PERGAMON

Computers & Education 40 (2003) 237–253

COMPUTERS & EDUCATION

www.elsevier.com/locate/compedu

Sage, guide or ghost? The effect of instructor intervention on student participation in online discussion forums

Margaret Mazzolini*, Sarah Maddison

Centre for Astrophysics & Supercomputing, BSEE, Mail Box 31, Swinburne University of Technology PO Box 218, Hawthorn VIC 3122 Australia

Received 13 May 2002; accepted 18 September 2002

Abstract

When facilitating asynchronous discussion forums, should online instructors be encouraged to take a prominent 'sage on the stage' role, a more constructivist 'guide on the side' role, or an ultra low profile as 'the ghost in the wings'? There is no shortage of anecdotal advice on how to conduct discussion forums in online education, but there appears to be very little research available so far to back that advice up. In this study of an online astronomy program with approximately 200 participants, we investigated the way that the rate at which instructors post and how often those instructors initiate discussions correlate with several variables—student posting rates, lengths of discussion threads, and student survey responses concerning their educational experience. We found that the ways in which instructors post to forums can influence students' forum discussions and perceptions, but not always in expected ways. On average, frequent posting by instructors did not lead to more student postings, and the more the instructors posted, the shorter were the lengths of the discussions overall. On the other hand, while most students rated their educational experience highly, instructors who posted frequently were judged on average to be more enthusiastic and expert than those who did not. Clearly the number of student postings and the rate at which instructors participate are not simple indicators of the quality of forum discussions. We need to find more subtle measures of the effectiveness of asynchronous discussion forums for learning and teaching.

Keywords: Computer-mediated communication; Teaching/learning strategies; Adult learning; Distance education and telelearning

* Corresponding author.
E-mail address: mmazzolini@swin.edu.au (M. Mazzolini).

0360-1315/03/$ - see front matter © 2002 Elsevier Science Ltd. All rights reserved.
PII: S0360-1315(02)00129-X

1. Introduction

One of the key distinguishing features of online education, as compared with other forms of distance education, is the opportunity for instructors and students to interact via online asynchronous discussion forums (Rosman, 1999). Asynchronous discussion forums are used to a varying degree in different online academic programs, and in widely different ways. They can be used for social interaction only, for discussion of assignments and other assessable work, as a collaborative tool for individual project groups, for tutorial purposes, or as a central part of the teaching strategy. Likewise they may be entirely voluntary, be used as a ''hurdle'' requirement (compulsory but carrying no intrinsic assessment weight), or as an integral part of the assessment mix. A body of papers, articles and book chapters on the social and pedagogical aspects of discussion forums is starting to build up—see, for example, Eastmond (1995), Hiltz (1994), Paloff and Pratt (1999, 2001), Salmon (2000)—but not all are research based.

Student–staff ratios in online courses that use discussion forums may vary from 10s to 1, up to 100s to 1. The mix of student–student and student–instructor interaction in discussion forums can vary widely too. Depending on the purpose of the forum, instructors may (1) limit discussions to one or more instructor-initiated themes, (2) lead more general discussions, (3) assume the role of answering most of the questions from students, (4) moderate the discussions but maintain a low profile in them, or (5) even be entirely absent from the discussions. To extend constructivist jargon somewhat, the role of the instructor (Thomas, 2001) may vary from being the 'sage on the stage', to the 'guide on the side' to 'a ghost in the wings'! The 'ideal' degree of visibility of the instructor in discussion forums depends very much on the purpose of those forums. In this study we have investigated asynchronous forums that are used for tutorial-type teaching purposes and form part of the assessment mix.

The educational philosophy underlying the design of an online program is crucial to the way in which instructors are expected to participate in online discussions. If the instructor assumes the 'sage on the stage' role then they will lead discussions and probably close them off, where appropriate, and so would be expected to be amongst the most frequent contributors to the discussions. If, in contrast, the program has been designed according to a constructivist-type model meant to encourage students to initiate discussions and answer each other's questions, then the instructor, as the 'guide on the side', would probably not want to dominate the discussions. So what level of instructor intervention is optimal? Most instructors involved in online education have opinions on these issues, but there is not a great deal of relevant research data available on which to base a choice between those opinions.

Discussion in the literature generally suggests that it is important that instructors play an active, visible part in forum discussions. For example, Paloff and Pratt (1999), state that instructors participate as 'cheerleaders', attempting to motivate deeper learning through online discussions than would usually occur in a face-to-face classroom situation. It is also recognized that instructor participation may be overdone: too much participation by the instructor may reduce the amount of student–student interaction and create an unnecessary degree of reliance on the teacher (Paloff & Pratt, 2001).

Bridging the instructor–student gap is always an important issue in distance education (Salmon, 2000). Retention rates are also a constant concern. Online education courses anecdotally have low retention rates (Frankola, 2000), though most course providers tend to keep their retention rates to themselves. Effective discussion forum interactions are considered to support good online

learning, and student–student interactions are believed to encourage students to feel that they are part of an online learning community, and therefore aid retention rates (Solomon & Mazzolini, in press). However the degree to which instructors need to be involved in those discussion forums affects the economics of online courses, and therefore an understanding of the effect that instructor intervention has on student discussions in forums is important to the whole design of online delivery.

2. Study outline

In this study, we have investigated the frequency with which instructors post to assessment discussion forums in an online program designed according to a constructivist-type model. That is, we restricted our study to a program in which discussion forums have been designed to encourage students to initiate most of the discussions and answer each other's questions, with guidance and encouragement from the instructor where appropriate.

The success or otherwise of discussion forums like these has to do with the quality of the predominantly student–student interactions, plus the depth of learning which takes place within these forums. These outcomes are not easy to measure. However there are measurables that, however simplistic, might provide some indication of what level of instructor intervention makes for an effective discussion forum. Arguably, a necessary (if not sufficient) condition for a discussion forum to aid deep learning is for it to contain a sizeable number of postings by students. We also suggest that a discussion forum is more likely to aid deep learning if it contains a significant number of lengthy discussion 'threads' (where a thread is built up from an initial posting and the replies received, forming an extended asynchronous 'conversation' on a particular topic or issue).

In this study we have measured the overall number of student postings in forums, as compared with the number of postings by instructors, plus the effect that frequent postings by instructors have on the length of discussion threads. In particular, we investigated if

1. The number of postings by instructors has any significant relation to the overall rate of student postings—that is, does a highly visible instructor encourage a greater rate of student postings overall, or is there any truth in the idea that an 'overly interventionist' instructor could actually discourage student participation?
2. The number of postings by instructors has any significant relation to the average length of discussion threads—that is, do frequent postings by the instructor encourage students to discuss a topic at length, or could they tend to 'close off' discussions by being overly interventionist, for example, by answering questions prematurely?
3. The number of times that an instructor initiates new discussion threads (rather than just contributing to threads initiated by students) significantly influences the overall rate of student postings and the length of discussion threads - that is, if instructors take the lead in discussions, does that affect student participation?
4. The number of postings by instructors has any significant relation to students' perceptions of the usefulness or otherwise of discussion forum interactions on their learning in an online environment. We also studied more general responses to survey questions relating to the whether the instructors were enthusiastic and demonstrated expertise, the usefulness of the discussion forums, and their satisfaction with the overall educational experience.

3. Study context

This study involved a study of discussion forum participation rates by students and instructors in Swinburne Astronomy Online (Germany & Mazzolini, 2002). Swinburne Astronomy Online (SAO) is an online, postgraduate suite of Masters/Graduate Diploma/Graduate Certificate astronomy courses offered by Swinburne University of Technology, Australia. In semester 2, 2001, there were approximately 200 students resident in 34 countries enrolled in this program. The authors are the current coordinator (SM) and the designer and original coordinator (MM) of SAO.

SAO students all study online, with no attendance component to the program, are 'lifelong learners' aged in the mid 40s on average and, generally speaking, are astronomy enthusiasts if not fanatics! Students in SAO study a selection from 15 online units (subjects), 11 of which were available by the end of 2001. SAO uses a hybrid online form of delivery, with image- and animation-rich course content provided on CD-ROMs and the Internet used for communication, research, and assessment purposes. The assessment mix involves computer-managed testing, essays, asynchronous discussion forum contributions and project work (Mazzolini, 2000, 2002).

Discussion forums are a key feature of all SAO units, and contribute 30% of the total assessment marks in all SAO units except for the three major project units. Students are divided up into groups containing up to approximately 30 students per instructor, and each group of students has its own set of discussion forums, with a new forum opened typically each 2 weeks during the teaching semester. Each of these forums is provided for discussions about the current course material being studied in any particular unit. In each 2-week forum, students are required to post at least one question or 'extension comment' about the current course material, plus answer at least one question posed by someone else. The 30% possible total mark for forum participation is made up of a 'regular participation' contribution (typically 9%) plus a mark (typically 21%) rewarded for the three postings which have been nominated by the student as being their best discussion forum contributions for the unit.

SAO instructors are professional astronomers, some of whom are Swinburne academic staff (4 of the 11 instructors in Semester 2, 2001, for example), but a number of whom are employed full-time at observatories, universities or research institutions around the world. These instructors have widely varying levels of background experience in the teaching of astronomy, and of necessity, their activities are coordinated by email discussions between the instructors and coordinator. The coordinator's task is to provide as uniform a teaching approach as is possible across SAO units, but there will be variations due to factors such as

- individual teaching styles and personalities of instructors;
- whether the students concerned are 'beginners' at forum discussions or experienced SAO students;
- how much the instructors engage in 'off forum' one-to-one correspondence with their students;
- the type and level (introductory or advanced) of course content in each unit; and
- the availability of good textbooks or other resources for each unit.

These factors could all be expected to influence the frequency of discussion forum participation by SAO instructors. Other more subtle effects that could influence an instructor's forum partici-

pation rate are the personalities and abilities of the students that happen to be assigned to their forums. An aim of this study is to investigate whether such variations in the rate of instructor participation have any significant relation to the level and type of student participation.

Casual observation of forum discussions over several semesters had suggested to the authors that instructors who are actively involved in the forums do tend to encourage student participation, but this is complicated by differences between forums containing students who are mostly new to SAO ('beginner' units) and forums for the more advanced units, where the students are 'seasoned' discussion forum participants. This study investigates the effect of instructor participation on student participation in a more systematic way than is possible by casual observation, and in the process produced some surprises for the authors!

4. Methodology and data collection

The SAO program offers an excellent opportunity to make comparative studies of student and instructor participation in discussion forums. As the program steadily increases in size, there are a growing number of forums being conducted 'in parallel' in any semester. Although the astronomy course material being discussed varies according to unit, all forums are conducted under the same overall guidelines and with the same assessment criteria. For example, in Semester 2, 2001, the seven SAO units on offer involved 11 instructors in all, as four of those units had sufficient enrolments to require that they be split into two discussion forum streams. (A major project unit was also offered, but as its format of discussion forum participation and assessment is substantially different to that of 'regular' units, it was not included in this study.)

This particular study was motivated mainly by an assumption that the participation rate by students, plus the length of discussion threads, might provide some simplistic measure of the quality of the discussion forum interactions. However this assumption may not tally with students' perceptions of whether discussion forums are in practice a useful part of an online program. Therefore the study also included analysis of student evaluation surveys of the current students in the online program concerned (SAO), conducted independently by Swinburne's Quality Education Office. The intention was to find out if their perceptions of the learning experience correlate at all with the frequency of discussion group postings by their instructors.

Advantages of the approach taken in this study include its 'after the event' nature, in that no experimental research intervention has taken place to influence the rate and nature of discussion forum postings by either students or (especially) instructors. Another advantage is the nature of the resource provided by the SAO program for research studies such as this, given the relatively large number of discussion forums conducted according to the same general criteria, in the same format, and with the same overall pool of students.

Limitations of this approach include the lack of any control over the details of conduct and membership of the various SAO discussion forums, and the fact that the forums for the more advanced units are composed of students with more experience in taking part in discussion forums, and thereby, perhaps, less reliance on instructor input than are the others. Also, the response rate to the survey component of the study was only 35% on average.

This particular study analysed archives of SAO discussion forum contributions from Semester 2, 2000, Semester 1, 2001 and Semester 2, 2001. These represented discussions by approximately

- 135 students representing 200 unit enrolments in 6 units, divided up into 8 discussion groups (with 8 instructors), in Semester 2, 2000
- 180 students representing 270 unit enrolments in 7 units, divided up into 10 discussion groups (with 10 instructors), in Semester 1, 2001, and
- 200 students representing 280 unit enrolments in 7 units, divided up into 11 discussion groups (with 11 instructors), in Semester 2, 2001

The archives of these SAO discussion forums contain between about 80 to 200 postings each for every 2-week period. The data was analysed for each 2-week discussion forum, then overall averages were then calculated for each instructor and discussion group over complete semesters, and it is those averages that are tabulated and discussed in Sections 5 and 6. Three semesters of data gave us averages for 29 discussion groups in total.

The Swinburne Quality Education Unit conducts confidential surveys of all Swinburne University of Technology students each semester. In the second part of this study, we analyzed SAO student responses over three semesters to statements concerning the enthusiasm and expertise of their instructors, the usefulness of discussion forums and their overall satisfaction with the educational experience provided by SAO. All responses were given on a 1 (strongly disagree) to 5 (strongly agree) Likert Scale. The survey responses were sorted by instructor and compared with the frequency of forum postings by that instructor, to see if students with instructors who regularly contribute to discussion forums are more likely to rate aspects of the educational experience highly than are students of instructors who contribute infrequently. (As mentioned earlier, the response rate to the survey component of the study was 35% on average.)

5. Results—effects on student participation

The data were analyzed in terms of the following variables for each discussion forum:

- percentage of instructor postings = (no. of instructor postings)/(total no. of postings) × 100
- posting rate by students = (total no. of student postings)/(total no. of students)
- average discussion thread length = (total no. of student postings)/(total no. of discussion threads)
- Percentage of discussion threads initiated by instructors = (no. of discussion threads initiated by instructors)/(total no. of discussion threads) × 100

5.1. Influence of frequency of instructor postings on student participation rates and length of discussion threads

The results of the comparison between the percentage of instructor postings to the posting rate by students for each discussion forum are shown in Fig. 1a. The analysis gave a Pearson R-value $r = 0.01$, sample size $N = 29$, indicating that no significant correlation exists in the data. Casual observation had suggested to us that instructors who posted frequently would encourage greater participation rates by students in SAO—clearly this was not the case!

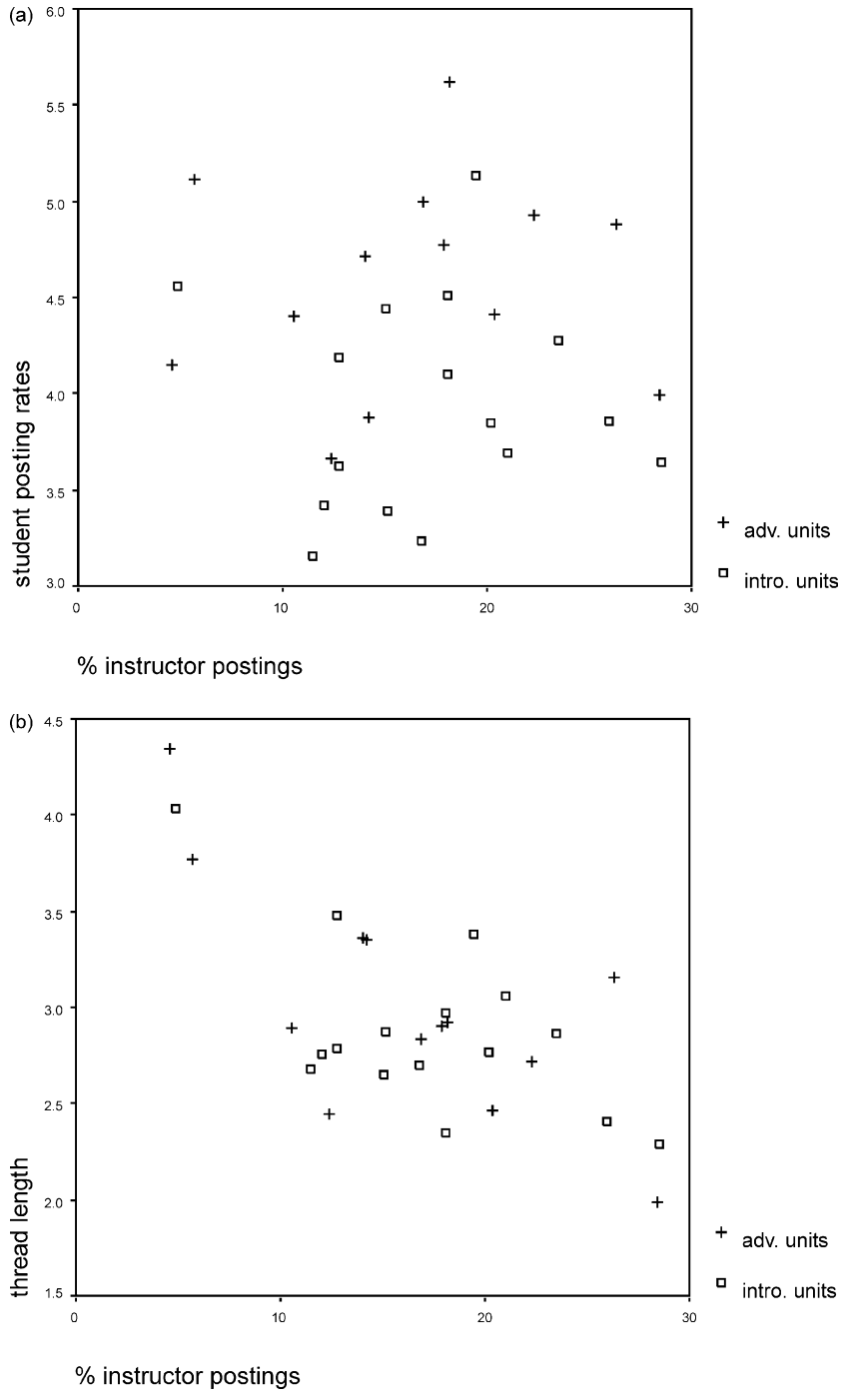

Fig. 1. (a) Student posting rates versus percentage of instructor postings on discussion forums. (b) Average discussion thread length versus percentage of instructor postings on discussion forums. (c) Student posting rates versus percentage of threads started by instructors on discussion forums. (d). Average discussion thread length versus percentage of threads started by instructors on discussion forums.

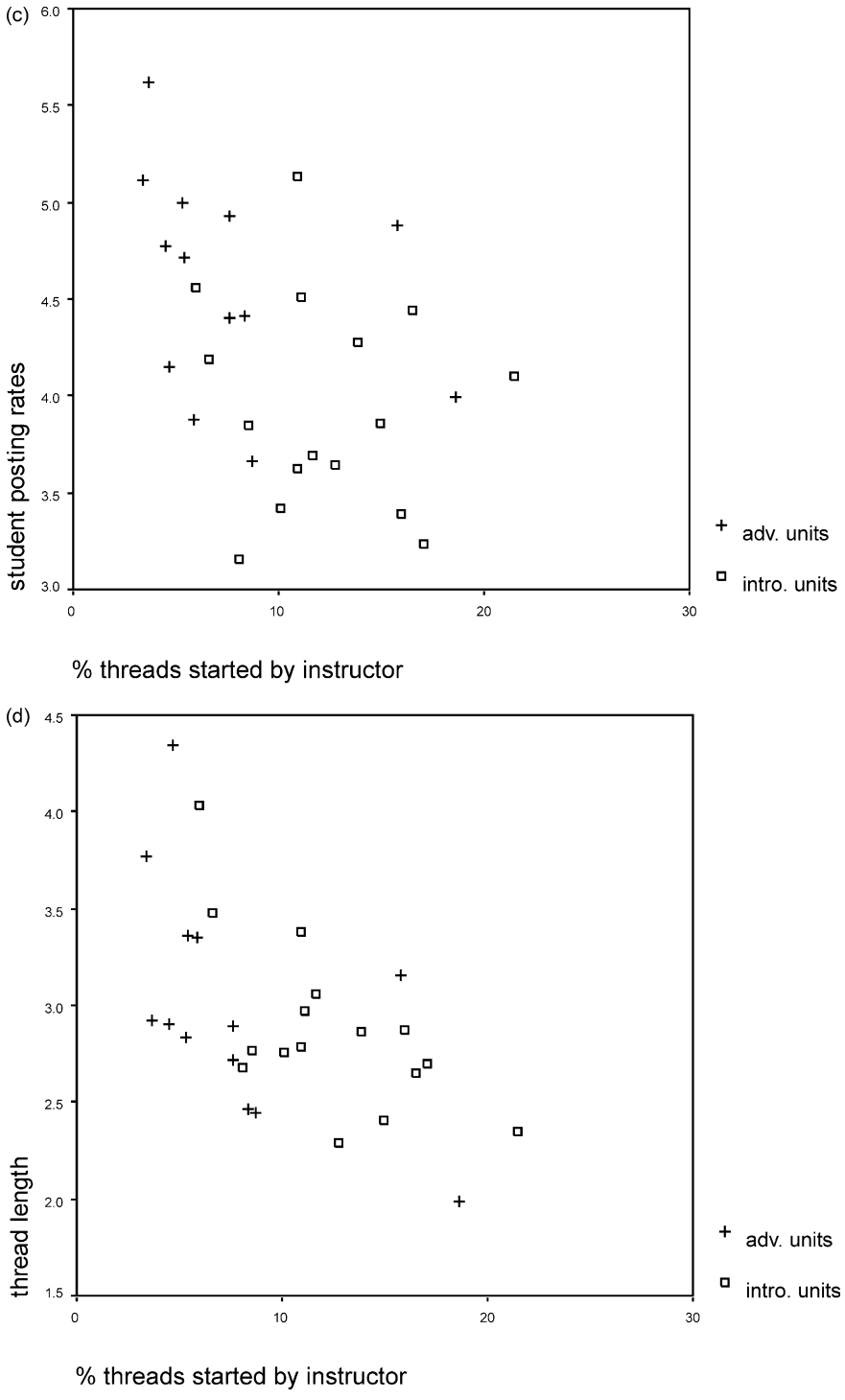

Fig. 1 (*continued*).

We then compared the percentage of instructor postings to the average discussion thread length for each discussion forum. The results are shown in Fig. 1b, with a Pearson R-value $r = -0.67$, sample size $N = 29$, and significance level $P < 0.01$ indicating a statistically significant negative correlation. The negative correlation was slightly higher for students in the advanced units (who had already studied at least one SAO unit previously) than for those in the units containing a high proportion of beginners, but it was significant for both groups.

In other words, frequent posting by instructors to discussion forums did not lead to more student postings on average, and the more the instructors posted, the shorter were the discussion threads on average. If long discussion threads indicate in depth discussion, does this indicate that instructors are best advised to keep as quiet as possible?

5.2. Influence of instructor-lead discussion threads on student participation rate and length of discussion threads overall

The results of comparing the percentage of discussion threads initiated by instructors to the posting rate by students for each discussion forum are shown in Fig. 1c. The analysis gave a Pearson R-value of $r = -0.41$, sample size $N = 29$, significance level $P < 0.05$ which again indicates a statistically significant negative correlation.

This negative correlation was significant for students in the advanced units (who had already studied at least one SAO unit previously) but not for those in the units containing a high proportion of beginners. So, on average, instructors who are active in initiating discussion threads did not appear to have stimulated more discussion than usual, and, with the more advanced students, may actually have limited the amount of discussion.

When we compared the percentage of discussion threads initiated by instructors to the average discussion thread length for each discussion forum, we obtained the results shown in Fig. 1d, with a Pearson R-value $r = -0.58$, sample size $N = 29$, $P < 0.01$ which again indicates a statistically significant negative correlation.

This negative correlation was equally significant for students in both the advanced and (mainly) beginner units. It seems that SAO instructors who were active in starting up discussion threads on average ended up with shorter discussion threads than did instructors who largely left it to the students to initiate discussions.

One way of interpreting these results is to recognize that students may respond rather differently to questions posed by fellow students to those posed by instructors. They may respond quickly to questions posed by fellow students as a way of 'helping those students out', but may be more cautious in responding to instructors' questions. The latter may be more likely to be seen by students as an assessment tool rather than as a request for information.

6. Results—effects on student perceptions

The results in the last section suggest that students may contribute more to forums and pursue discussion threads at greater length if instructors intervene in a minimal way. However it does not necessarily follow that their perception of students' learning experience improves if the instructors are at best minimally involved in discussions.

In the second part of the study we analyzed student responses to relevant statements in independently run Swinburne Quality Education Unit surveys, and compared them to the average percentage of instructor postings for each class. Responses are recorded on a 1–5 Likert Scale, which is an ordinal scale measurement. As the Pearson correlation coefficient assumes at least interval scales, analysis of correlations between survey results and the average percentage of instructor postings using the Pearson correlation coefficient is not appropriate. Instead, we used one-way analysis of variance (one-way ANOVA) tests. (Note that most SAO student survey responses are quite positive, resulting in few responses in the 1–3 section of the Likert Scale, which does tend to limit the extent of the statistical inferences which we can draw from this data.)

6.1. Influence of frequency of instructor postings on both the enthusiasm shown and the expertise demonstrated by instructors

Each semester, SAO students have been asked to respond on a 1–5 Likert Scale to the survey statements: "The online instructors were enthusiastic" and "The online instructors demonstrated expertise in the course matter".

The results of the comparison between the set of survey responses on the statement "The online instructors were enthusiastic" and the percentage of instructor postings to each forum, are shown in a scatter diagram in Fig. 2a. Here we include data from 29 discussion forums and 248 student survey responses. Not surprisingly, the ANOVA test suggested that there was a small but significant difference (F ratio $F(4, 243) = 5.113$, significance level $P < 0.005$, effect size $\eta^2 = 0.08$) between student perceptions of the enthusiasm of their instructors, depending on the frequency with which their instructor has posted to their discussion forums. Trends in the data are illustrated in Fig. 2b, which plots averaged survey responses for each discussion forum. (Note however that the ANOVA analyses reported here are all carried out using all student survey responses, not just the averages.)

It is hardly surprising that students perceive instructors who post often as enthusiastic, but are they considered to be more expert also?

We compared the set of survey responses on "The online instructors demonstrated expertise in the course matter" to the percentage of instructor postings to each forum. The results are shown in the scatter diagram in Fig. 3a, where again we have used data from 29 discussion forums and 248 student survey responses. The ANOVA test suggested that there was a significant difference ($F(4, 243) = 8.063$, $P < 0.001$, $\eta^2 = 0.11$) between student perceptions of expertise demonstrated by their instructors, depending on the frequency with which their instructor has posted to their discussion forums. Trends in the data are illustrated in Fig. 3b, which plots averaged survey responses for each discussion forum. Again, the trend is, as one would expect, that instructors who post infrequently tend not to be perceived by their students as displaying great expertise.

6.2. Influence of frequency of instructor postings on students' perception of the usefulness of discussion forums and overall student satisfaction with the educational experience

The Swinburne Quality Education student surveys are designed to evaluate learning and teaching outcomes across the university generally, rather than to probe the specific teaching techniques used in SAO. However as we are particularly interested in exploring student reactions

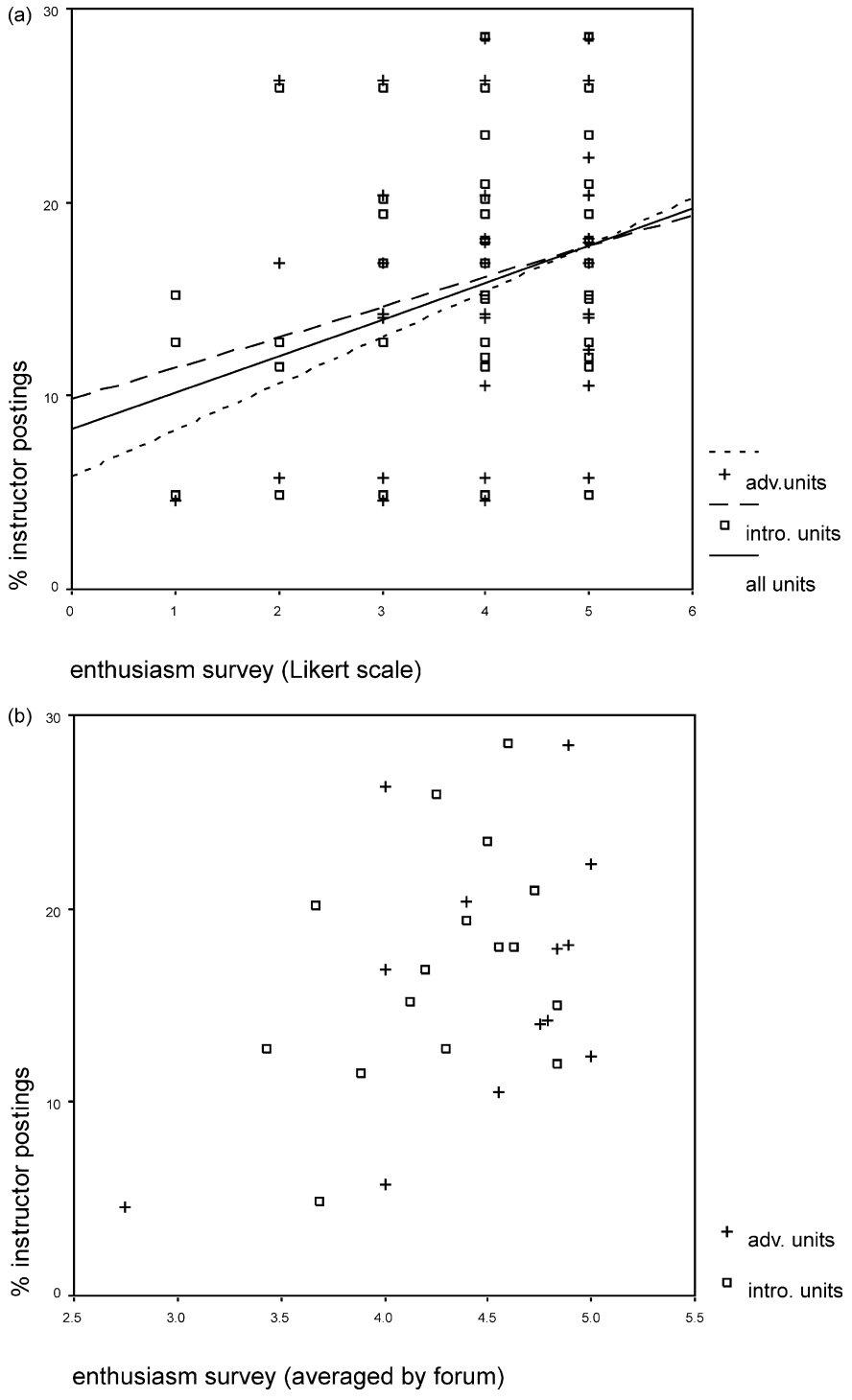

Fig. 2. (a) Percentage of instructor postings versus student responses to survey question (Likert scale): "The online instructors were enthusiastic"; (b) percentage of instructor postings versus student responses to survey question (Likert scale): "The online instructors were enthusiastic", averaged over each discussion forum.

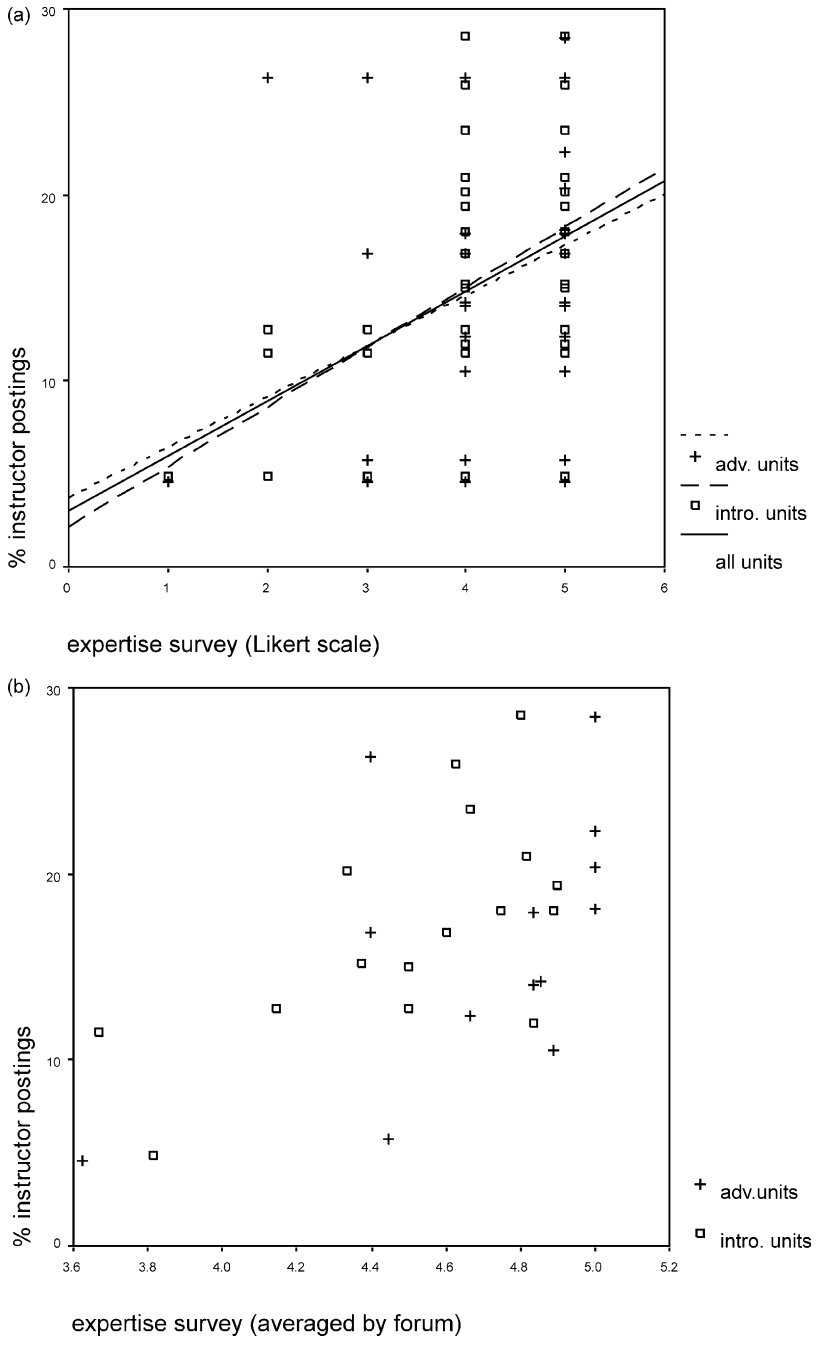

Fig. 3. (a) Percentage of instructor postings versus student responses to survey question (Likert scale): "The online instructors demonstrated expertise in the course matter"; (b) percentage of instructor postings versus student responses to survey question (Likert scale): "The online instructors demonstrated expertise in the course matter", averaged over each discussion forum.

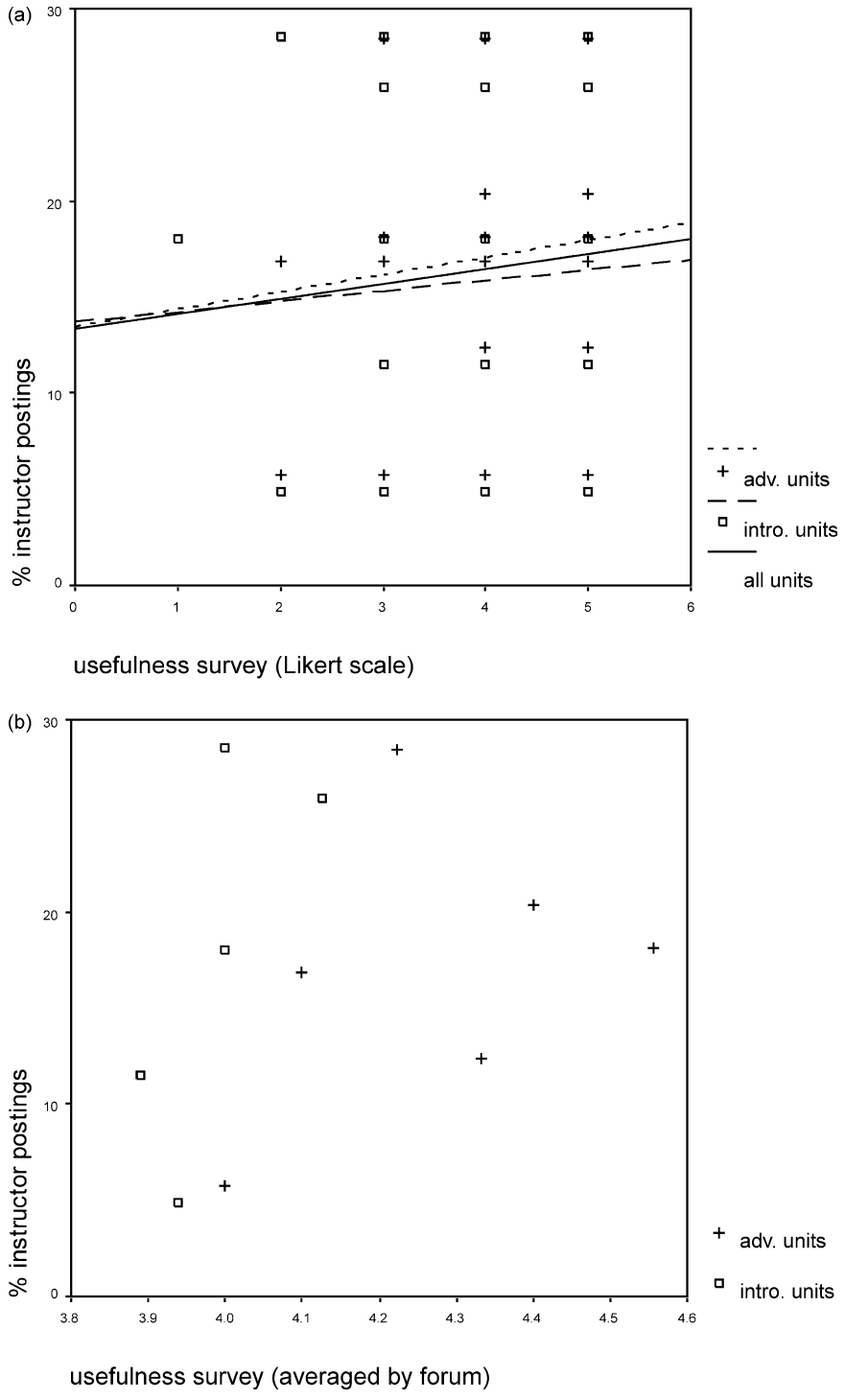

Fig. 4. (a) Percentage of instructor postings versus student responses to survey question (Likert scale): "I found the newsgroups useful"; (b) percentage of instructor postings versus student responses to survey question (Likert scale): "I found the newsgroups useful" averaged over each discussion forum.

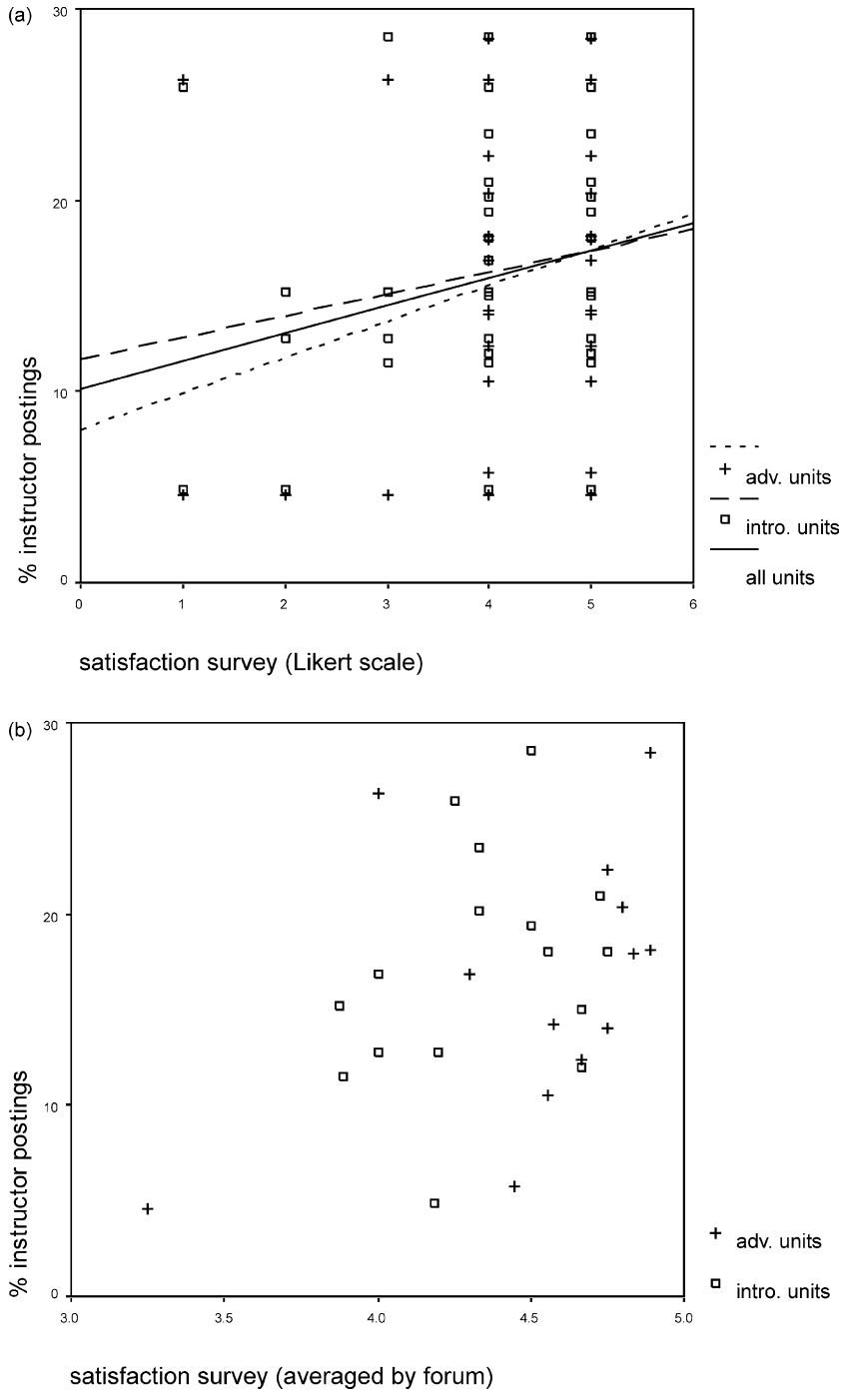

Fig. 5. (a) Percentage of instructor postings versus student responses to survey question (Likert scale): "Overall I was satisfied with the educational experience provided"; (b) percentage of instructor postings versus student responses to survey question (Likert scale): "Overall I was satisfied with the educational experience provided" averaged over each discussion forum.

to the use of discussion forums in SAO, in Semester 2, 2001 we gained permission to include in the survey an item asking students to respond on a 1–5 Likert Scale to the statement: ''I found the newsgroups useful''. (Note that SAO employs newsgroup technology to deliver its discussion forums.) Also, at the end of each survey, students are always asked to respond to the statement: ''Overall I was satisfied with the educational experience provided''.

The results for the ''I found the newsgroups useful'' statement, as compared to the percentage of instructor postings to each forum, are shown in a scatter diagram in Fig. 4a, this time for 11 discussion forums and 96 student survey responses only. To illustrate any overall trends, Fig. 4b shows averages of the survey responses for each discussion forum. The ANOVA test shows no sign at all of any significant correlation ($F(4, 91) = 0.378$, $P = 0.824$, $\eta^2 = 0.02$), but the sample size is too small (one semester's survey responses only) to be conclusive. More data from future semesters will be needed before we can draw any overall conclusions from this particular survey statement.

Discussion forums are only one aspect of the students' SAO experience, which also includes CD-ROM course material, essays, personalized projects, etc. We were interested to analyze student responses to the ''Overall I was satisfied with the educational experience provided'' statement to see if differences in the level of instructor participation in discussion forums would be enough to influence student perceptions of their experience as SAO students overall.

The results are shown in a scatter diagram in Fig. 5a for our data from 29 discussion forums and 248 student survey responses. The ANOVA test suggests that there is a mildly significant difference ($F(4, 243) = 3.058$, $P < 0.05$, $\eta^2 = 0.05$) between student perceptions of overall satisfaction depending on the frequency with which their instructor has posted to their discussion forums.

Trends in the data are illustrated in Fig. 5b, which again shows averaged survey responses for each discussion forum. Note in Fig. 5b that the overall trend appeared to be highly influenced by one 'outlier' discussion forum group who rated their overall satisfaction particularly lowly, with an average rating of 3.25, which is three standard deviations ($SD = 0.38$) away from the mean for all discussion forums of 4.42. When as a test we eliminated the responses from students in this particular discussion forum from our ANOVA analysis, then the analysis did not establish a significant correlation ($F(4, 243) = 1.731$, $P < 0.15$, $\eta^2 = 0.03$) Therefore our results suggest a correlation whereby instructors who posted very infrequently may have had a negative influence on student satisfaction overall, but this conclusion may have been biased by results from one particular discussion forum.

There were two more discussion forums (see Fig. 5b) where the level of instructor participation was also very low but where students nevertheless gave very positive responses to this question about student satisfaction. Therefore while we have no particular reason to eliminate the responses from the outlier forum, the results indicate that most SAO students tend to rate their satisfaction with their overall educational experience highly, whether their instructors post frequently or not.

7. Discussion

Establishing that a statistically significant correlation exists is not enough in itself to establish cause and effect. In this sense, the aim of this study was firstly to establish a reasonable hypothesis

on ways in which instructor participation may affect student participation in discussion forums, rather than establish any conclusive causal relationship. This study was also the initial step in a plan to explore whether simple measures of participation tell us anything about the quality of interactions in a discussion forum. Discussion forums in online education are usually intended both to support learning and teaching, and to foster a sense of online community (and hopefully boost completion and retention rates in the process). It is therefore very important to develop an educational research-based understanding of how these aims can be achieved.

The first part of our study (Section 5) does *not* support the hypothesis that situations where instructors posted frequently to SAO discussion forums resulted in greater participation rates by students. Further, the more instructors posted to discussion forums, the shorter were the discussion threads on average. Instructors who were active in initiating discussion threads did not appear to stimulate more discussion, and may actually have limited the amount of discussion (with the more advanced students) and the length of discussion threads (with all students). As speculated in Section 5, students may possibly react more positively to questions posed by fellow students ('cries for help') rather than questions posed by instructors (which may be perceived to be probes to expose gaps in understanding).

While SAO encourages its instructors to facilitate rather than dominate discussions (that is, to act as 'guides on the side' rather than as 'sages on the stage'), we have seen (Section 6) that SAO students do respond favorably to the perceived enthusiasm and expertise of instructors who post relatively frequently, even if, in the process, their own contributions to the discussions tend to decrease. At least in SAO, instructors who play only a minimal part in online discussion forums are unlikely to be very popular with students, even if the discussions on their forums appear to be thriving. Thus we would not be wise to encourage instructors to act totally as 'ghosts in the wings': SAO students appreciated instructors who contributed often, even if that meant that the students themselves contributed less. Did they, for example, appreciate those instructor contributions just because the instructors saved them the effort of answering all the difficult questions, or did they feel that they really learnt more when instructors contributed more? Although the rate of student participation and the length of their discussion threads may be common intuitive ways used by instructors to judge the 'health' of their discussion forums, it is far from clear from this study that they are useful measures to judge the quality of the learning taking place there. Clearly, we need better measures of the quality of interactions in a discussion forum.

As SAO discussion forums are assessable, it could be hypothesized that the marks that students received for their discussion contributions may have provided another measure of the health of a forum. However this is not an independent test, as the same instructors who contributed to varying degrees to the discussions also marked the students' forum contributions. Further, the course content material varied from class to class, and so the usefulness of pre and post testing techniques would also have been limited.

In the process of this study, a number of possibilities for future work have suggested themselves. We intend to analyze more closely the way in which instructors post in discussions, what happens when forums tend to be dominated by a few 'vocal' students, and the effects on discussions of the numbers of participants in a discussion forum. Another key issue to study is just how generalizable are our results. We would like to see a similar analysis with other mature age, lifelong online learners, and also analyses of the interactions of young, undergraduate, on-campus students and their instructors in discussion forums, to see if similar correlations emerge. However

even if the results of this study turn out to be relevant only to enthusiastic online, lifelong learners, students like ours represent a growing market for online educational programs. It is still important to study how best to facilitate learning through online discussions for special interest groups like the SAO students.

In the specific case of the SAO program, the results of this study and future work will be used to help counsel new instructors on how much they should intervene in SAO discussion forums, and what forms that intervention should take. To the extent that this research is generalizable, we hope that it will help to increase our understanding of the ways in which instructor participation may influence student interactions in discussion forums. A useful measure of the quality of forum discussions remains elusive—we need to find more subtle measures of the effectiveness of asynchronous discussion forums for learning and teaching.

Acknowledgements

We would like to acknowledge the help of the Swinburne Quality Education Unit and the members of the Swinburne Astronomy Online Team, plus useful discussions with Drs. Carolyn Owen and Alex Mazzolini.

References

Eastmond, D. V. (1995). *Alone but together—adult distance study through computer conferencing*. Cresskill, NJ: Hampton Press.

Frankola, K. (2000). *Why online learners drop out*. Available:http://www.workforce.com/feature/00/07/29/.

Germany, L., & Mazzolini, M., (2002). Swinburne astronomy online—a world-wide classroom. In: *Proceedings of the Tenth United Nations/European Space Agency Workshop on Basic Space Science: Exploring the Universe—Sky Surveys, Space Exploration, and Space Technologies, Seminars of the United Nations Programme on Space Applications* (13, pp. 13–18), New York: United Nations.

Hiltz, S. R. (1994). *The virtual classroom—learning without limits via computer networks*. Greenwhich, CT: Ablex Publishing Corporation.

Mazzolini, M. (2000). Assessment techniques in an online astronomy course. *Publications of the Astronomical Society of Australia*, *17*, 141–144.

Mazzolini, M. (2002). The use of online discussion forums as a learning and teaching tool in astronomy. *Publications of the Astronomical Society of Australia*, *19*, 448–454.

Paloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace—effective strategies for the online classroom*. San Francisco: Jossey-Bass.

Paloff, R. M., & Pratt, K. (2001). *Lessons from the cyberspace classroom—the realities of online teaching*. San Francisco: Jossey-Bass.

Rosman, M. H. (1999). Successful online teaching using an asynchronous learner discussion forum. *JALN*, *3*(2). Available: http://www.aln.org/alnweb/journal/Vol3_issue2/Rossman.htm.

Salmon, G. (2000). *E-moderating: the key to teaching and learning online*. London: Kogan Page.

Solomon, J., & Mazzolini, M. How can the computer help students in this age of life long learning? In *Proceedings of the 2001 ICPEC International Conference on Physics Education in Cultural Contexts*. Korea National University of Education, 13–17 August (in press).

Thomas, C. (2001). *On line or face-to-face: which is the better way to "talk"?* Available: http://iiswinprd03.petersons.com/distancelearning/code/articles/distancelearnface7.asp.