50

A chi-square test of independence was performed to examine the relationship between student question quality and student performance. The relationship was not significant, X^2 (6, N = 50) = 2.80, p = .834.

Lecturer Participation and Student Performance

Of the 109 student groups, 54 student groups were engaged by lecturer questions in the lecturer-supported asynchronous discussion forum by way of factual, probing, generative and orienting questions. As shown in Table 7, the 54 student groups which had lecturer questions posed to them in the lecturer-supported asynchronous discussion forum (M=14.13, SD=2.47) compared to the 55 student groups who did not had lecturer questions posed to them in the forum (M=14.55, SD=2.45) did not demonstrated statistically significant difference in group mark, t(107) = -.90, p = 0.19.

Table 7. Summary Statistics for Lecturer Engagement with Student-Groups versus Lecturer Non-Engagement with Student-Groups

	Lecturer Engagement with Student Groups	**Lecturer Non-Engagement with Student Groups**
Number of Groups	54	55
Mean Group Mark	14.13	14.55
Standard Deviation	2.47	2.45

Lecturer Question Quantity had a range of 1 – 9. Low Lecturer Question Quantity was categorised as lecturer posing 1 – 3 questions, medium Lecturer Question Quantity was categorised as lecturer posing 4 – 6 questions, and high Lecturer Question Quantity was categorised as lecturer posing 7 – 9 questions. For these 54 student groups, the Student Performance by way of Group Mark had a range of 8 – 18 marks, which were categorised via the grading scheme of A: 16-20 marks, B: 13-15 marks, C: 10-12 marks, and F: 0-9 marks. Table 8a summarises this information.

Table 8a. Student Performance and Lecturer Question Quantity

	Student Performance				
Lecturer Question Quantity	**Grade A**	**Grade B**	**Grade C**	**Grade F**	**ROW TOTAL**
Low	16	19	7	1	43
Medium	1	3	3	1	8
High		2	1		3
COLUMN TOTAL	17	24	11	2	54

A chi-square test of independence was performed to examine the relationship between lecturer question quantity and student performance. The relationship was not significant, X^2 (6, N = 54) = 6.49, p = .371.

For the 54 student groups which were engaged by lecturer questions in the forum, the Lecturer Question Quality had a range of 1 – 25. Low Lecturer Question Quality was categorised as lecturer question quality aggregate score of 1 – 7, medium Lecturer Question Quality was categorised as lecturer question quality aggregate score of 8 - 14, and high Lecturer Question Quality was categorised as lecturer question quality aggregate score of 15 - 25. Table 8b summarises this information.

Table 8b. Student Performance and Lecturer Question Quality

	Student Performance				
Lecturer Question Quantity	**Grade A**	**Grade B**	**Grade C**	**Grade F**	**ROW TOTAL**
Low	14	14	4	2	34
Medium	2	6	6		14
High	1	4	1		6
COLUMN TOTAL	17	24	11	2	54

A chi-square test of independence was performed to examine the relationship between lecturer question quality and student performance. The relationship was not significant, X^2 (6, N = 54) = 9.43, p = .151.

DISCUSSION

The first finding relates to the statistically significant difference in student performance of the groups that posed questions in the lecturer-supported asynchronous forum versus student groups that did not participate in the forum. Specifically, student groups participating in the forum had lower scores. This seemingly counterintuitive result may actually reflect that, where there is a lack of understanding of the Quantitative Methods concepts, student groups may seek out lecture support via the online discussion forum, by way of posing factual, comprehension and integration type questions.

Regarding Research Hypothesis 1, we examined the influence of student participation in the form of questions in an asynchronous lecturer-supported discussion forum on student performance. The results of the chi square test of independence indicated that there is no significant relationship between the student question quantity and the student performance dependent variable by way of group project mark. Similarly, for Hypothesis 2, there is no significant relationship between the student question quality and student performance. While these findings were not consistent with previous research related to online discussion forums, which reported higher performance by students who post on online discussion forums (Cheng et al., 2011; Halabi & Larkins, 2016; Yoo & Kim, 2014), the findings were somewhat in line with research that indicate that higher interaction on discussion forums is not linked to significantly better student performance (Davies & Graff, 2005). Of more relevance is the lack of consistency of the findings of this research work with that of Duncan, Kenworthy and McNamara (2012), which indicated that student engagement, both in terms of

student quantity and student quality in asynchronous discussion forums had positive impact on final examination performance and overall course grades.

With research hypotheses 3 and 4, we examined the influence of lecturer participation in the form of questions in an asynchronous lecturer-supported discussion forum on student performance. The results of the chi square test of independence indicated that there is no significant relationship between lecturer question quantity and student performance as well as, lecturer question quality and student performance dependent variable by way of group project mark. Past literature had not explicitly examined the role of lecturers on student performance measured using objective assessment. Instead, past research such as Blignauta and Trollip (2003), Mazzolini and Maddison (2003) and Parks-Stamm et al. (2017) focused on lecturer postings on student participation and reported satisfaction.

The findings from hypotheses 1 and 2 were the most inconsistent result from the literature. A number of factors may be attributed to this inconsistent result which could be pulled out from the conceptual framework presented in Figure 1. Firstly, the asynchronous lecturer-supported discussion forum served to augment a Face-to-Face learning environment, where students had multiple other avenues to engage with the lecturer for support, such as speaking with the lecturer before class and after class, and meetings during office hours. As such, the degree of forum participation may be lower in this type of environment as opposed to fully online environments, which would show up in the student question quantity.

Secondly, the learning objective in this study was application of knowledge, while analysis and evaluation are the learning objectives of many forums described in the literature such as in Abawajy (2012) and Gao et al. (2013). This distinction in learning objective would therefore impact the nature of engagement on the forum, and perhaps explain the level of student question quantity and student question quality.

Thirdly, in this study, the asynchronous discussion forum was designed as a lecturer-supported forum, and not as a participation forum, which is often the type of forum reported in the literature. As such, unlike in participation online discussion forums which are designed to promote discussion for comprehension, critique, construction of knowledge or sharing knowledge (Gao et al., 2009), in this case of the lecturer-supported asynchronous discussion forum, students would primarily be motivated to engage in the discussion forum if they believed that they needed additional support towards meeting the group project objectives. Again, the degree of forum participation may be lower in this type of online asynchronous discussion forum, which would show up in the student question quantity and student question quality.

Fourthly, as the forum was designed as a lecturer-supported asynchronous forum, student participation was measured by way of student questions, and not measured by way of coding of all student messages, which is often the manner in which student participation is reported in the literature. The literature often reports on guided discussion forums, where students respond to lecturer questions, and respond to student posts (Aloni & Harrington, 2018). As such, the approach used in this research for assessing student engagement would not capture all types of student postings on the discussion forum.

While the use of online discussion forums is increasing in popularity, the literature has shown mixed results in terms of the linkage between these discussion forums and student performance. This research study did not support the positive relationship with an asynchronous support discussion online forum

and student performance, both in terms of student participation and in terms of lecturer participation, measured by way of student questions and lecturer questions, respectively. These findings may raise the question as to whether it is worth setting up and administering asynchronous lecturer-supported discussion forums? This study does not produce a definitive answer. On the one hand, the asynchronous lecturer-supported discussion forum promotes student engagement, and it serves as an additional mechanism to assist in student learning. The discussion forum could therefore serve as a critical tool for students who self-identify as needing additional support and who may have a preference to engage with the lecturer via this online forum medium. On the other hand, in the augmented environment, students have multiple means of obtaining support, and so, the asynchronous lecturer-supported discussion forum may be underutilized, both in terms of the quantity and quality of student participation.

Future studies on engagement with asynchronous discussion forums may move us closer to the answer. This point brings us to the main contribution of this research, which was the conceptual framework, which proposes a structure to guide the assessment of the evaluation of the efficacy of discussion forums on student learning. The conceptual framework proposes the consideration of the learning environment, learning objective, forum design, forum implementation and evaluation of learning, to examine discussion forums.

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