Achieving better peer interaction in online discussion forums: A reflective practitioner case study

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This paper documents the initial phase of a research project to improve peer interaction in a discussion forum for a Spatial Sciences class (unit) at Curtin University. A number of strategies were implemented to redress the low levels of online participation prevailing for a number of years. Three research questions were formulated to evaluate the effectiveness of teaching and learning initiatives. The analysed statistical data for this unit obtained from Blackboard revealed positive correlations between students' results and their participation in the discussions forum, which was supported by students' comments on the forum. The statistical measures used offered a way of ensuring a more objective evaluation of the effectiveness of the changes, with evidence of promising improvements in participation levels. The initiatives of offering incentives to participate in the discussion forum and creating a positive community environment appear to have marginally increased levels of achievement.

Introduction

Whether classes are delivered face-to-face or online, or a combination of both, the challenge is to facilitate the most effective learning experience by way of quality student interaction and engagement (e.g., Song & McNary, 2011). The aim of this paper is to test strategies used to improve peer interaction in online discussion forums aimed at encouraging participation and collaborative learning. The specific motivation came from the need to improve peer interaction in the discussion forum for Geographic Data Analysis units at Curtin University in Australia. Accordingly, three research questions were developed to evaluate the effectiveness of peer online engagement, and some positive results emerging from this study are outlined later in the paper.

Literature

The rationale for a more detailed review of the literature rather than a brief overview was to ensure critical reflection informed the changes made to improve the level and quality of peer interaction for online learners in these units.

The value of e-learning

With the rapid development of online learning in higher education, there has been a great increase in the literature exploring ways to ensure this form of learning is interactive and effective. Research has addressed the broader issues of educational psychology and motivation, and effective pedagogical practice. More specifically, this case study takes the lead from how discipline-specific studies have productively used discussion forums to enable active engagement and peer learning among students; for instance, in Medicine

(Makoul, Zick, Aakhus, Neely & Roemer, 2010), Nursing (Roehm & Bonnel, 2009), and Information Management (Hou, 2011), to name a few.

There is broad consensus that e-learning initiatives make a valuable contribution to the overall teaching and learning options available to educators; however, whatever the mode of delivery, thought needs to be given to the relationship between course design and student interaction (Song & McNary, 2011). Embedding e-learning effectively continues to be a challenge, and it is clear that "… much remains to be learnt about how technology can best be used to enhance student learning" (Winter, Cotton, Gavin & Yorke, 2010).

The advantages of online learning for students, including the greater flexibility, autonomy, and control over the time they have to think, reflect and respond (Swan, 2004; Wu, 2003), ironically, also result in attendant challenges in terms of managing the higher level of focus, self-motivation, independence, and initiative (Serwatka, 2003; Smart & Cappel, 2006) required for this form of study. The likelihood remains high that students will find the online learning experience impersonal, disconnected and confusing. The same, of course, can be said about the advantages and disadvantages of traditional classroom teaching, so the critical issue is carefully planned teaching and learning design and practice to create environments where possible disadvantages are identified and actively addressed (Parisio, 2011). This is reflected in the focus in the literature on facilitating active engagement and instructor-student and peer-to-peer knowledge sharing, and fostering the connectedness that comes from being part of a community of inquiry, something Chan and Chan (2011) refer to as "computer-supported collaborative learning" or CSCL.

The importance of knowledge sharing among students is also underscored by Ma and Yuen (2011), who point out that student connection and social relationships are the main ingredients in effectively exchanging ideas and developing an understanding of key concepts and issues among learners. Expecting this to occur spontaneously is a major pitfall; some kind of careful and creative instructor orchestration is vital to creating a quality environment of trust, risk-taking and respectful critical dialogue.

Discussion forums

Discussion forums are one of the key ways of promoting peer interaction and collaborative learning in this form of education. Miyazoe and Anderson (2010) suggest that constructivism and knowledge building, involving reflective and collaborative learning, and supported by scaffolding, are crucial for a quality online learning environment. A combination of the unit's educational design and the instructor's facilitation forms the basis of the learning environment, so a focused, present and proactive instructor is important to facilitating positive learning experiences. In this sense, the instructor models the kinds of communication principles, interaction protocols, and commitment to students that sets the ground for the teaching-learning contract.

The aim, however, is to promote even greater peer-to-peer interaction and less dependence on the instructor. As Scherer Bassani (2011) points out, there is a need to actively promote participation in discussion boards. At the same time, to counter the

danger of student isolation and disconnection in online learning, Rovai (2007) argues that courses need to be designed so that they provide motivation for students to engage in productive discussions. To ensure that this engagement is productive and effective, it is vital to clearly describe what is expected of students, perhaps in the form of a discussion rubric (Rovai, 2007). Expecting that students will be cognisant of the features of quality discussion, collaboration and critical reflection is a dangerous assumption to make.

Participation and quality engagement

Two key challenges are addressed in recent research into participation in discussion boards: first, ensuring participation in the forum; and second, ensuring quality discussion in the forum. Educators need to scaffold student motivation by being explicit about expectations and ground rules for online discussion forums, for this sets the framework for interaction, peer collaboration and dialogue. Accordingly, a number of researchers point out the need for higher order learning tasks that promote critical thinking (Richardson & Ice, 2010) and evaluation (Cheng, Paré, Collimore & Joordens, 2011) in discussion forum interaction. Hou (2011), in a mixed method study in a cohort of 32 Information Management students, found that role playing and problem-solving were effective strategies to ensure student interaction. Zydney, deNoyelles and Seo (2012) tested an online protocol with one cluster of tertiary students and more open questions with another cluster. Although they used a small convenience sample, their findings suggest this approach has the capacity to enhance dynamic interaction and provide richer learning experiences. Similarly, Gikandi, Morrow and Davis (2011) found formative feedback and authentic assessment are excellent ways to encourage quality participation and interaction that facilitates the sharing of knowledge and creates a community of inquiry. More recently, "flipped classrooms" are being promoted as an extension of blended learning initiatives, and this approach places "more of the responsibility for learning on the shoulders of students while giving them greater impetus to experiment" (Educause, 2012).

Managing expectations

Educators face a number of pressures in providing engaging and effective participation in an online environment. One crucial factor is that responses to student must be timely, for significant time lags in feedback from peers and instructors are a distinct disadvantage of asynchronous discussion forums (Dringus & Ellis, 2005). Kalman and Rafaeli (2005) and Niemi (2002) identify the frustration distance students expressed in their messages when they do not receive feedback on their postings within a reasonable time frame. There is little doubt that late responses have a negative effect on the vitality of discussion forums, and one outcome of this is that the participation rate is likely to drop due to such delays (Dringus & Ellis, 2010). At the same time, Mazzolini and Maddison (2007, p. 204) point out that the timing of instructor intervention is critical, for "coming in too early with comments tends to shut down discussion." The key is for the instructor to manage expectations, to be clear about reasonable response times, and to model effective and timely communication.

At the same time, however, the workload pressure faced by instructors in online discussion forums tends to be high. This expectation to provide timely feedback to students creates real dilemmas for lecturers as they juggle other pressing responsibilities and time demands. Because of the rigidity of online discussion tools, instructors need to check forums regularly and spend a great deal of time in responding to students' postings (Nandi, Hamilton, Chang & Balbo, 2012). The trap, then, is spending an inordinate amount of time on marginal tasks instead of focusing on the most vital teaching activities. Accordingly, encouraging peer-to-peer interaction in online discussion forums is one very constructive response to this dilemma (Balaji & Chakrabarti, 2010).

Motivating student engagement

A study by Cheng, Paré, Collimore and Joordens (2011) involving over 1000 psychology students found evidence for the value of peer interaction in building a quality discussion forum learning experience. Cheng et al. found students who voluntarily engage in online discussion forums achieve better examination results than those who do not. Although the examination results were only marginally superior, the results suggest benefits if students do in fact engage. Those students who do not participate in a blended learning environment may be missing out on the opportunity for quality interaction with their peers.

Establishing an environment in which the students are proactive and independent learners in the collaborative sense (see Chan & Chan 2011, above) is crucial for avoiding the dependency and passivity that may characterise more instructor-focused forums. Hew and Cheung's (2008) work demonstrates the value of structuring in student facilitation of peer interaction to achieve higher levels of participation. They point out that most studies have been conducted on the lecturer's or instructor's role in facilitating participation, and not on student-directed involvement. A more student-focused approach to enriching participation involves scaffolding motivation, so offering more extrinsic incentives may be a necessary part of the process.

In summary, the literature suggests that online learners, in particular, face challenges such as lack of contact with peers, limited sense of belonging to the learning community, and frustration about receiving delayed feedback to postings. Lecturers or instructors with existing heavy workloads face the added pressure of more actively engaging students through discussion forums. It is clear, however, that there are constructive strategies being used to develop better discussion forums and improve levels of participation in these forums (Persell, 2004; Prestera & Moller, 2001; Rovai, 2007; Tate & Strickland, 2008; Tulbure, 2011). One such strategy is offering more extrinsic incentives (Hew & Cheung, 2008). Further, the indication is that voluntarily engaging in online discussion forums has positive examination results for students (Cheng, Paré, Collimore, & Joordens, 2011).

Research questions

Three research questions were formulated to evaluate the effectiveness of the teaching and learning strategies that were deployed on the basis of the above critical review of the literature.

1. Is there a relationship between the frequency of students' postings on the Blackboard forum and their final marks?

Learning is now increasingly seen to be embedded into social interaction (Khoshneshin, 2011), and participation in discussion forums can promote active learning and collaborative problem-solving skills to achieve better results. By asking and responding to questions, reflecting on thoughts from peers or instructors, showing initiative and being responsible for their own and others' learning, students become central to the education process (Khoshneshin, 2011). Consequently, students' final marks for one of the major assessment pieces in this unit could be improved through participation in the Blackboard forum, as measured by the number of postings on the Blackboard forum.

2. Is there a relationship between the role students played in the discussion forum and their final marks?

Frequency of posting captures student participation levels quantitatively. However, the quality of postings, defined in this study as the role students played in the discussion forum, could also affect their final marks. Identifying the roles played offers a better picture of the nature of student interaction in discussion forums. According to Persell (2004), the roles played by instructors and students can be categorised in this way:

Student roles
- Starters: questioning, raising issues, reflecting on teaching materials
- Responders: answering questions, posting new questions
- Facilitators: tutoring, introducing new learning sources, administrating

Instructor roles
- Host: creating and managing the discussion forum
- Connector: connecting different threads, sources, students for synthesising purpose
- Mirror: reflecting students' thoughts and raising questions.
- Technical supporter: technically supporting students to use online tools and resources
- Evaluator: assessing students' performance in discussion forum

3. Is there a relationship between response time lag and student engagement on the discussion board?

The time lag in receiving feedback from peers and instructors is one of the disadvantages of asynchronous discussion forums (Dringus & Ellis, 2005). Kalman and Rafaeli (2005) identify the frustration experienced by distance students, as expressed in their messages when they do not receive feedback for their postings within a reasonable time period. Late

responses can have a negative effect on the vitality of a discussion forum. Participation rates may drop due to the lack of a response or a delay in the response time (Gikandi et al., 2011). This research question investigates how student engagement in discussion boards is influenced by the response time lag of peers and instructors.

Method

Context

Students enrolled in the Geographic Data Analysis (GDA) unit participated in this research. Aa an introductory unit to Spatial Analysis, it aims to provide students with the ability to understand, manipulate, and analyse geographic data and information for a range of applications.

A brief outline of this double-badged unit (it is available at undergraduate and postgraduate levels), and the students enrolled, gives a clearer picture of the context for this study. The units were taught by the first-named researcher (Xia).

- *GDA 181* is a first year unit in the Bachelor of Surveying and Bachelor of Science (Geographic Information Science). Thirty-eight students in this course were studying in on-campus mode and the other three were in distance education mode. Some were international onshore students with the remainder being domestic students.
- *GDA 581* is a postgraduate version of the unit for students without undergraduate GIS qualifications. The students were undertaking certificate, diploma or master degree courses in the Department of Spatial Sciences. Of the 42 students, 30 in this unit were studying in a distance education mode.

These classes consist of a mixture of face-to-face instruction and online content, tutorials and assessment with a total of eighty five students. Students enrolled offshore, in different states, or in rural areas of Western Australia were unable to attend on-campus lectures and tutorials so, instead, had access to online lectures recorded by screen capture tools and simulated fieldwork, and online tutorials. Not having the same opportunities as their campus-based counterparts for peer engagement via assistance with problem solving and feedback on tutorials, the online discussion forum provided a platform for them to interact with each other. This forum enabled them to seek out timely feedback from instructors and peers, and in many instances to provide it for others.

Teaching strategies

The lecturer teaching these units faced the problem of how to go about increasing discussion forum usage – for both classroom and off-campus students – in this blended learning environment. The strategies adopted included the following:

- bonus points in the final mark based on the frequency and quality of the participation;
- reaction posting (Tate & Strickland, 2008; Rovai 2007);

- role playing (i.e., starters, responders, facilitators);

developing a learning community by using controversy, humour, personal experience, and positive feedback;

- managing students' expectations of question responding times at the beginning, and keeping the promise (Prestera & Moller, 2001; Tulbure, 2011); and,
- brief training on self-discipline and time management skills (Kalman & Rafaeli, 2005; Prestera & Moller, 2001; Roehm & Bonnel 2009).

Participants

Out of the 85 students enrolled in the *Geographic Data Analysis* (GDA) unit, a relatively small sample of 30 students participated in the discussion forums.

Data collection and data analysis methods

Statistical data drawn from the online learning management system, Blackboard, was derived from the normal teaching process. This information includes: the name; student number; marks, including quizzes, exams and two assignments; and the content, time, and posting threads. Aggregated and de-identified data sources were used for this study, assuring anonymity and confidentiality.

To examine these questions from a more objective standpoint, descriptive statistical methods were adopted to test the statistical association between these relationships. Data (discussion postings and final results) obtained from the Blackboard site were analysed using the SPSS software. The data was categorised into groups in order to determine students' roles and level of participation in the discussion forums, as well as their final results for the unit. To assist with the exploration of these relationships, and to determine the degree of relation between the variables examined in this study (Kiess, 1996), Pearson Correlation Coefficient procedures were carried out in order to explore the relationship between students' frequency of postings, the roles they played in the discussion forum and their final results. The results of this process are reported in the following section.

Results

Question 1: Is there a relationship between the frequency of students' postings and their final marks?

A Pearson product-moment correlation was computed to determine the relationship between the students' number of postings and their final results for the unit. As indicated in Table 1, there was a positive, small to medium correlation between postings and results, which was mildly statistically significant ($r = .315$, $n = 85$, $p < .003$).

Table 1: Pearson Correlation Table: Students' frequency of postings and their results

		Results	Number of postings
Results	Pearson Correlation	1	.315**
	Sig. (2-tailed)		.003
	N	85	85
Number of postings	Pearson Correlation	.315**	1
	Sig. (2-tailed)	.003	
	N	85	85

** Correlation is significant at the 0.01 level (2-tailed).

The graph in Figure 1 displays the participants' (n=85) number of postings in relation to their final marks (results). Visually, this graph shows a positive, though small to medium, correlation between the students' posting frequency and their marks.

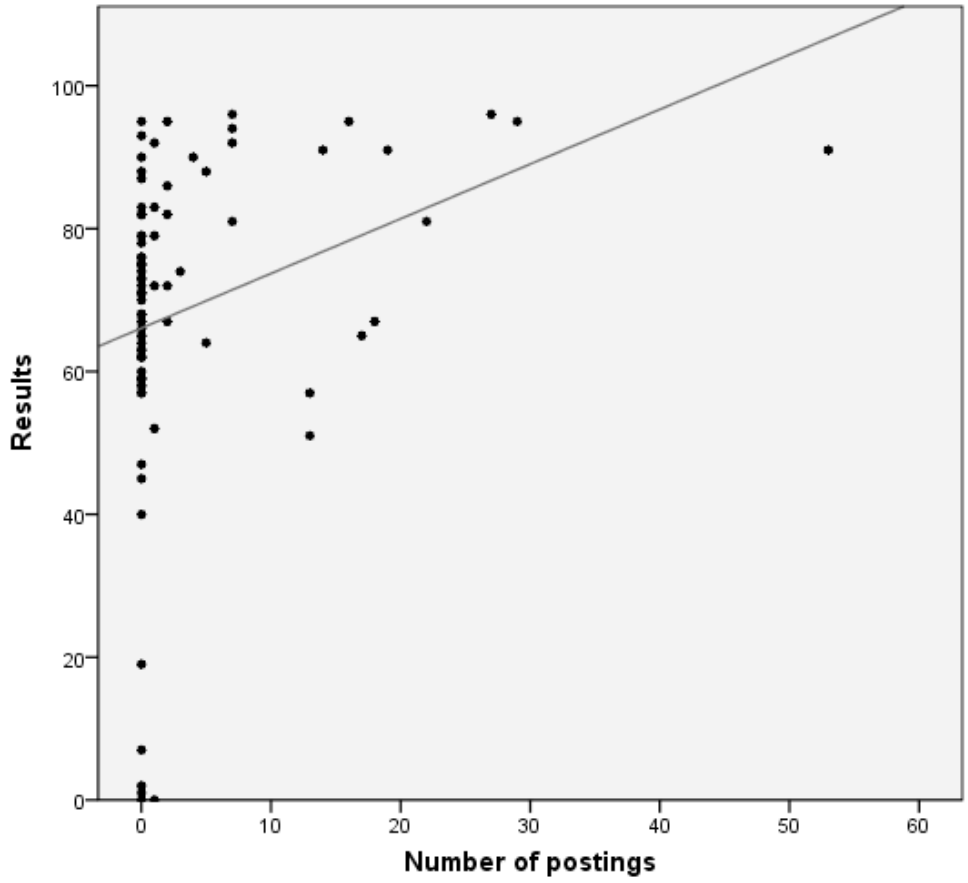
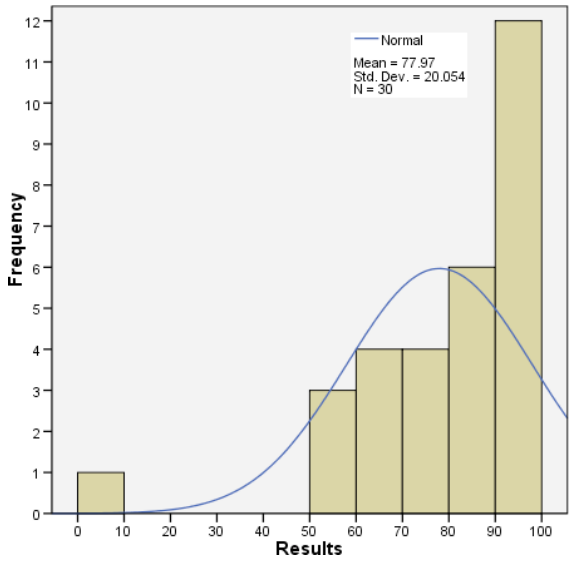
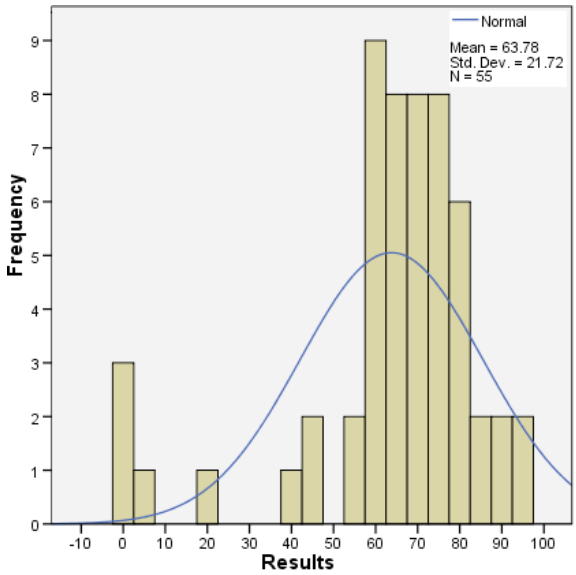


Figure 1: Scatterplot: Relationship between students' frequency of postings and their results

Figure 2 shows the normal distribution graph of students' results (mean = 78%) for those participated in the discussion board for this unit and the normal distribution graph of results (mean = 64%) for those who did not. While there may have been other variables that may account for this difference of means, further investigation is reasonably well justified.



Students' final results who did participate



Students' final results who did not participate

Figure 2: Histogram graphs: Final results of students who did and did not participate in the forum

Question 2: Is there a relationship between the role students played in the discussion board and their final marks?

Table 2 shows the calculated Pearson product-moment correlation for determining the relationship between the students' discussion role and their final results. There was a positive, moderate correlation between roles and results, which was moderately statistically significant ($r = .395$, $n = 85$, $p < .001$).

Table 2: Pearson Correlation Table: Students' discussion board role and their results

		Unit results	Number of postings
Unit results	Pearson correlation	1	.393**
	Sig. (2-tailed)		.001
	N	85	85
Roles	Pearson correlation	.393**	1
	Sig. (2-tailed)	.003	
	N	85	85

** Correlation is significant at the 0.01 level (2-tailed).

The box plot displayed in Figure 3 (n=84) shows the maximum/minimum, the mean, and the upper/lower quartile of the students' results in relation to the roles they played in the

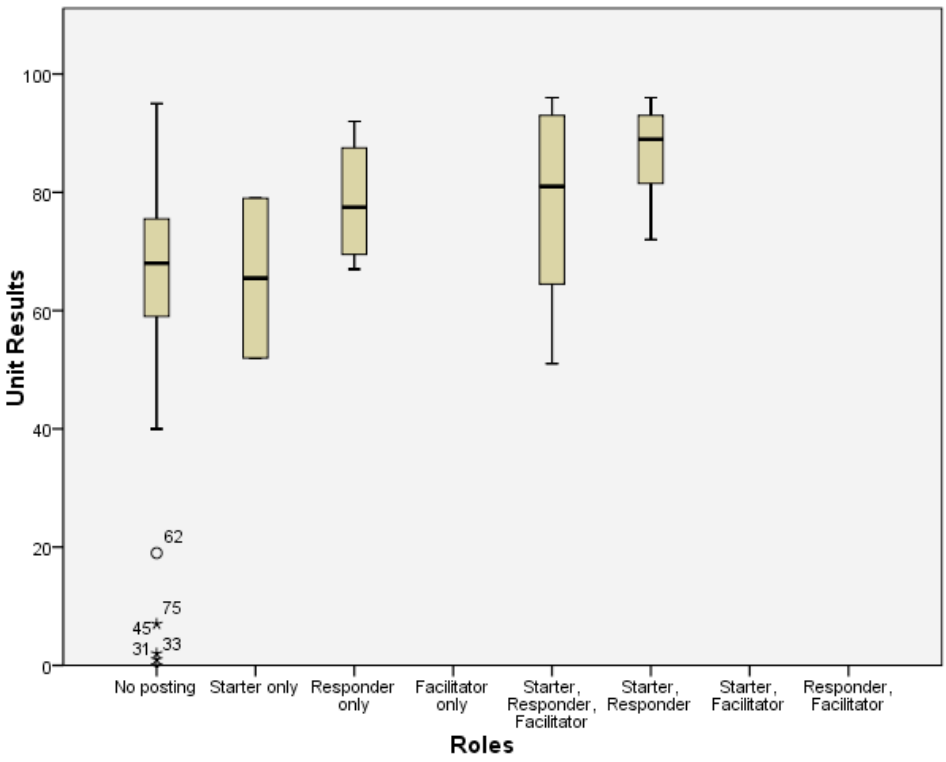


Figure 3: Box plot: Student's roles in the discussion board and their final marks

discussion board. The Starter Only student who achieved 0 for the final mark (this person did not complete the unit) was omitted in order to provide a more balanced representation of the mean results. Some students were Starters Only and others were Responders Only. There were no Facilitators Only. While some other students carried out all three roles (Starters, Responders and Facilitators), others were Starters and Responders Only. There were no Starters/Facilitators Only and no Responders/Facilitators Only.

Figure 3 shows the majority of students who played a role or multiple roles in this discussion board achieved a final mark of above 60% for this unit. However, a rather high proportion of students who did not participate in the discussion board also achieved high results.

Question 3: Is there a relationship between response time lag and student engagement on the discussion board?

The lecturers' response time to students' postings was assessed. From the first discussion posting to the last, the discussions for this unit occurred over a period of exactly 100 days. Figure 4 shows the frequency of postings during this timeframe and when the assessment items were due.

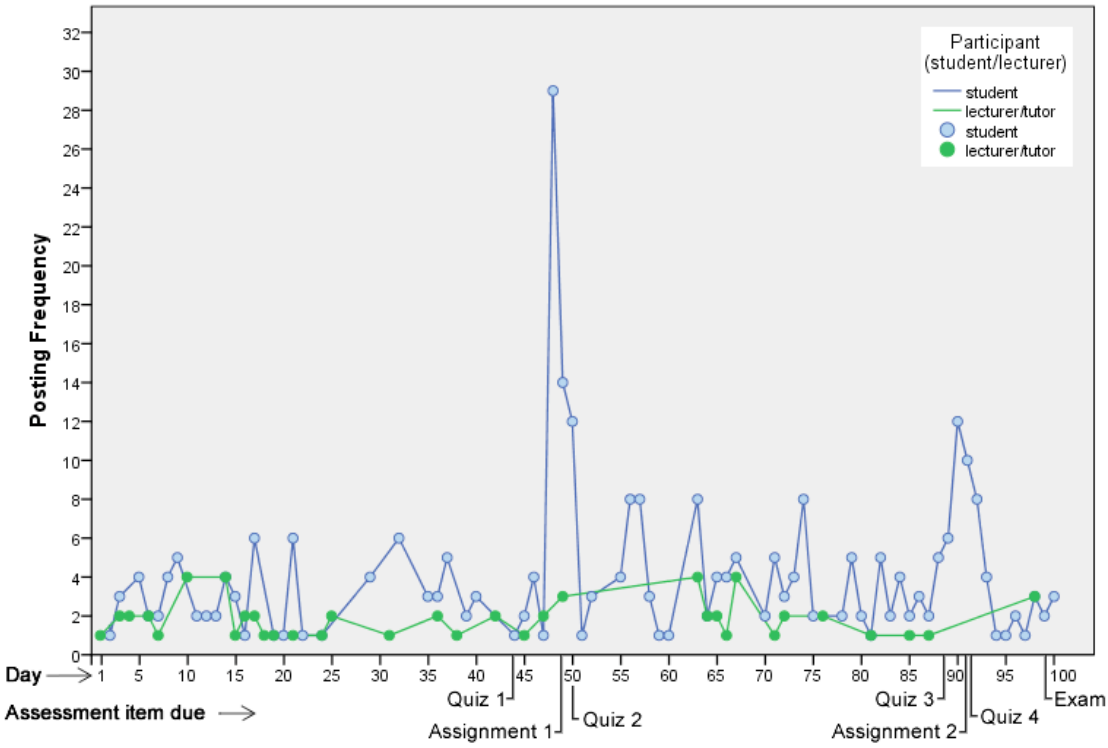


Figure 4: Line graph: Students' and lecturers' frequency of posting and due days for assessment items

Unsurprisingly, the discussion activity for students increased around the days when assessment items were due. Discussion on these days generally centred on questions regarding the assignment requirements. When the first group of assessment items (Assignment 1 and Quizzes 1 and 2) were due (around day 43), there was a sharp spike in the number of student discussion postings. Between the first group and second group of due assessment items (Assignment 2 and Quizzes 3 and 4), there was regular discussion activity due to the ongoing desire of students to understand the second group of assessments. There was then another sharp spike of discussion activity when the second group of assessment items was due (around day 90).

Figure 4 also reveals that there were some notable time lags between the students making postings (particularly around the time when assessment items were due) and the lecturers' responses. The lecturers were most active with responding to students during three noticeable periods (around days 12, 66 and 97). The first period (around day 12) occurred after students posted an introduction at the commencement of the unit (around day 5); here, the lecturers were acknowledging the students' postings. The second period (around day 66), the lecturers responded to students' questions and discussions regarding the first group of assessment items (around day 43). The third period (around day 97), the lecturers responded to students' questions and discussions regarding the second group of assessments (around day 90).

Discussion

The results outlined above show that there were several students who did not participate in the online discussions, but who still attained high final results. The calculated findings, however, indicate that there is a mild relationship between the participants' results and their level of participation on the discussion board, as well as a moderate relationship between the participants' results and the roles they played in the discussion forum. An overall review of the relationship between these students' final marks and their posting frequency confirms, however, that students are able to derive benefits from participating in the discussion forum (Balaji & Chakrabarti, 2010). The average final mark of students participating in the discussion forum is marginally higher than that of non-participating students (Chan & Chan, 2011; Cheng et al., 2011). Furthermore, students' participation levels in the discussion forum were found to be associated with their final marks. Students who functioned as Starters were found to be primarily passive learners. These students asked questions without responding to the answers to their questions provided by other students or lecturers. In this sense, there is little evidence of critical thinking, possibly indicating a passive acceptance on their part. Their marks were found to be relatively low in comparison to students more actively engaged in the forum. Conversely, students who functioned as both Starters and Responders were found to perform better by being actively involved in learning and interaction with peers and lecturers, something also confirmed by Niemi (2002).

Further investigation, therefore, is warranted to determine the practical significance of these results. In a follow-up study, it would be interesting to investigate issues such as: whether those students who participated in the discussion board believed that their

engagement helped them to pass the unit or to obtain higher results; why so many students did not participate; students' perceptions of the overall usefulness of the discussion forum; and, the value of their lecturers' postings.

The issue of time lag also warrants further investigation. While lecturer workload issues may predominantly account for the time lag, the lag (averaging 12 days for the three periods) was observed by the lecturers to be beneficial to the students' active learning as it allowed them time to help each other with the assessment items. This allowed the lecturers to act more as facilitators, while students worked on resolving problems/questions relating to the assessment items amongst themselves.

Regardless of these three noticeable spikes, the lecturers did maintain a reasonably constant level of posting frequency through the duration of this unit, as shown in Figure 4. The lecturers reported to have spent on average 30 to 60 minutes per day reading and responding to students' discussion board postings. While an online lecturer's role is important to maintaining ongoing discussions, determining the timing of responses to student questions appears to be very important in to facilitating an active learning environment (Mazzolini & Maddison, 2007; Rovai, 2007). Jumping in too soon to answer students' questions could possibly inhibit other students from putting forward possible solutions to their class members' questions (Mazzolini & Maddison, 2007). Issues surrounding the lecturers' role, the time lag, as well as the implications this has for an online lecturer's workload, are worthy of further investigation (Nandi, Hamilton, Chang & Balbo, 2012).

The major role of the lecturer is that of technical supporter. This role started from the second week of the semester until the last week. As the host of Blackboard, the lecturer asked students to introduce themselves and express their need for these two units, to acknowledge the students' involvement, and to provide feedback on students' posts (including links between students' needs and unit content and future action to meet students' needs). The students responded positively, especially distance students. The results suggest that once students were attracted into the Blackboard discussion, the lecturer acted in a connector role - to link students together, to encourage them to help each other, and to provide feedback on their questions and responses.

The key challenge in a blended mode learning environment is attempting to engage internal students as well as off-campus students in a productive online discussion board environment that enables collaborative learning (Khoshneshin, 2011; Miyazoe & Anderson, 2010; Scherer Bassani, 2011). The incentive strategy used by the lecturer enabled students to secure bonus points in their final mark if they demonstrated they offered voluntary help to other students or were actively involved in the Blackboard discussion forum (Tate & Strickland, 2008; Rovai 2007).

Phase two of the project plans to more systematically examine the quality of the online experience by incorporating students' assessment of involvement in discussion forums. A closer examination of the depth and quality of learning for students engaging in discussions forums, as well as the roles played by the lecturer, will build upon the findings

of this study and maintain a focus on ongoing improvement. It is well-recognised that it is primarily assessment that drives learning, so linking assessment to interaction in creative and strategic ways is vital to opening up the space for such practice to move from extrinsically to intrinsically-motivated.

Conclusion

This paper has examined strategies to improve peer interaction in online discussion forums. A Curtin University Spatial Sciences unit was used to evaluate the effectiveness of strategies introduced in 2011 based on a review of the literature. The research has resulted in encouraging findings. The three key findings are as follows:

1. Increased student participation levels were achieved in this process.
2. A reasonably strong level of statistical association between the roles students played in the discussion board and their final marks was evident.
3. The time lag between the students making postings (particularly around the time when assessment items were due) and the lecturers' responses was found to be beneficial to the students' active learning, as it allowed them time to help each other with the assessment items.

To further test the findings of this study, and to consolidate the improvements made, another phase of research is planned to determine whether those students who did participate in the discussion board believe that their engagement helped them to pass the unit or obtain higher results. Issues surrounding the lecturer's role, the time lag, as well as the implications this has for an online lecturer's workload will also be examined. Further, it is important to develop an instrument to measure students' roles in the discussion forum and their learning styles, and a better measure to assess students' qualitative and quantitative participation in the discussion forum. In order to address these issues, the next stage of the research is aimed at designing and implementing more effective activities for increased student participation in discussion forums.

References

Balaji, M. S. & Chakrabarti, D. (2010). Student interactions in online discussion forum: Empirical research from 'Media Richness Theory' perspective. *Journal of Interactive Online Learning*, 9(1), 1-22. http://www.ncolr.org/jiol/issues/pdf/9.1.1.pdf

Chan, C. K. K. & Chan, Y. Y. (2011). Students' views of collaboration and online participation in Knowledge Forum. *Computers & Education,* 57(1), 1445-1457. http://dx.doi.org/10.1016/j.compedu.2010.09.003

Cheng, C. K., Paré, D. E., Collimore, L. M. & Joordens, S. (2011). Assessing the effectiveness of a voluntary online discussion forum on improving students' course performance. *Computers & Education,* 56(1), 253-261. http://dx.doi.org/10.1016/j.compedu.2010.07.024

Dringus, L. P. & Ellis, T. (2005). Using data mining as a strategy for assessing asynchronous discussion forums. *Computers & Education,* 45(1), 141-160. http://dx.doi.org/10.1016/j.compedu.2004.05.003

Dringus, L. P. & Ellis, T. (2010). Temporal transitions in participation flow in an asynchronous discussion forum. *Computers & Education,* 54(2), 340-349. http://dx.doi.org/10.1016/j.compedu.2009.08.011

Educause (2012). 7 things you should know about flipped classrooms. http://net.educause.edu/ir/library/pdf/ELI7081.pdf

Gikandi, J. W., Morrow, D. & Davis, N. E. (2011). Online formative assessment in higher education: A review of the literature. *Computers & Education*, 57(4), 2333-2351. http://dx.doi.org/10.1016/j.compedu.2011.06.004

Hew, K. F. & Cheung, W. S. (2008). Attracting student participation in asynchronous online discussions: A case study of peer facilitation. *Computers & Education,* 51(3), 1111-1124. http://dx.doi.org/10.1016/j.compedu.2007.11.002

Hou, H. T. (2011). A case study of online instructional collaborative discussion activities for problem-solving using situated scenarios: An examination of content and behavior cluster analysis. *Computers & Education,* 56(3), 712-719. http://dx.doi.org/10.1016/j.compedu.2010.10.013

Kalman, Y. M. & Rafaeli, S. (2005). Email chronemics: Unobtrusive profiling of response times. Paper presented at the 38th Hawaii International Conference on Systems Sciences, Big Island, HI, USA. http://www.computer.org/csdl/proceedings/hicss/2005/2268/04/22680108b.pdf

Khoshneshin, Z. (2011). Collaborative critical thinking in online environment. *Procedia - Social and Behavioral Sciences,* 30, 1881-1887. http://dx.doi.org/10.1016/j.sbspro.2011.10.366

Kiess, H. O. (1996). *Statistical concepts for the behavioral sciences* (2nd ed.). Needham Heights, Massachuetts: Allyn & Bacon.

Ma, W. W. K. & Yuen, A. H. K. (2011). Understanding online knowledge sharing: An interpersonal relationship perspective. *Computers & Education,* 56(1), 210-219. http://dx.doi.org/10.1016/j.compedu.2010.08.004

Makoul, G., Zick, A. B., Aakhus, M., Neely, K. J. & Roemer, P. E. (2010). Using an online forum to encourage reflection about difficult conversations in medicine. *Patient Education and Counseling*, 79(1), 83-86. http://dx.doi.org/10.1016/j.pec.2009.07.027

Mazzolini, M. & Maddison, S. (2007). When to jump in: The role of the instructor in online discussion forums. *Computers & Education,* 49(2), 193-213. http://dx.doi.org/10.1016/j.compedu.2005.06.011

Miyazoe, T. & Anderson, T. (2010). Learning outcomes and students' perceptions of online writing: Simultaneous implementation of a forum, blog, and wiki in an EFL blended learning setting. *System,* 38(2), 185-199. http://dx.doi.org/10.1016/j.system.2010.03.006

Nandi, D., Hamilton, M., Chang, S. & Balbo, S. (2012). Evaluating quality in online synchronous interactions between students and discussion facilitators. *Australasian Journal of Educational Technology*, 28(4), 684-702. http://www.ascilite.org.au/ajet/ajet28/nandi.html

Niemi, H. (2002). Active learning – a cultural change needed in teacher education and schools. *Teaching and Teacher Education,* 18(7), 763-780. http://dx.doi.org/10.1016/S0742-051X(02)00042-2

Parisio, M. L. (2011). Engaging students in learning through online discussion: A phenomenographic study. In *Changing demands, changing directions. Proceedings ascilite Hobart 2011*. http://www.ascilite.org.au/conferences/hobart11/downloads/papers/Parisio-concise.pdf

Persell, C. H. (2004). Using focused web-based discussions to enhance student engagement and deep understanding. *Teaching Sociology*, 32(1), 61-78. http://dx.doi.org/10.1177/0092055X0403200107

Prestera, G. E. & Moller, L. A. (2001). Facilitating asynchronous distance learning. Exploiting opportunities for knowledge building in asynchronous distance learning environments. Paper presented at the Mid-South Instructional Technology Conference Middle Tennessee State University. http://www.eric.ed.gov/contentdelivery/servlet/ERICServlet?accno=ED463723

Richardson, J. C. & Ice, P. (2010). Investigating students' level of critical thinking across instructional strategies in online discussions. *The Internet and Higher Education,* 13(1-2), 52-59. http://dx.doi.org/10.1016/j.iheduc.2009.10.009

Roehm, S. & Bonnel, W. (2009). Engaging students for learning with online discussions. *Teaching and Learning in Nursing,* 4(1), 6-9. http://dx.doi.org/10.1016/j.teln.2008.07.003

Rovai, A. P. (2007). Facilitating online discussions effectively. *The Internet and Higher Education,* 10(1), 77-88. http://dx.doi.org/10.1016/j.iheduc.2006.10.001

Scherer Bassani, P. B. (2011). Interpersonal exchanges in discussion forums: A study of learning communities in distance learning settings. *Computers & Education,* 56(4), 931-938. http://dx.doi.org/10.1016/j.compedu.2010.11.009

Serwatka, J. (2003). Assessment in on-line CIS courses. *Journal of Computer Information Systems*, 43(3), 16-20. http://www.highbeam.com/doc/1P3-453246031.html

Smart, K. L. & Cappel, J. J. (2006). Students' perceptions of online learning: A comparative study. *Journal of Information Technology Education*, 5, 201-219.

Song, L. & McNary, S. (2011). Understanding students' online interaction: Analysis of discussion board postings. *Journal of Interactive Online Learning*, 10(1), 1-14. http://www.ncolr.org/jiol/issues/pdf/10.1.1.pdf

Swan, K. (2004). Learning online: Current research on issues of interface, teaching presence and learner characteristics. In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education: Into the mainstream.* (pp. 63-79). Needham, MA: Sloan Center for Online Education. http://sloanconsortium.org/node/925

Tate, K. & Strickland, J. (2008). Issues with using discussion boards and incentives in teacher education research. Paper presented at the Society for Information Technology & Teacher Education International Conference, Las Vegas, Nevada, USA. http://www.editlib.org/p/27364

Tulbure, C. (2011). Do different learning styles require differentiated teaching strategies? *Procedia - Social and Behavioral Sciences,* 11, 155-159. http://dx.doi.org/10.1016/j.sbspro.2011.01.052

Winter, J., Cotton, D., Gavin, J. & Yorke, J. D. (2010). Effective e-learning? Multi-tasking, distractions and boundary management by graduate students in an online environment. *ALT-J: Research in Learning Technology,* 18(1), 71-83. http://www.researchinlearning technology.net/index.php/rlt/article/download/10753/12376

Wu, A. (2003). Supporting electronic discourse: Principles of design from a social constructivist perspective. *Journal of Interactive Learning Research*, 14(2), 167-184. http://www.editlib.org/p/1980

Zydney, J. M., deNoyelles, A. & Kyeong-Ju Seo, K. (2012). Creating a community of inquiry in online environments: An exploratory study on the effect of a protocol on interactions within asynchronous discussions. *Computers & Education,* 58(1), 77-87. http://dx.doi.org/10.1016/j.compedu.2011.07.009

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