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**The Effect of Synchronous and Asynchronous Participation on
Performance in Online Accounting Courses**

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ABSTRACT

This paper examines the relationship between MBA students' performance and participation in two online environments: a synchronous forum (chat room) and an asynchronous forum (discussion board). The *quality* and *quantity* of students' participation is used to predict their final exam and course grade performance outcomes. We find that the total *quality* of students' participation is positively related to final exam performance but the total *quantity* of students' participation is related to overall course performance. We also find that synchronous engagement with the course (combined *quality* and *quantity*) drives these results and has twice the exam and grade impact relative to asynchronous course engagement. We conclude that encouraging high quality and frequent participation in both synchronous and asynchronous forums will help maximise student performance.

Keywords: Online-Learning, Synchronous, Asynchronous, Participation, Performance

INTRODUCTION

Technological advances are rapidly changing educational environments, bringing new opportunities and significant challenges for students, educators and educational institutions (Bennett and Maton 2010; Collins and Halverson 2010; Marshall 2010). While online learning has been called “the dynamic education vehicle of our time” (Barnard 2005) and is becoming more and more common across the disciplines, there is still much to be learned about the pedagogy of teaching courses online (Arbaugh 2005a, 2005b; Niles and O'Neill 2007; Oncu and Cakir 2011). However, the evidence is mixed on student learning in online courses. For example, Hron *et al.* (2000) find no differences in knowledge acquisition for students in structured versus unstructured online classes, while Tan *et al.* (2000) find participation and engagement in structured online forums is positively related to the quality of students' outcomes. We extend the online learning literature by exploring the performance impact of student engagement in synchronous (chat room) and asynchronous (discussion board) online forums.

We currently know little about the learning impact of engagement in these two online forums. Kubey *et al.* (2001) find greater use of synchronous communications is associated with impaired academic performance more so than asynchronous applications. McBrien *et al.* (2009) find students rated synchronous virtual classrooms highly due to the convenience, autonomy and quality of discussions they evoked. In contrast, Perera and Richardson (2010) find the quantity of material accessed via asynchronous forums and the quantity of asynchronous discussion interaction, rather than time spent online per se, positively impacts final exam performance. Others find students perceive synchronous forums as either providing them with core material to fall back on or as a tutor communication (Love and Fry 2006), and as a result students are unwilling to participate in synchronous online activities (Wells *et al.* 2008).

We contribute to this emerging literature and examine the relationship between Executive MBA students' participation and performance in an online and off-campus accounting course. We measure student participation in terms of their engagement with two types of online forums: (1) a synchronous forum (i.e., a chat room, scheduled during fixed time periods, within which the instructor and students simultaneously engage in text-based chat to discuss course-related content) and (2) an asynchronous forum (i.e., discussion boards accessible by the students and instructor 24 hours a day, 7 days per week, where students and

the instructor intermittently pose questions and comments to each other in “threads” of related communications). Both the *quality* and *quantity* of students’ participation in these forums are used as predictors of final examination and overall course performance. Student participation in chat rooms and discussion boards is strongly recommended in the course materials and by the instructors, but participation is voluntary.

Results suggest that the total *quality* of students’ participation (in synchronous and asynchronous forums combined) is positively related to final exam performance. In contrast, the total *quantity* of students’ participation is positively related to overall course performance. We also find that synchronous engagement with the course (combined *quality* and *quantity*) drives these results and has twice the impact on final exam and overall course performance relative to asynchronous course engagement. These results are robust to alternative specifications of participation. Finally, we find engagement in the two forums positively impacts performance over and above total online engagement.

The paper proceeds as follows. The next two sections first review the online learning literature and then distil three research hypotheses. We then describe the paper’s research methodology and present the results. Finally, we discuss the result and conclude with some recommendations for online education programs.

ONLINE LEARNING LITERATURE REVIEW

Online learning and virtual class forums are a reality in today’s organisational (Clark and Gibb 2006; Shea-Schultz and Fogerty 2002) and educational environments (Alavi and Leidner 2001; Collins and Halverson 2010). While the practice of using internet-based classroom environments continues to rise, research in this area is lacking (Brower 2003; Duncan *et al.* 2011; Oncu and Cakir 2011). Arbaugh’s (2005a) review of research on online learning shows that most of the conceptual work in this domain started in 1999, with empirical research first published relatively recently in 2000.ⁱ

While this field is developing, as educators we recognise the need for our students to learn skills related to effective and efficient communication in internet-based forums. This is particularly true as organisations of all shapes and sizes become increasingly dependent upon inter- and intra-organisational online communications (e.g., worker-worker, worker-client, boss-subordinate, buyer-seller) (Clark and Gibb 2006). With such a universal demand for

online skill acquisition and development, educators at all levels are working to create online environments that are conducive to learning (Drennan *et al.* 2005; Rogers 2000). As Segrave and Holt (2003) note, our knowledge base as educators in this domain is not only inadequate, but the small amount of research we do have is drawn from isolated tests or anecdotal experience (Alavi and Leidner 2001; Arbaugh 2005a). What most researchers do appear to agree upon is that online students require embedded opportunities for reflection and engagement as well as, ideally, supportive guidance from faculty to maximise learning (May and Short 2003).

This is consistent with the notion that effective online courses are those in which “student-centered learning communities” are created (Clark 2001; Poole 2000). These communities are characterised by fluid and co-created learning processes where the faculty member is no longer an information provider, but a facilitator and member in the process of knowledge creation. To create this in a traditional classroom environment is difficult for many educators and more difficult in the online environment (McBrien *et al.* 2009).

One obvious challenge of online education is maintaining quality as educators question whether student learning is compromised in an online environment. To address this concern, Chernish *et al.* (2005) conducted a study to compare academic achievement across three teaching contexts: traditional classroom, instructional television and online (over the internet). They found no significant differences in student learning across the three contexts. One area in which they did find a difference was students’ level of comfort in the class, with 25% of the students in the online class rating themselves as “uncomfortable” with the online environment. Additionally, only 33% of the online students reported satisfaction with general classmate interaction, versus 80% satisfaction for students in the traditional classroom setting. Finally, only 49% of the online students felt that they could communicate easily with others (as compared to 66% in the traditional classroom setting). Chernish *et al.* (2005) highlights the challenge for online educators. While student learning across the different contexts was not adversely affected in their study, students were significantly less comfortable with the online learning environment than they were in the traditional face-to-face format.

It may be that students’ low levels of comfort stem from a lack of student-teacher interaction. Dunbar (2004) argues that one of the greatest challenges of online course delivery is the

reduced interaction between student and teacher. She cites numerous reports of student evaluations where restricted availability on the part of the instructor was the greatest weakness of the class. In fact, in a setting similar to our study, Gagne *et al.* (2001) ran a comparative study of online versus face-to-face graduate accounting classes. Although they found no difference in student performance, they did find that the students in the online course were less satisfied with instructor availability. Research in this area is still inconclusive. Some studies find high levels of student satisfaction with the interactive components of online courses (Lindner *et al.* 2002) and others find high levels of dissatisfaction with interactive components, leading students to complain about feelings of isolation (Kelsey *et al.* 2002). Palmer and Holt (2009) found clear communication lines in an online environment contributes significantly to student satisfaction.

While the research on interaction and satisfaction is inconclusive, educators would be remiss if they dismissed the importance of student interaction in online courses. Research has shown that one way to increase interaction is to provide flexible support through online tutoring (Fischer *et al.* 2003). When compared to face-to-face tutorial or mentoring situations, online tutoring may require “more frequent and more explicit purpose-setting, progress-reporting, and problem solving communications” (O’Neill and Harris 2004). Faculty may need to establish timeframes for responses by stating when responses will be generated (e.g., “when a question is posted, I will respond to it within 24 hours Monday-Friday, weekend postings will have a response on Monday before 12:00pm”). Moreover, online tutors should establish relationships with individual students, creating one-on-one virtual dialogues that can later be merged into larger discussion threads for groups.

The type of online environment used, synchronous or asynchronous, is another challenge in teaching an online course. Synchronous forums (i.e., students and faculty are logged on simultaneously) have the benefit of real-time communications between students and faculty member(s). Students can ask questions and receive an immediate response; faculty members can pose questions and watch for immediate or delayed responses. Delayed responses may highlight the need to further engage students with the topic, describe alternative applications or give other examples. Synchronous forums allow for a much higher level of interactivity than time-delayed or asynchronous forums. Wells *et al.* (2008) find, however, that students are reluctant to engage in synchronous communication even though they embrace online course materials. Love and Fry (2006) suggest that this is because students consider online

materials as a safety net rather than a supplementary learning tool. Finally, higher online presence, such as synchronous communication, can in fact be detrimental to academic performance due to the quantum of late night online activity (Kubey *et al.* 2001).

Asynchronous forums (e.g., discussion boards), while challenging in terms of creating a high level of interactivity and sense of community, are the most common online mechanisms used today (Brower 2003; Hull and Saxon 2009; Yang 2008). Asynchronous delivery may be particularly useful when students are working together across different time zones (Arbaugh 2000; Berger 1999)ⁱⁱ because students can “attend” class discussions or group work at their convenience. Additionally, as discussed by Brower (2003), there is no limit to the “air time” for students, meaning they are able to contribute to class at any time, any day and for an unlimited duration. Students report that the provision of online discussion boards is a significant motivator to learn (De Lange *et al.* 2003). More importantly the evidence suggests that the quantity of discussion messages is positively related to examination performance but quantity of time online is not (Perera and Richardson 2010).

We add to this literature by exploring the relationship between Executive MBA students’ online participation and performance in a required accounting course. We examine student participation in two online forums – a chat room (a synchronous online setting) and a series of discussion boards (an asynchronous online setting) – in terms of both *quality* and *quantity* of student participation. Performance is measured as the students’ final examination scores, as well as their overall course grades. Our goal is to better understand the relationships between participation and performance in online settings so that we can make informed decisions about how to promote student learning in online educational environments.

HYPOTHESIS DEVELOPMENT

Research supports the view that a positive correlation exists between the amount of online interaction and students’ learning (Graham and Scarborough 2001; Perera and Richardson 2010). This may be particularly true when online courses include different types of online student interactions. For example, three types of interactions are described in the literature: learner-to-learner (e.g., student team members working together over email), learner-to-content (e.g., students accessing PowerPoint slides over the internet), and learner-to-instructor (e.g., chat room and discussion boards) (Love and Fry 2006; Moore and Kearsley 1996; Sugahara and Boland 2006). While all three types of interaction may increase student

participation and learning, learner-to-instructor interactions have been shown to have the greatest effects. We argue that this relationship should be maintained for online interactions across both synchronous and asynchronous online environments. Some students will prefer the predictability and interaction of the synchronous, regularly scheduled chat sessions with weekly questions posed and issues raised. In this environment, students and faculty interact, discussing prescribed topics and assigned questions in an internet-based dialogue. Other students may need more time to process ideas and form questions; these students may be more comfortable participating in the asynchronous forum than in the synchronous forum. The freedom and autonomy to tailor contributions to their individual needs may raise their interest, enthusiasm and comfort with the class, which may positively impact learning and performance. We therefore hypothesise the following for the combined participation in synchronous and asynchronous forums:

Hypothesis 1: Student total online participation (*quality* and *quantity*) will positively influence (a) final examination and (b) overall course performance scores.

Hypothesis 1 focuses on the relationships between performance and students' total *quality* and total *quantity* of participation. One issue that the hypothesis does not address is the question of whether or not students' participation in each of the isolated online forums (the synchronous chat room and the separate asynchronous discussion boards) has a differential impact on student final examination and overall course performance. This issue is particularly important given the paucity of research comparing differences in student learning outcomes across types of online forums. As Conaway *et al.* (2005) highlight, there is very little information about how *quality* versus *quantity* of student online interaction will differentially predict performance. We examine this question in terms of the synchronous and asynchronous forms of participation utilised in this course and hypothesise the following:

Hypothesis 2: Students' participation (*quality* and *quantity*) in each online forum in isolation (synchronous and asynchronous) will positively influence (a) final examination and (b) overall course performance scores.

The quantity of participation in an online environment is related to improved examination performance (Davidson 2002; Davies and Graff 2005). This research shows a positive association between the quantity of online files accessed, the number of online discussion messages posted by students, and their examination performance (Perera and Richardson

2010). While *quantity* of participation may be an important predictor of performance, our focus is on assessing the impact of the *quality* of students' participation. The concern for quality is not new to education. Over the years quality frameworks were created to differentiate the quality of a student's learning.

As early as the 1930s, Dewey (1938) raised the issue of different levels of student learning, arguing that experiential learning provided students with one of the richest opportunities for cognitive development and skill acquisition. Subsequently, Bloom's (1956) six-level taxonomy classified the quality of student learning as knowledge, comprehension, application, analysis, synthesis and evaluation. This taxonomy is not prescriptive in that behaviours can fall at any point on the continuum, with upward and downward movement and multiple behaviours common. Evaluation represents behaviours indicating the highest level of cognitive development in the taxonomy. Extending Bloom's taxonomy to student participation leads to the following: students who engage in analysis, synthesis and evaluative discussions (i.e., functioning at the higher quality of learning levels) are more likely to perform better than students who are only memorising, comprehending or simply applying concepts (Athanassiou *et al.* 2003).

Biggs (1976) developed an alternative framework for conceptualising students' behaviours in classroom settings. Biggs' behaviour questionnaire and his later study process questionnaires (Biggs 1987; Biggs *et al.* 2001) conceptualize student learning behaviours as "deep" versus "surface" approaches to learning. With a deep learning approach, students are striving to maximise meaning, drawing upon their intrinsic interest in the topic area. With a surface learning approach, students simply rote learn material to avoid the possibility of failure. While arguably each of these approaches captures important aspects of student learning, the nature of our research data and observed behaviours determined our choice of measure. In this study we employ Bloom's (1956) taxonomy to classify the quality of observed student interactions with the course via the synchronous and asynchronous forums. Therefore, in terms of better understanding the relationship between total participation *quality* and performance in online environments, we hypothesise the following:

Hypothesis 3: The *quality* of students' synchronous and asynchronous participation in the online forums will positively influence (a) final examination and (b) overall course performance scores.

METHODOLOGY

Student performance and their participation through online forum interaction in an online Executive MBA accounting course provide the data for the research. The course was taught virtually using narrow-cast video lectures, chat rooms, and discussion boards. In addition to the weekly readings and exercises, the teaching tools used in the class are as follows:

1. A one-hour lecture per week, via narrow cast satellite TV.
2. A one-hour follow-up to the lecture per week, focused on problem demonstration and discussion, also via narrow cast satellite TV.
3. A two-hour weekly chat session, run by the course instructor. The chat sessions represent the synchronous interactions examined in this study.
4. A discussion board for each topic in the course was open to students at any point during the course. Instructors access this board intermittently to respond to any student-posted questions and to stimulate further discussions via comments and questions. The discussion board posts represent the asynchronous interactions examined in this study.

All students enrolled in the course were familiar with both the chat room (synchronous) and discussion board (asynchronous) forums. To assist with visibility of the discussion boards, instructors referred to the discussion boards in the chat sessions.

Participants

A total of 272 Executive MBA students participated in this study: the first class (85 students), second class (67 students) and third class (120 students). All students were enrolled in the online MBA program and were participating in a required accounting course. The students contributed to the synchronous and asynchronous forums at their discretion. The course undertaken was the same format in terms of assessment items; however, the course improved over time with amendments to the discussion board structure that improved interaction and accessibility. The chat room sessions remained unchanged in format and delivery mode. The overall website was also restructured and improved over the time period of the three classes.

Dependent Variable

Two separate measures of student performance are used as dependent variables: (a) the student's grade in the final examination, *FinalExam*; and (b) the student's overall performance in the course, *TotalScore*. The final examination, *FinalExam*, comprised 40 per

cent of the total course grade and is specifically designed to focus on aspects of deeper application-oriented learning (Biggs 1987). The examination is based on a case study by McNamara and Duncan (1996), which is presented as an agenda for the Board Finance Subcommittee to finalize the annual accounts for a dummy corporation. The final examination is designed to elicit student responses that encompass the six components of Bloom's (1956) taxonomy of educational objectives: knowledge, comprehension, application, analysis, synthesis and evaluation. The final exam accomplishes this goal, in terms of case content, via eight accounting problem areas set as agenda items that the student must address: accounts receivable, inventory, marketable securities, revenue recognition (internet sales, sales policy, a special sale), investment in associate company, revaluation of assets, developmental expenses for a new product and dividend and taxation.

The overall course performance, *TotalScore*, incorporates the final examination (40%) plus grades for other assessment items, such as individual and group project work (40%) and review quizzes (20%). The *TotalScore* performance measure, therefore, incorporates individual and group assessment, as well as a series of quizzes that concentrate primarily on the knowledge aspects of accounting education.

Independent Variables

Synchronous Forum: Chat Room

The synchronous forum comprised 10 chat sessions through the Blackboard course website, which provides an electronic whiteboard. Chat sessions were 2 hours in duration. Students could attend either of two weekly chat sessions. Blackboard provides transcripts of the chat sessions, which include the dialogue and identity of each participant. We measured both the *quantity* and *quality* of participation. The quantity of student participation in the chat room, *SyncQuant*, is the aggregate number of times a student made a comment, posed a question or raised an issue in any of the chat rooms. The quality of the students' participation, *SyncQual*, involves rating their individual comments or questions between one and six, derived from Bloom's (1956) taxonomy of student learning behaviours.

Asynchronous Forum: Discussion Board

A discussion board was set up for each administrative issue and for each lecture and tutorial, plus one discussion board for each assessment item. For the purposes of this study, administrative items were excluded from the analysis. The quality and quantity rating

systems described above for chat sessions (synchronous) were also applied to the discussion board (asynchronous) to measure participation quality, *AsyncQual*, and quantity, *AsyncQuant*.

To ensure consistency in applying the Bloom rating system, two accounting instructors worked together to develop the ranking. With an agreed protocol for ranking established, one of the accounting instructors coded the statements. A second independent coder also coded the statements according to the protocol. Coder reliability was measured using a Kappa coefficient, which is the proportion of agreement following adjustment for chance agreement. There was a high level of agreement with a Kappa of 0.81, which is significant at the 5% level (*F*-test).

The following examples of students' comments and their affiliated quality ratings illustrate the application of the ranking protocol. At the lowest levels of the taxonomy (knowledge and comprehension, coded as a 1 and 2 respectively), a student wrote the following question in a chat room: "*Am I correct in saying that a "sale" requires a market transaction?*" (coded as 1). In terms of the middle levels of the taxonomy (application and analysis, coded as a 3 and 4 respectively), a student posed the following question on a discussion board: "*If I own less than 50% of a company but I have convertible shares that enable me to convert my holding to greater than 50%, could I be said to have control of the company?*" (coded as 3). Finally, in terms of the highest levels of the taxonomy (synthesis and evaluation, coded as 5 and 6 respectively), a student stated with respect to a case analysis in a chat session: "*Here is what my interpretation is... While I had the capacity to control the company, I never exercised that capacity because my membership on the Board was 50/50 with a second investor and there was an independent Chairman of the Board, so in fact, in terms of controlling the financial decisions, I didn't actually exercise control because I didn't have it*" (coded as 6).

RESULTS

Descriptive statistics are reported in Table 1. Two additional variables are computed from the base measures – *TotalQual* is the combination of the chat room (synchronous) and discussion board (asynchronous) quality scores and represents a total quality of participation score for each student. Similarly, *TotalQuant* is the total quantity of participation across both the chat rooms and the discussion boards. The minimum scores of zero and low average scores indicate there are a number of students in each cohort who did not engage in either the

chat room or the discussion boards. Conversely, there are also a number of students who were highly active and exhibited high quality interaction. Due to the wide dispersion of quantity and quality levels across students (i.e. high variance), the average for any variable is not necessarily an indication of the explanatory power of the independent variables. Similarly, the exam scores and total score are highly variable and cover almost the full range of potential scores from zero to 100 percent. The key question to address is whether the variance in performance measures are correlated with variance in the participation measures.

INSERT TABLE 1 HERE

Table 2 reports the correlation matrix for the dependant and independent variables. As expected, students' overall grades for the course (*TotalScore*) and their final examination grades (*FinalExam*) are highly correlated (0.67); the difference is the averaging impact of group assessment grade on the *TotalScore* variable. Table 2 also shows that the quality and quantity measures are correlated with each other. Specifically, *TotalQual* and *TotalQuant* are correlated 0.77, *SyncQual* and *SyncQuant* are moderately correlated at 0.51, and the discussion board ratings for quality and quantity of participation (*AsyncQual* and *AsyncQuant*) are highly correlated at 0.85. The latter is potentially problematic for any testing of the relative impact on performance of quality versus quantity of participation, especially for *AsyncQual* and *AsyncQuant*. The high bivariate correlations suggests a multicollinearity issue and thus it is prudent to consider if this is evidence of a measurement and/or construct validity problem within the study. While multicollinearity is arguably a data issue, if the data for the independent variables are correlated sufficiently, then the estimated coefficients are unreliable and the standard errors are inflated (Belsley *et al.* 1980; Gujarati and Porter 2009). The model is still a good predictor, but the interpretation of the individual coefficients and weights within the model could be questionable. It is the latter that is important to this study and hence, we conducted additional analyses to better understand and capture the dimensions in the data.

INSERT TABLE 2 HERE

Combining independent variables, via a principal components analysis, is suggested as a way to address potential multicollinearity issues (Belsley *et al.* 1980; Gujarati and Porter 2009). Hence, we conducted an exploratory principal components analysis (PCA) to investigate the

underlying dimensionality of the independent variable data for the four measures: *SyncQual*, *SyncQuant*, *AsyncQual* and *AsyncQuant*. The PCA indicated two factors with eigen values greater than one were appropriate given the scree test plotⁱⁱⁱ. There are two common tests that indicate a reliable factor result. The KMO test determines whether there is sufficient correlation between variables to provide usable factors. This measure was above the minimum cut-off of 0.5 for our sample. The second test, Bartlett’s test of sphericity, determines whether the residuals are randomly distributed. For the factor solution in Table 3 Bartlett’s test of sphericity was significant at $p < 0.01$ level. We used Varimax rotation with Kaiser Normalisation to estimate the two factors, reported in Table 3, because this produces independent factors and thus addresses the multicollinearity issue for subsequent analysis.

INSERT TABLE 3 HERE

The factors represent the degree to which students engaged with the online forums in terms of time and energy to study and master the course material (McBrien *et al.* 2009; Robinson and Hullinger 2008). We label the two factors as synchronous engagement (*SyncEng*) (largely influenced by the *SyncQual* and *SyncQuant* dimensions) and asynchronous engagement (*AsyncEng*) (a weighted combination of the four variables, but largely represents the common variance of *AsyncQual* and *AsyncQuant*). The rotated factor scores are saved and the two factors *SyncEng* and *AsyncEng* are used in regressions to explore the relative impact of synchronous and asynchronous engagement on student performance (*FinalExam* and *TotalScore*) for the subject.

Hypothesis 1:

The first hypothesis proposed that a student’s total online participation would positively influence performance. Equations 1(a) and 1(b) below operationalise Hypothesis 1. The equations use the final examination score and the total course scores respectively as dependant variables. A pooled OLS regression was used to estimate the models.

$$FinalExam = \alpha_1 + \alpha_2 TotalQual + \alpha_3 TotalQuant + \epsilon \quad (1a)$$

$$TotalScore = \alpha_1 + \alpha_2 TotalQual + \alpha_3 TotalQuant + \epsilon \quad (1b)$$

In the null form, Hypothesis 1 is operationalised as: $\alpha_2 = \alpha_3 = 0$ for each equation. Table 4 presents the results of the regressions to test of this hypothesis. For the student’s final

examination score, the estimation results for equation 1(a) indicate a significant positive relationship between the quality of students' participation (*TotalQual*) and the final examination scores (*FinalExam*), and a significant negative relationship between the quantity of students' participation (*TotalQuant*) and their final examination scores (*FinalExam*). These results suggest that the higher the *quality* of students' participation in synchronous and asynchronous forums the higher the final exam score. On the other hand, the higher the *quantity* of students' participation, the lower the final exam score will be. This is unexpected and we will discuss this later.

Equation 1(b) tests the effects of *quality* and *quantity* of participation on a student's overall grade for the entire course (*TotalScore*), as opposed to just their final examination score. For *TotalScore*, the quantity (or number of times a student participated) is the only significant variable ($p=0.004$), but this time we find a positive effect. This suggests that the more a student participates in any course-based online setting, the higher the overall course grade.

INSERT TABLE 4 HERE

Hypothesis 2:

Hypothesis 2 proposed that quality and quantity of student participation in each online forum in isolation – synchronous and asynchronous – would impact positively on (a) the final examination and (b) overall course performance. However, as discussed earlier, the quality and quantity measures are highly correlated, hence we can only test hypothesis 2 in terms of total engagement via both the synchronous and asynchronous environments. Each equation is presented as two sub-equations (a) where the final examination score is the dependent variable and (b) where the overall grade for the course is the dependent variable.

$$FinalExam = \alpha_1 + \alpha_2 SyncEng + \alpha_3 AsyncEng + \varepsilon \quad (2a)$$

$$TotalScore = \alpha_1 + \alpha_2 SyncEng + \alpha_3 AsyncEng + \varepsilon \quad (2b)$$

In the null form, Hypotheses 2a and 2b are operationalised as: $\alpha_2 = \alpha_3 = 0$. Table 4 presents the relationships between engagement in the two forums and performance in the final examination and overall course. Equation 2a tests the hypothesis that the aggregate level of both synchronous and asynchronous forms of engagement, *SyncEng* and *AsyncEng*, explain the final exam performance. The results show synchronous engagement via the chat room is

significantly related to the final exam performance, *FinalExam*, at the 5% level. However, asynchronous engagement has a more marginal positive impact (significant at the 10% level) on exam performance. The results reported in Table 4 for equation 2b suggest that both synchronous and asynchronous engagement impact positively on the total performance score, *TotalScore*, for the subject. The chat room synchronous engagement has three times the impact on total course score relative to asynchronous engagement. This result suggests that chat room interaction is more important than discussion board engagement for performance in online subjects. The results underpin the general conclusion that the quality and quantity of both forms of engagement impact final exam and total course performance.

Hypothesis 3:

Hypothesis 3 posits a positive relationship between the quality of students' participation in online forums, *SyncQual* and *AsyncQual*, and their performance. This hypothesis is examined in two forms, one with the students' final examination scores, *FinalExam*, as the dependent variable and the other with the students' overall course grade, *TotalScore*, as the dependent variable. The equation for Hypothesis 3 is as follows:

$$FinalExam = \alpha_1 + \alpha_2 SyncQual + \alpha_3 AsyncQual + \epsilon \quad (3a)$$

$$TotalScore = \alpha_1 + \alpha_2 SyncQual + \alpha_3 AsyncQual + \epsilon \quad (3b)$$

In the null form, Hypothesis 3 is operationalised as: $\alpha_2 = \alpha_3 = 0$. Table 4 presents the results for equations 3a and 3b. The quality of students' participation in chat rooms (*SyncQual*) was positively related to both their final exam and overall course scores. The quality of students' participation in discussion boards (*AsyncQual*) was also positively related to their final examination and overall course performance scores. However, only the relationship with overall course performance, *TotalScore*, was significant at the $p \leq 0.05$ level ($p=0.029$).

Robustness Test

We conducted additional analyses of the total quantity of online interaction to test the robustness of the results. For one cohort of students ($n = 120$) we were able to capture the total number of interactions with the online site. For each student this measure, *TotalAccess*, includes the quantity of interaction with the two forums (synchronous and asynchronous) plus all other interaction with the online course materials and information. Our proposition is that total access to the online course would positively impact performance (Perera and Richardson

2010). However, given the earlier results we would also expect that if synchronous and asynchronous online activities do impact performance, then they should provide additional explanatory power above the *TotalAccess* measure. This is because the *TotalAccess* measure, by definition, will include higher learning activities, as well as routine and administrative type tasks, such as checking the course outline, downloading lecture notes, reading assessment instructions and uploading assignments.

Due to the overlap in the measures identified earlier, we first conducted a PCA of the *TotalAccess* measure along with the four quality and quantity measures (for synchronous and asynchronous engagement) for the reduced dataset of 120 students. The principal components matrix is reported in Table 5. The variables loaded on three distinct factors which accounted for 96.7% of the total variance. The KMO measure of sampling adequacy was greater than 0.5 and Bartlett's test of sphericity was significant at $p < 0.01$ level, indicating that the model is appropriate for PCA. To differentiate the robustness analysis from the main analysis, we label the engagement factors *SyncEng2*, *AsynEng2*, and *CourseEng*. The first two factors are similar to the prior analysis and capture synchronous and asynchronous engagement (i.e. combined *quality* and *quantity*). The third factor captures the unique aspects of total course engagement that are distinct from the engagement via the synchronous and asynchronous forums.

INSERT TABLE 5 HERE

To test the robustness of the results we estimated two new equations where the three engagement factors are regressed on the two performance measures, final examination scores and the students' overall course grade, as per equations 4a and 4b below.

$$FinalExam = \alpha_1 + \alpha_2 SyncEng2 + \alpha_3 AsynEng2 + \alpha_4 CourseEng + \varepsilon \quad (4a)$$

$$TotalScore = \alpha_1 + \alpha_2 SyncEng2 + \alpha_3 AsynEng2 + \alpha_4 CourseEng + \varepsilon \quad (4b)$$

The OLS estimation of equations 4a and 4b are reported in Table 6. The results show that students' total engagement in the online course, *CourseEng*, positively impacts both the final exam and total course grade. We also find that synchronous engagement, *SyncEng2*, has additional explanatory power for both the final exam and total course performance,

significant at 5% level or better. Asynchronous engagement has a marginal positive performance impact, significant at the 10% level. The pattern of results for engagement in the two forums is consistent with the earlier analysis reported in Table 4. We conclude that while all forms of engagement in the online course positively impact performance, synchronous engagement appears to be more important especially with respect to final exam performance when higher levels of learning are tested.

INSERT TABLE 6 HERE

DISCUSSION

The results support the use of online forums as learning tools in distance education programs. We find the *quality* of students' participation in online forums is positively related to final exam performance. This is consistent for the aggregated "pooled" test of synchronous (chat room) and asynchronous (discussion board) forums (Hypothesis 1a), as well as each type of forum engagement on its own (Hypothesis 2a). These results suggest students' exam performance can be enhanced through engagement in online forums. Thus, for online educational programs, students should be encouraged to attend chat sessions or other synchronous learner-to-instructor forums. Further, students should monitor what others write in online forums and be motivated to ask meaningful questions and provide insightful comments. Our recommendation makes intuitive sense because the instructor leads the chat rooms and motivates the students by posing a series of questions and comments that could be indicative of what will be asked of students on the final examination. In most classroom environments (virtual included), the instructor not only leads the discussions, but also creates the examinations. This suggested focus on the chat room is strengthened by the outcome of Hypothesis 3a. In that analysis, the quality of chat room participation is significantly related to performance, and yet the quality of discussion board participation is not. Many of the threads in discussion boards are composed of learner-to-learner communications. While each topic had a discussion board, it was difficult for students to develop in-depth interaction because a discussion may move to another issue before the student learning processes are complete. Additionally, the discussion board is not restricted to issues raised by the instructor, but rather is open to issues raised by any student, regardless of how closely the topic may be related to the course content.

Students' overall course grades (comprising 40% final examination, 25% group project, a 15% individual paper and review quizzes worth 20%) was positively related to the students' total *quantity* of participation (Hypothesis 1b). This finding was supported by Hypothesis 2b, which shows engagement in synchronous and asynchronous forums is positively related to overall course grade. This finding suggests that students are able to effectively ask questions and understand responses about not only course-based content, but also application of course materials to all of the assigned components of the course. Although chat room discussions are primarily focused on content-related topics, the discussion board (and to some extent the early and latter parts of each chat room interaction) has questions about the individual paper, group projects, and other student-generated topics and application. Additionally, in terms of overall course grades, we found that the *quality* of students' chat room discussions, and to a lesser extent the *quality* of discussion board contributions, were positively related to performance (Hypothesis 3b).

For asynchronous discussion boards, it comes as no surprise to us that the quality of students' discussion board participation was not related to final examination performance (Hypothesis 3a). When reviewing the students' comments and questions, we noted that there were a large number of comments and questions about issues other than those related to the specific conversation the instructor initiated. There were the occasional high-level quality questions raised; however, these tended to be about issues stemming from group project applications or individual student work situations (i.e., not examination related). It may be that the students who were the most engaged in high quality discussion forum conversations were heavily focused on group project-oriented coursework rather than final examination conceptualization and application.

Interestingly, we did not see the expected positive relationship between total *quantity* of forum participation and final examination performance (Hypothesis 1a). In unreported analysis we regressed total quantity (*TotalQuant*) against final exam score and found no significant relationship. If the negative coefficient in column 1a of Table 4 is not a spurious result then our best explanation would stem from our anecdotal evidence that there is a percentage of students who ask a large number of basic-level knowledge-based questions throughout the course of the semester. These forum interactions may not assist with an exam that focuses on critical thinking rather than declarative knowledge. A possible solution is the use of a 'Frequently Asked Question' page that addresses knowledge-based questions leading

to a more effective role for forums. Our robustness analysis does, however, show that higher total online course engagement positively impacts exam and overall course performance.

In aggregate the results suggest that synchronous engagement has a larger positive impact on student performance relative to asynchronous engagement. It would be easy to conclude from this that it is more important to build synchronous forums into online courses. However, we note that student engagement in discussion boards (asynchronous forum) has a positive impact on both final examination performance (Hypothesis 2a) and overall course grades (Hypothesis 2b). A similar pattern was observed with the robustness test for synchronous versus asynchronous engagement while controlling for total online course access. We therefore argue that asynchronous forums also have a useful role in student learning. In addition to this evidence, there are two other reasons why the role of asynchronous forums should not be discounted. First, it would appear that students are comfortable asking each other for help with topics across the range of assessment tasks. Some discussion threads start with basic concepts then progress to more advanced application, synthesis, and evaluation, while other strands focus solely on basic concepts for the assessment task at hand. Second, because asynchronous online environments are available for students 24 hours a day, 7 days per week, they are an asset to student learning across a wide range of assessment tasks. Random sampling indicates that students across all time zones contribute to the discussion board at any time during the day or night. This ease of access, providing students with time to think and respond to points, may drive the positive asynchronous engagement-performance relationship for the total course grade, where non-exam assessment clarification is often via learner-to-learner discussion.

These results should be considered in light of a potential endogeneity issue in that weaker students ask more questions (higher *quantity* of engagement) but may still perform poorly due to the low *quality* interaction. This suggests that a potential driver of participation quality is the student's underlying intellectual capacity. Unfortunately, data constraints do not allow us to introduce such a control. However, the robustness analysis, which combines into an index the quality and quantity measures for synchronous and asynchronous engagement while controlling for total online engagement, finds that both forms of engagement positively impact performance. This suggests that the overall tenor of the results are supported and not simply an artefact of intelligence or confounding endogeneity issues.

CONCLUSION

Student participation in online forums is the important driver of performance in an online learning environment. This is one of a small handful of studies that support a positive relationship between the quantity of participation and performance, particularly in terms of discussion boards. This finding suggests that faculty need not only be concerned with encouraging students to contribute at higher and higher cognitive levels, but also be encouraging students to simply “join in” virtual discussions. Engagement itself may be a simple, yet effective, way of increasing students’ performance. To promote this, faculty members need to set clear performance expectations for their students. One way to encourage high quality contributions is to include a rubric of performance expectations. Conaway *et al.* (2005) provide a template for this type of rubric; they define an unsatisfactory contribution as a “limited response that only touches the surface of the answer... does not build the usefulness of the discussion”, a satisfactory response as one that “completes the assignment as required by responding with a useful answer or comment in a timely manner” and an outstanding response as one that “completes assignment by posting insightful ideas that are fully developed and demonstrate a genuine understanding of the topic...comments often extend the discussion and offer unique opportunities to apply the material” (Conaway *et al.* 2005). They suggest presenting this rubric to students in the syllabus to set the tone for expectations of high level questioning, reflecting and communicating in online courses. Finally, the results suggest a three-tier structure for online learning environments: (1) a ‘Frequently Asked Questions’ page that deals with basic declarative knowledge issues; (2) asynchronous discussion boards that promote application and analysis and allow learner-to-learner discussion and support; and (3) synchronous learner-to-instructor forums to focus on higher level learning.

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TABLE 1
Descriptive Statistics

Variable	Definition	Minimum	Maximum	Mean	Std. Deviation
<i>FinalExam</i>	<i>Score for the final examination.</i>	0	98.5	45.7	25.88
<i>TotalScore</i>	<i>Total score for the whole course.</i>	1	98	65.3	19.56
<i>TotalQual</i>	<i>Combined score of the quality ratings assigned to each individual student's statements (i.e., questions or comments) from both the chat room sessions and discussion boards.</i>	0	105.03	4.93	9.88
<i>TotalQuant</i>	<i>Total number of times the student participated in a either the chat room sessions or discussion boards.</i>	0	69.00	3.93	7.07
<i>SyncQual</i>	<i>Sum of the quality ratings for each student's participation (i.e., comments or questions) across all of the chat room sessions.</i>	0	40	3.71	6.51
<i>SyncQuant</i>	<i>Aggregate number of times a student made a comment, posed a question or raised an issue in any of the chat rooms.</i>	0	38	3.11	5.62
<i>AsyncQual</i>	<i>Sum of the quality ratings for each student's participation (i.e., comments or questions) across all of the discussion board strands.</i>	0	97	1.22	6.54
<i>AsyncQuant</i>	<i>Aggregate number of times a student participated in an online discussion board stream (unlimited maximum number possible).</i>	0	31	.81	2.85

n=272 for each variable

TABLE 2
Correlation Matrix

	<i>FinalExam</i>	<i>TotalScore</i>	<i>TotalQual</i>	<i>TotalQuant</i>	<i>SyncQual</i>	<i>SyncQuant</i>	<i>AsyncQual</i>
<i>FinalExam</i>	1						
<i>TotalScore</i>	.674***	1					
<i>TotalQual</i>	.218***	.291***	1				
<i>TotalQuant</i>	.087	.325***	.770***	1			
<i>SyncQual</i>	.260***	.290***	.756***	.519***	1		
<i>SyncQuant</i>	.024	.306***	.591***	.925***	.512***	1	
<i>AsyncQual</i>	.070	.151**	.758***	.648***	.146**	.384***	1
<i>AsyncQuant</i>	.170**	.203**	.747***	.660***	.278***	.324***	.851***

*** Correlation significantly different to zero at the 1% level

** Correlation significantly different to zero at the 5% level

n=272 for all cells.

TABLE 3
Two Factor Rotated Component Matrix

	<i>SyncEng</i>	<i>AsyncEng</i>
<i>SyncQual</i>	0.898	0.040
<i>SyncQuant</i>	0.809	0.275
<i>AsyncQual</i>	0.127	0.960
<i>AsyncQuant</i>	0.190	0.933

n = 272, Variance Explained = 84.59%

TABLE 4
Participation and Performance

Equation	1a	1b	2a	2b	3a	3b
Performance Measure	<i>FinalExam</i>	<i>TotalScore</i>	<i>FinalExam</i>	<i>TotalScore</i>	<i>FinalExam</i>	<i>TotalScore</i>
<i>Intercept</i>	43.755 (0.000)	61.638 (0.000)	45.696 (0.000)	65.307 (0.000)	41.771 (0.000)	61.849 (0.000)
<i>TotalQual</i>	0.969 (0.000)	0.200 (0.132)				
<i>TotalQuant</i>	-0.723 (0.017)	0.683 (0.004)				
<i>SyncEng</i>			4.252 (0.004)	6.349 (0.000)		
<i>AsyncEng</i>			2.098 (0.088)	2.607 (0.010)		
<i>SyncQual</i>					1.014 (0.000)	0.822 (0.000)
<i>AsyncQual</i>					0.130 (0.291)	0.333 (0.029)
Tolerance	0.407	0.407	1.00	1.00	0.979	0.979
Adj R ²	0.056	0.103	0.026	0.117	0.062	0.090
F	9.096	16.58	4.673	18.888	9.922	14.322
p>F	(0.000)	(0.000)	(0.010)	(0.000)	(0.000)	(0.000)

Parameter coefficients with one-tailed p values in parentheses.

Each equation is a pooled regression for n=272 cases.

SyncEng = Rotated Principle Component representing total Synchronous engagement (see Table 3)

AsyncEng = Rotated Principle Component representing total Asynchronous engagement (see Table 3)

See Table 1 for variable definitions

TABLE 5
Three Factor Rotated Component Matrix

	<i>SyncEng2</i>	<i>AsyncEng2</i>	<i>CourseEng</i>
<i>SyncQual</i>	0.948	0.159	-0.049
<i>SyncQuant</i>	0.941	0.105	0.167
<i>AsyncQual</i>	0.139	0.987	0.038
<i>AsyncQuant</i>	0.132	0.986	0.072
<i>TotalAccess</i>	0.072	0.071	0.993

n = 120, Variance Explained = 96.7%

TABLE 6
Robustness Analysis Total Course Access and Performance

Equation	4a	4b
Performance Measure	<i>FinalExam</i>	<i>TotalScore</i>
<i>Intercept</i>	59.150 (0.000)	65.475 (0.000)
<i>SyncEng2</i>	3.820 (0.036)	2.794 (0.026)
<i>AsyncEng2</i>	3.014 (0.079)	2.288 (0.051)
<i>CourseEng</i>	7.365 (0.000)	5.151 (0.000)
Tolerance	1.00	1.00
Adj R ²	0.108	0.124
F	5.806	6.589
p>F	(0.001)	(0.000)

Parameter coefficients with one-tailed p values in parentheses. n=120 cases.

SyncEng2 = Rotated Principle Component Synchronous engagement (see Table 5)

AsyncEng2 = Rotated Principle Component Asynchronous engagement (see Table 5)

CourseEng = Rotated Principle Component Course engagement (see Table 5)

ENDNOTES

ⁱ This review, discussed in Arbaugh (2005a), included management education publications such as *Journal of Management Education*, *Management Learning*, *Journal of Education for Business* and *Business Communication Quarterly*.

ⁱⁱ See Brower's (2003) paper for a thorough description of the rationale behind her use of asynchronous discussion boards in an online executive MBA OB/HR course.

ⁱⁱⁱ The scree test is the accepted method for determining the number of factors to extract. The scree test involves graphing the eigen values and looking for where a 'scree' forms which is the natural bend or break point in the data where the curve flattens out (Costello and Osborne 2005; Rummel 1970).