Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses

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This paper looks at factors affecting student satisfaction with and perceived learning from asynchronous online learning. It reports on an empirical investigation that explored relationships between student perceptions and course design factors in 73 SUNY Learning Network courses in the Spring, 1999 semester. The study found that three general factors – clarity of design, interaction with instructors, and active discussion among course participants – significantly influenced students' satisfaction and perceived learning. Such findings are related to various kinds of interactivity and a 'community of inquiry' model of online learning.

Introduction

Asynchronous online courses have important features in common. Kearsley (2000), for example, asserts that the virtual classroom is a 'unique social context, much different from that of a regular classroom'. On the other hand, online classes can be as various as face-to-face classes. Indeed, researchers have argued that the structure (Romiszowski & Cheng 1992), transparency (Eastmond 1995), and communication potential (Irani 1998) of course designs heavily impact upon students' satisfaction, learning, and retention in online courses. This paper investigates these and other design factors in the unique environment of asynchronous online learning in terms of their relationships to student satisfaction and perceived learning in online courses. It relates these empirical findings to notions of interactivity and a 'community of inquiry' model of online learning.

Background

Many believe that the defining characteristic of the computing medium, if one can think of the computer as a single medium at all, is its interactivity (Bolter 1991; Landow 1992; Murray 1997; Turkle 1997). Indeed, researchers concerned with computer-based education have identified

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three kinds of interactivity that may affect learning in online courses: interaction with content, interaction with instructors, and interaction with classmates (Moore 1989). Of course, none of the three modes of interaction function independently in practice. Interaction among students, for example, is supported by instructor facilitation and support and, because it centres on content, can be seen as a variety of that type of interaction. These forms of interaction, however, provide useful lenses for thinking about interaction online.

Indeed, a useful way of thinking about the three forms of interaction is provided by Rourke *et al.'s* 'community of inquiry' model of online learning (figure 1). If one equates cognitive presence in this model with interaction with content, teaching presence with interaction with instructors, and social presence with interaction among students, it gives a good representation of how all three work together to support learning online.

FIGURE 1
**Community of inquiry model of online learning
(Rourke *et al.* 2000)**
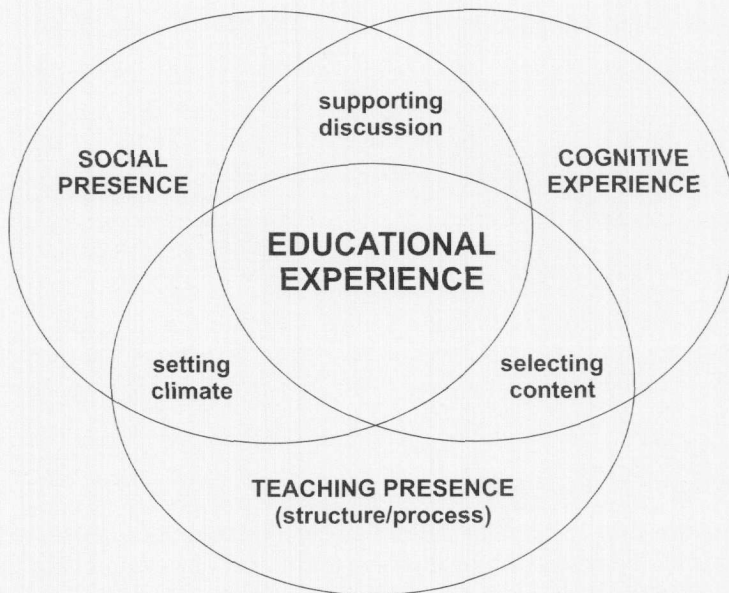
Although interaction with content has been well researched in other media domains, interaction with instructors and interaction with classmates have been most investigated to date in the asynchronous online medium. These literatures are reviewed below.

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Interaction with content

In spite of the fact that, in general, learners are aware of the enormous amount of content available through the World Wide Web (WWW), many are overwhelmed by it. Shank (1998), however, warns that information is not learning. Indeed, researchers agree that many computer-based educational offerings provide poor learning opportunities (Bork 1986; Janicki & Liegle 2001). What we do know about design for online learning has been extrapolated from research on computer-based learning in general, and multimedia design in particular. Janick and Liegle (2001) have synthesised the work of a range of instructional design experts in these areas (Anderson & Reiser 1985; Gagne, Briggs & Wager 1988; Hannafin & Peck 1988; Tennyson 1989; Jonassen *et al.* 1995; Ward & Lee 1995) to develop a list of ten concepts they believe support effective design of Web-based instruction. These are:

- Instructors acting as facilitators
- Use of a variety of presentation styles
- Multiple exercises
- Hands-on problems
- Learner control of pacing
- Frequent testing
- Clear feedback
- Consistent layout
- Clear navigation
- Available help screens

While it is reasonably well accepted that these design principles support computer-based learning, it remains to be seen whether or not they can be applied to online courses. Further research in these areas is definitely needed.

Interaction with instructors

The relationship between student-teacher interactions and learning outcomes has been well documented in traditional classrooms (Madden & Carli 1981; Powers & Rossman 1985). Of particular importance in face-to-face classrooms is teacher immediacy and immediacy behaviours. 'Immediacy' refers to the 'psychological distance between communicators' (Weiner & Mehrabian 1968). Educational researchers have found that teachers' verbal (i.e. giving praise, soliciting viewpoints, humour, self-disclosure) and nonverbal (i.e. physical proximity, touch,

eye contact, facial expressions, gestures) immediacy behaviours can lessen the psychological distance between themselves and their students, leading (directly or indirectly, depending on the study) to greater learning (Kelley & Gorham 1988; Gorham 1988; Christophel 1990; Rodriguez, Plax & Kearney 1996).

It stands to reason that interactions with instructors would be equally important online. This has led certain researchers to suggest that asynchronous media, because they support fewer affective communication channels, are less capable of representing the 'social presence' of participants in online courses (Short, Williams & Christie 1976). Researchers experienced with online teaching and learning, however, contest this view, arguing that rather than being impersonal, computer-mediated communication often seems to be 'hyper-personal' (Walther 1994).

Participants in computer-media communications, they argue, create social presence by projecting their identities and building online communities through verbal immediacy behaviours alone (Gunawardena & Zittle 1997; LaRose & Whitten 2000; Rourke et al. 2001; Richardson & Swan 2001).

Indeed, Picciano (1998) found that instructors' activity was related to students' perceived learning in online education courses. Jiang and Ting (2000) found correlations between perceived interactions with instructors and the average numbers of responses per student that instructors made and the average numbers of responses students themselves made in course discussions. Richardson and Ting (1999) compared the perceptions of two groups of students involved in asynchronous learning. They found that students learning through written correspondence with instructors were more concerned with instructor feedback, whereas students learning online felt that all interactions with instructors mattered.

Other researchers have investigated changing roles of teachers working in virtual classrooms. Coppola, Hiltz and Rotter (2001) assert that in any environment, teachers have three roles – cognitive, affective, and managerial. They found that online the cognitive role shifts to one of deeper complexity, the affective role requires faculty to find new tools to express emotion, and the managerial role requires greater attention to detail, more structure, and additional student monitoring. Anderson, Rourke, Garrison and Archer (2001) report similar categories of what they call 'teaching presence' (direct instruction, facilitating discourse, and design and organisation) and similar shifts in responsibilities. Finally, Fuller et al. (2000) used Myers-Briggs and Transaction Ability inventories to relate teaching tendencies and styles to instructor effectiveness and satisfaction in online environments. They identify four challenges for virtual instructors:

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- overcoming the faceless classroom

- adapting to student centered teaching

- managing time and techniques, and

- establishing the learning community.

Taken together, current research on teaching online seems to indicate a heightened need for instructor activity and interaction in online environments, as well as highlighting the overlap with content interactions (the need for attention to structure and design), and interaction among students (the need to establish the learning community). Clearly, online pedagogy deserves further investigation.

Interaction among students

Interactions among students through course discussions seem to be one of the most influential features of online courses (Swan *et al.* 2000). They are also the best-researched to date.

Wells (1992), for example, asserts that subjects that involve discussion, brainstorming, and reflection are best suited to the online format. Perhaps this is because online discussions are significantly different from face-to-face discussions. To begin with, all students have a voice and no students can dominate the conversation. The asynchronous nature of the discussion makes it impossible for even an instructor to control. Accordingly, many researchers note that students perceive online discussion as more equitable and more democratic than traditional classroom discussions (Harasim 1990; Levin, Kim & Riel 1990). In addition, because it is asynchronous, online discussion affords participants the opportunity to reflect on their classmates' contributions while creating their own, and on their own writing before posting them. This tends to create a certain mindfulness among students and a culture of reflection in an online course (Hiltz 1994; Poole 2000). Indeed, Gunawardena, Lowe and Anderson (1997) found evidence for construction of knowledge in online discourse.

However, as Eastmond (1995) reminds us, computer-mediated communication is not inherently interactive, but depends on the frequency, timeliness, and nature of the messages posted. Ruberg, Moore and Taylor (1996) found that computer-mediated communication encouraged experimentation, sharing of ideas, increased and more distributed participation, and collaborative thinking. They also found that for online discussion to be successful, it required a social environment that encouraged peer interaction facilitated by instructor structuring and support. Hawisher and Pemberton (1997) relate the success of the online courses they reviewed to the value instructors placed on discussion.

Students in these courses were required to participate twice weekly and 15% of their grades were based on their contributions. Picciano (1998) similarly found that students' perceived learning from online courses was related to the amount of discussion actually taking place in them. Likewise, Jiang and Ting (2000) report correlations between perceived learning in online courses and the percentage of course grades based on discussion, and between perceived learning and the specificity of instructors' discussion instructions.

Such findings indicate that interaction among students is an important factor in the success of online courses. This could lead us to suspect that collaborative learning activities might also be supportive of success. However, researchers who have investigated collaborative learning online have found it remarkably unsuccessful (Sturgill, Martin & Gay 1999; Hawisher & Pemberton 1997). Hmelo, Guzdial, and Turns (1998) suggest that asynchronous formats might not be appropriate for the negotiation of difficult issues that require rapid turn taking in conversation and shared access to objects that cannot be easily referenced in electronic spaces. Whether collaborative learning itself does not mesh well with asynchronous formats or we have yet to discover effective ways to support it remains to be seen and deserves further exploration.

In any case, research thus far indicates that online courses that are well structured and easy to use, that take advantage of increased access to instructors, and that feature more equitable and democratic discussion are the most successful. Such factors clearly deserve further investigation. In the sections which follow, we do just that. We first describe the SUNY Learning Network (SLN) and the methodologies we used to collect information from its students and courses in the spring of 1999. We then present and discuss our findings concerning the relationships between student perceptions and course design factors in selected SLN courses.

The SUNY Learning Network

The SUNY Learning Network is the infrastructure created to support asynchronous online courses for the 64 institutions and nearly 400 000 students of the State University of New York (SUNY) system. Its primary goals are to bring SUNY's diverse and high quality programs within the reach of learners everywhere, and to be the best provider of asynchronous online instruction it can. An additional objective has been to take an efficient approach in supporting the SUNY campuses. Rather than each campus developing its own online interface and support network, SLN has developed and implemented operational and support services that can be shared across the entire system.

The SUNY Learning Network started as a regional project involving campuses in the Mid-Hudson Valley. Its first courses were offered in the 1995–96 school year. With generous support from the Alfred P. Sloan Foundation, SUNY System Administration, and participating campuses, it grew from offering eight courses to 119 students in its initial year to offering more than 1 500 courses to over 15 000 students in the 2000–2001 school year.

The SUNY Learning Network is not a replacement for campus-based courses; rather, it is another option for students enrolled in SUNY programs. The SLN provides support for SUNY professors to take their traditional offerings online, using an SLN-developed Lotus Notes interface that is common to all courses.

The delivery of SLN courses is through five Lotus Domino servers to students who access them using common Web browsers. SLN has tried to be mindful of the requirements of the slower Internet access capabilities that students may have in their homes, and so works to keep resource-heavy media to a minimum. SLN students participate in each course as a cohort, starting and ending according to the calendar of the campus offering it. Participation, then, is asynchronous but not self-paced. While there are no mandatory synchronous activities, there are due dates for activities.

Individual faculty members are ultimately responsible for course development, but SLN and some campuses provide instructional design and technical support. This assistance is part of a well organised faculty development process. There are face-to-face, hands-on workshops, remote instructional design and technical support, as well as print and Web-based resources. Students get technical assistance seven days a week through the SLN Help Desk.

Methodology

In the spring of 1999, approximately 3 800 students were enrolled in 264 courses offered through SLN. At the end of the semester, students in all courses were asked to complete an online survey. The survey consisted of mostly multiple choice, forced-answer questions eliciting demographic information and information concerning students' satisfaction, perceived learning, and activity in the courses they were taking. Respondents were also given the opportunity to add open-ended comments to the survey.

A total of 1 406 students returned the survey. We believe that not only is this rate of return quite good, but that it is probably reasonably balanced. Although students not completing courses would not have returned the survey, the better students would not have completed it either because it

was given very late in the semester. One-way analyses of variance was performed on this data to look for significant differences in student satisfaction and perceived learning relative to students' demographics and perceptions of online learning. For the purposes of this paper, only significant differences in student satisfaction and perceived learning relative to student perceptions of their interactions with course content, instructors, and classmates in the courses are considered.

Because we were especially interested in actual course designs and the relationship between course design features and student perceptions, we also looked at 22 design features and course variables in a subset of the courses offered in the spring 1999 semester. We decided to examine only courses in which five or more students were enrolled and for which there was a 40% or greater rate of return on the student satisfaction survey. While such a methodology favours slightly larger courses, we felt it necessary because the alternative would have been to base such analyses on the perceptions of one or two students. This procedure left us with 73 courses, or 28% of the total courses offered. There were 1 108 students were enrolled in the courses whose design features we examined.

Two of the researchers separately examined each of the 73 courses and rated their content on twenty-two variables using Likert-type scaling. Ratings for each course were checked for agreement, and disagreements were resolved by consensus with reference to the courses themselves. Averages for student satisfaction, perceived learning, interaction with instructor, and interaction with peers were computed and added to individual course design records. Correlations were run to look for relationships between course design variables and student perceptions.

Results

Student survey data

The Spring 1999 SLN online survey consisted of eight demographic questions and 12 questions concerned with students' perceptions of their online learning experiences. These included their satisfaction, perceived learning, and activity in the courses they were taking. For the purposes of this paper, only these latter categories are relevant. Table 1 summarises those findings. It shows high levels of satisfaction with and perceived learning from SLN courses in the Spring 1999 semester. The findings also indicate that most students believed their level of interaction with the course materials, with their instructor, and with their peers was as high or higher than in traditional face-to-face courses.

TABLE 1
Spring 1999 student satisfaction survey
Student perceptions data (*N* = 1 406)

Satisfaction with course	very satisfied	49%
	satisfied	39%
	not very satisfied	8%
	not satisfied	4%
Perceived learning	more than expected	47%
	as much as expected	41%
	less than expected	11%
	nothing	1%
Perceived interaction with instructor	a great deal	31%
	sufficient	53%
	insufficient	14%
	none	2%
Perceived interaction with classmates	a great deal	20%
	sufficient	56%
	insufficient	16%
	none	8%
Personal activity in course *	much higher	20%
	higher	25%
	about the same	35%
	less	20%

* 'Compared to classroom-based instruction, how would you rate your level of activity in this course?'

Indeed, student comments show that in many cases respondents felt that the asynchronous format actually supported interactivity and involvement:

'I feel that I had many opportunities to be a part of my learning process – more than in other classes. In a traditional setting, students usually don't get to participate as much, but in this class I felt like I took a much more active role in my learning.'

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'Student participation was all online discussion. I found this much better than I had guessed it would be at the beginning of the term. Being able to reflect before responding and being able to look forward and backward in a discussion was very beneficial.'

'I really enjoyed the online discussions. Students who normally would not participate in class did; people who would normally dominate class discussions couldn't; and you could focus on discussing the specific things you were interested in. This is the best form of class participation I have seen.'

These results suggest that both the technology and our technological literacy have evolved to a point where asynchronous online environments can support teaching and learning that is perceived to be as effective as teaching and learning in regular classrooms. Of course, we believe these findings in part derive from the care given to designing the SLN interface, and from the hard work of the SLN multimedia instructional designers (MIDs) who helped instructors tailor existing courses to the asynchronous format. Indeed, they can be contrasted with Sturgill, Martin and Gay's (1999) findings that students believed that technology had a negative effect on their learning.

We had several ideas about online learning before we started this study. Some of these were amenable to investigation using one-way analyses of variance with student satisfaction and perceived learning as the dependent variables. These analyses and the results they generated are highlighted below in terms of their relationship to various kinds of interactivity (Moore 1989; Rourke *et al.* 2001).

Interaction with content

Students who reported higher levels of activity in courses also reported higher levels of satisfaction and higher levels of learning from them.

In the online survey, students were asked to compare their personal activity in the course they took with their activity in a traditional classroom. Forty-five per cent rated their activity as 'higher' or 'much higher' than in face-to-face classrooms, and 35 per cent rated it as 'about the same'.

It stands to reason that students who are more active in courses, online or off, will be more satisfied with them and will learn more from them. Analyses of variance confirmed these hypotheses. Significant differences in student satisfaction $(F_{(3,1402)} = 44.21, p < .01)$ and perceived learning $(F_{(3,1402)} 90.20, p < .01)$ were found among students reporting differing levels of activity in the online courses they were taking. Students who rated their level of activity as high also reported significantly higher levels of course satisfaction and significantly higher

levels of perceived learning. Frequent and engaging interaction (in whatever manner) with course content thus was shown to be an important course design feature. These results support Moore's (1989) concern with interactivity, as well as Rourke, *et al.'s* (2001) 'community of inquiry' model. Future research should investigate this area further and seek to distinguish better between types of interactions.

Interaction with instructor

Students who had high perceived levels of interaction with the instructor also had high levels of satisfaction with the course and reported higher levels of learning than students who thought they had less interaction with the instructor.

Student-teacher interaction has been shown to significantly affect learning in both regular classrooms (Madden & Carli 1981; Powers & Rossman 1985; Kelly & Gorham 1988; Christophel 1990; Rodriguez, Plax & Kearney 1996) and online (Jiang & Ting 2000; Picciano 1998; Richardson & Ting 1999; Swan *et al.* 2000). In the online survey, students were asked whether they had 'a great deal', 'sufficient', 'insufficient', or no interaction with their instructors. Eighty-four per cent reported that they interacted with their instructor a great deal or sufficiently. Interestingly, two percent reported no interaction with their instructor at all.

Analyses of variance indicated that student-teacher interaction was indeed strongly related to student satisfaction and perceived learning in Spring, 1999 SLN courses. It revealed significant differences in student satisfaction $(F_{(3,1402)} = 188.97, p < .01)$ and perceived learning $(F_{(3,1402)} = 168.25, p < .01)$ among students interacting with their instructors at differing perceived levels. Students who reported low levels of interaction with their instructors also reported the lowest levels of satisfaction with their courses and the lowest levels of learning. In contrast, students who reported high levels of interaction with their instructors also reported higher levels of satisfaction with their courses and higher levels of learning from them.

These findings, although expected, do highlight the importance of student-teacher interactions in asynchronous online environments. Students who do not have adequate access to their instructors feel they learn less and are less satisfied with their courses. While not precise indicators of learning effectiveness, these factors are nonetheless important in themselves. They show, for example, that it may not be possible to 'automate' teaching and learning online, or that at very least, some critical level of interactivity across categories needs to be maintained. In any case, the results clearly indicate that courses that include ample opportunity for interaction with instructors are preferable

to those with limited or no interaction, and that interaction with instructors is a crucial factor in online learning (Moore 1989; Rourke *et al.* 2001). Future research should explore the relationship between students and teachers online more deeply.

Interaction among students

Students who reported high levels of interaction with their classmates also reported higher levels of satisfaction and higher levels of learning from courses.

In the online survey, students were asked whether they had 'a great deal', 'sufficient', 'insufficient,', or no interaction with their classmates in the online courses they were taking. Seventy-six per cent reported a great deal or sufficient interaction; 24 per cent reported insufficient or no interaction.

Interaction with classmates is another important part of learning in regular classrooms. The importance of peer interaction online is suggested by research findings concerning discussion (Hawisher & Pemberton 1997; Jiang & Ting 2000; Picciano 1998; Swan *et al.* 2000; Richardson & Swan 2001; Rourke *et al.* 2001). We hypothesised that perceived interaction with classmates would affect student satisfaction and perceived learning in SLN courses as well. Analyses of variance confirmed this. Significant differences in students' satisfaction with the courses they were taking $(F_{(3, 1402)} = 68.91, p < .01)$ and perceived learning from them $(F_{(3, 1402)} = 50.27, p < .01)$ were found for differing levels of perceived peer interaction. Students who rated their level of interaction with classmates as high also reported significantly higher levels of course satisfaction and significantly higher levels of learning.

These findings support the theorising of Moore (1989) and Rourke *et al.* (2001), and point to the importance of creating opportunities for interaction among classmates in online courses. As even such seemingly simple interactive forums as whole class discussion require careful consideration and a great deal of facilitation online, it also suggests that future research might investigate the efficacy of differing methods for building and maintaining peer interaction.

Course design data

The SLN Spring 1999 student survey produced and supported some interesting findings (Swan *et al.* 2000). These findings, however, were based entirely on student perceptions; thus, we decided to explore actual course design factors and their relationship to the former. We examined only courses with five or more students enrolled and for which we had a 40% or greater return rate. Two of the researchers separately examined the 73 courses that met inclusion criteria. Ratings on 22 variables for each

course were checked for agreement, and disagreements were resolved by consensus with reference to the courses themselves. Tables 2 through 4 summarise the course variables examined and percentages of courses given particular ratings. For respondents in each of the 73 courses examined, averages of four student perceptions – satisfaction, perceived learning, interaction with instructor, and interaction with peers – were then added to individual course design records, and correlations were run to look for relationships between course design variables and those measures.

TABLE 2
Spring 1999 course design features: Structure frequency data* (*N* = 73)

Course level	freshman / sophomore	74%
	junior /senior	18%
	graduate	8%
Class size	< 10	31%
	11 to 20	51%
	21 to 30	14%
	> 30	4%
Textbook?	yes	92%
	no	8%
Number of modules	1 to 5	22%
	6 to 10	59%
	11 to 15	14%
	16 to 20	5%
Consistency	all modules have similar structure	10%
	most mods have similar structure	48%
	some mods have similar structure	34%
	no consistency among modules	8%
External links	none	41%
	< 10	26%
	11 to 25	18%
	26 to 50	10%
	> 50	5%
Instructor's voice	first person	6%
	second person	36%
	third person	30%
	mixed	28%
Interface/ graphics	dense text only	10%
	text only	20%
	text & graphic org.	44%
	text, graphics & images	26%

* percentages indicate percentage of courses examined

Table 2 summarises findings concerning the ways in which the courses we examined were structured. One interesting finding was that these were a good deal smaller than their offline equivalents. Almost one-third (31%) had ten or fewer students, and one-half (51%) had between 11 and 20 students. Only 4% of the courses had enrolments greater than 30, a typical size for undergraduate study. Indeed, class sizes of 11 to 20 students may be optimal for online formats because of the importance of teacher-student and student-student interactions within them.

Another interesting finding regarding interface issues was that few of the courses had many links to external sites. Indeed, 26% of them had fewer than ten links and 41% had no links at all. Thus, fully two-thirds of the courses we examined made virtually no use of what many scholars (Bolter 1991; Landow 1992; Lanham 1993) consider a defining characteristic of the WWW – linking by association (Bush 1945). Such findings may indicate that course designers have been more influenced by the constraints of online environments than by their affordances. It might be interesting to investigate this idea further.

Table 3 shows findings concerning the six aspects of course design we thought might affect interactivity and that were explored in the selected courses. These included: frequency of interaction with the instructor and whether or not any gaps in that interaction existed, frequency of interaction among classmates, required student participation in course discussions, the authenticity of that discussion, and the average length of discussion responses.

In general, these findings reflect student perceptions and so suggest that students' perceptions concerning interactivity were a pretty good reflection of reality. The results give additional credibility to student reports, and suggest that they provide at least a viable starting point for thinking about online learning.

Table 4 summarises assessment data. The vast majority of the courses we looked at (74%) had assignments due weekly, and only eight per cent had assignments due less frequently than every other week. This seems to contrast with traditional course assessments at the college level. The finding again highlights online students' need for activity and contact. It may also be another example of the ways in which course designers are influenced by the constraints (rather than the affordances) of online environments.

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TABLE 3
Spring 1999 course design features: Interactivity frequency data* ($N = 73$)

Interaction with instructor	every 1 to 3 days	44%
	every 4 to 8 days	45%
	every 9 to 15 days	8%
	< every 15 days	3%
Gaps?	yes	64%
	no	36%
Interaction among classmates	every 1 to 3 days	7%
	every 4 to 8 days	41%
	every 9 to 15 days	22%
	< every 15 days	19%
	never	11%
Required participation in discussion	every 1 to 3 days	4%
	every 4 to 8 days	53%
	every 9 to 15 days	12%
	< every 15 days	18%
	not required	13%
Authenticity of discussion	extremely authentic	18%
	very authentic	48%
	somewhat authentic	22%
	not authentic	12%
Average length of discussion responses	no discussion	8%
	< 5 lines	14%
	5 to 10 lines	59%
	10 to 20 lines	18%
	> 20 lines	1%

* percentages indicate percentage of courses examined

TABLE 4
Spring 1999 course design features: Assessment frequency data* (N = 73)

Assignments due	> every 15 days	8%
	every 9 to 15 days	18%
	every 4 to 8 days	73%
	every 1 to 3 days	1%
Percentage of grade based on discussion	none	18%
	< 10%	7%
	10% to 25%	49%
	26% to 50%	25%
	51 to 75%	1%
	> 75%	0%
Percentage of grade based on papers	none	63%
	< 10%	1%
	10% to 25%	14%
	26% to 50%	11%
	51 to 75%	3%
	> 75%	8%
Percentage of grade based on other written assignments	none	42%
	< 10%	6%
	10% to 25%	18%
	26% to 50%	23%
	51 to 75%	10%
	> 75%	1%
Percentage of grade based on projects	none	71%
	< 10%	0%
	10% to 25%	11%
	26% to 50%	12%
	51 to 75%	4%
	> 75%	2%
Percentage of grade based on quizzes and tests	none	43%
	< 10%	0%
	10% to 25%	16%
	26% to 50%	27%
	51 to 75%	7%
	> 75%	7%
Percentage of grade based on cooperative or group work	none	87%
	< 10%	4%
	10% to 25%	7%
	26% to 50%	1%
	51 to 75%	1%
	> 75%	0%
Percentage of grade based on other assessments	none	86%
	< 10%	0%
	10% to 25%	6%
	26% to 50%	3%
	51 to 75%	1%
	> 75%	4%

* percentages indicate percentage of courses examined

The other assessment variables we looked at concerned the percentages of course grades that were based on differing kinds of assignments. Of interest here is the finding that almost three-quarters of the courses we examined based ten to 50 per cent of their course grades on students' contributions to online discussion. The other two most frequently used forms of assessment were written assignments, and quizzes and tests, which were employed in a little over half the courses examined. These findings suggest quite dramatic changes are being made in course structures to accommodate online formats. These changes seem to be in the direction of collective activities (Murray 1997; Turkle 1997) and constructivist pedagogies (Palinscar 1998). Further research should investigate such responses to the material characteristics of online teaching and learning (Haas 1996).

Correlations were run to test for relationships between course design features and the four student perception variables for which course averages were computed – student satisfaction, perceived learning, perceived interaction with the instructor, and perceived interaction with peers. Because rankings along the various course design variables were not normally distributed and their direction unknown, two-tailed Spearman's correlations were employed. Significant correlations are highlighted and discussed below in terms of their relationship to the three kinds of interactivity highlighted in the research (Moore 1989; Rourke et al. 2001).

All four student perception variables – student satisfaction, perceived learning, perceived interaction with the instructor, and perceived interaction with peers – were highly interrelated, but not identical.

Student satisfaction with the courses they were taking and their perceived learning from them were the most highly correlated variables we examined ($r = .784, p < .01$). They clearly did not measure the same perceptions, however, as some of the correlations with course design variables were significant for one but not for the other.

Correlational analyses also showed that the more interaction students believed they had with the instructor, the more satisfied they were with their courses ($r = .761, p < .01$) and the more they thought they learned ($r = .707, p < .01$). Similarly, the more interaction students believed they had with other students, the more satisfied they were with their courses ($r = .440, p < .01$), and the more they thought they learned ($r = .437, p < .01$). These findings reinforce the similar results from the analyses of variance run on the full data from Spring, 1999, and suggest that the smaller data set taken from 73 courses is representative of the whole. It is also interesting to note in regard to relationships among satisfaction, perceived learning, and interactivity that interaction with

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instructors seemed to have a much larger effect on satisfaction and perceived learning than did interaction with peers. This finding lends further support to the contention that interactions with instructors are critical factors in the success or failure of online learning (Jiang & Ting 2000; Picciano 1998; Swan *et al.* 2000).

Perceived interaction with course instructors and perceived interaction with peers were also highly correlated ($r = .517, p < .01$). Taken together these results give further evidence for the overlap the three categories of interaction suggested by Rourke *et al.* (2001).

Interaction with content

The greater the consistency among course modules, the more satisfied students were, the more they thought they learned, and the more interaction they thought they had with their instructors. The lower the number of modules in a course, the more students believed they learned from it.

Significant correlations were found between structural consistency among course modules and student satisfaction ($r = .333, p < .01$), perceived learning ($r = .474, p < .01$), and interaction with instructor ($r = .451, p < .01$). All of these correlations favoured greater consistency. In addition, perceived learning was found to be related to the number of modules in the course ($r = .338, p < .01$). The fewer the number of modules a course had, the more likely students were to report higher levels of learning from it. The strength and persistence of these correlations demonstrate the superiority of straightforward course designs with relatively few, similarly structured modules, of content clarity for supporting interaction with content. They support previous findings that link course structure to student satisfaction, learning, and retention (Romiszowski & Cheng 1992; Eastmond 1995; Irani 1998). Taken together, the findings highlight the fact that, lacking face-to-face communication, it is easy for students to get confused or lost in complex course structures making interaction with content more difficult. Course designers should keep this in mind and strive for both simplicity and redundancy.

It is perhaps also interesting to note in regards to interaction with content factors which did not show significant correlations with any of the student perception variables. No correlations were found between these and the use of graphical interfaces or between these and the number of links to external Websites. These are factors that anecdotal reports suggest matter to students' satisfaction with online learning. It is possible that our rating scales for these factors were imprecise and so obscured results. On the other hand, it may be that students as well as designers are

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sensitive to the constraints of online formats – in this case, downloading constraints, which, of course, will change. The notion clearly invites revisitation in the future.

Another interesting non-significance involves assessment. The only correlations between student perceptions and assessment factors involved percentage of grades based on discussion and cooperative work. No correlations were found between any student perception and percentages of course grades based on papers, other written assignments, projects, quizzes and tests, or anything else. It is hard to know what to make of this finding. Perhaps these latter assessments function in much the same way online as off and so went relatively unnoticed by students. On the other hand, it is possible that, at least within the SLN network, instructors and course designers have yet learned to exploit direct interaction with content in a positive way. Interactive exercises, for example, might make more of a difference in student perceptions. Still another possibility is that interaction with content is to a large measure accomplished through interactions with instructors and other students in online environments, and so was subsumed by other measures in this study.

In any case, interaction with content remains under-researched and something of a mystery in online teaching and learning. It definitely deserves further investigation.

Interaction with instructor

Students' perceptions of interaction with their instructors were related to the percentage of the course grade that was based on discussion and to the frequency of instructor feedback.

As previously noted, a correlation was found between students' perceived interaction with the instructor and the percentage of the course grade that was based on discussion ($r = .307, p < .01$). The greater the percentage of course grades based on discussion, the more interaction students believed they had with their instructors. In addition, students' perceived interaction with their instructor and the actual frequency of instructor feedback approached significance ($r = .269, p < .01$). These findings, while weaker than findings concerned with peer interactions, once again demonstrate the accuracy of student perceptions, and highlight the importance of instructor feedback and participation in class discussions. They also replicate the findings of Picciano (1998) and Jiang and Ting (2000).

It is also important to remember that student perceptions of interaction with their instructors were highly correlated with both satisfaction ($r = .761, p < .01$) and perceived learning ($r = .707, p < .01$). Perhaps the quality of interaction with instructors is more important than the

quantity of interactions. Qualitative analyses of these interactions might provide more answers in this regard and is an area deserving of future research. In any case, taken together, the results clearly indicate that instructors' activity is an important factor in the success of online learning.

In this vein, it is also interesting to note course design factors related to interaction with instructors for which no significant results were found. Neither class size nor student achievement levels, factors which are known to influence student perceptions in traditional classes, correlated significantly with any of the student perception variables. This lack of results, at the very least, indicates differing relationships between teachers and students in the online environment. It may be, for example, that instructors in face-to-face classes are limited in the amount of attention they can give to students in larger classes, whereas instructors in online classes are not. The notion surely deserves further investigation.

Another course design factor we thought might influence student perceptions was instructor voice. Our hypothesis was that more familiar forms of address in course lectures, for example, would help bridge the gap created by the lack of face-to-face communications. The results don't bear this out, but again our instruments may have been imprecise. On the other hand, it may be that other kinds of interactivity with instructors, instructor participation in discussions and instructor feedback on assignments in particular, far outweigh the tone of lectures. Positive correlations for both of these factors point in such direction. In any case, interaction with instructors is clearly a rich area for future research.

Interaction among students

The greater the percentage of the course grade that was based on discussion, the more satisfied the students were, the more they thought they learned from the course, and the more interaction they thought they had with the instructor and with their peers.

The correlation between the percentage of the course grade that was based on discussion and students' satisfaction with courses was significant ($r = .381, p < .05$). The correlation between the percentage of the course grade that was based on discussion and perceived learning approached significance ($r = .286, p < .10$). Thus, students were more satisfied with courses and believed they learned more when greater value was placed on discussion. Higher values put on discussion were also found related to greater perceptions of instructor ($r = .307, p < .05$) and peer interaction ($r = .455, p < .10$). Taken together, these findings point to the importance of discussion, and in particular to the value put on discussion, in the success of online courses. The findings also suggest

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that shared discourse among students and between students instructors has a positive effect on student satisfaction with courses. They support previous findings linking the valuing of discussion to student satisfaction and learning (Hiltz 1994; Gunawardena & Zittle 1997; Hawisher & Pemberton 1997; Picciano 1998; Jiang & Ting 2000; Poole 2000; Richardson & Swan 2001), and further demonstrate the importance of online discussion.

The greater the percentage of the course grade that was based on cooperative or group work, the less students thought they learned from the course.

Our results also show, however, that the greater the percentage of the grade that was based on cooperative or group work, the less students believed they learned from the course ($r = .320$, $p < .05$). This finding replicates those of other researchers who have explored collaborative learning online (e.g. Hawisher & Pemberton 1997; Sturgill *et al.* 1999). Student comments indicate that it was difficult to get group members to work together on projects in the few courses in which collaborative learning was tried. This may stem from embedded problems with asynchronicity (Hmelo *et al.* 1998). On the other hand, it may stem from instructor naivete concerning collaborative work. None of the nine courses which utilised collaboration employed such factors as interdependency and individual responsibility to maximise the collaborative experience (Johnson & Johnson 1992). Future research clearly should explore this issue further and look for ways to successfully employ collaborative strategies online.

Students' perceptions of interaction with their peers were related to actual interactions in courses, the percentage of the course grade that was based on discussion, required participation in discussions, and the average length of discussion responses.

A strong correlation was found between students' perceptions of their interactions with peers and the actual frequency of interactions between students ($r = .398$, $p < .01$). This finding demonstrates the accuracy of student perceptions of peer interactions. We also found correlations between students' perceived interaction with peers and the percentage of the course grade that was based on discussion ($r = .455$, $p < .01$), the required frequency of participation in discussion ($r = .369$, $p < .05$), and the average length of discussion responses ($r = .353$, $p < .01$). High levels of perceived interaction among students was related to actual interactivity, high values placed on discussion, greater required participation, and longer discussion responses. The results replicate previous findings (Hiltz 1994; Picciano 1998; Jiang & Ting 2000). Taken together, they suggest that discussion fosters interactivity among students and that several factors contribute to successful online discussions. Some

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of these are the value instructors place on discussion, the frequency of participation in discussions they require, and the average length of students' discussion responses. Clearly these deserve further investigation. Because of the demonstrable importance of online course discussions, qualitative analysis of discussion responses might also yield interesting and informative results.

Conclusions

The lack of significant correlations between student perceptions and so many course design features highlights the importance of the findings that were significant. The research findings on computer-mediated communication and asynchronous online learning, both those reported in the literature and the findings reported in this paper, are quite consistent. They point to three factors that contribute significantly to the success of online courses. These are a clear and consistent course structure, an instructor who interacts frequently and constructively with students, and a valued and dynamic discussion. It is our belief that this combination of factors is not an accident, but rather that they jointly support interaction with course content, interaction with course instructors, and interaction among course participants; that they jointly support the development of online communities of inquiry (Rourke *et al.* 2001). Many in the online education field believe that the development of such communities is critical to the success of online courses (Harasim 1990; Hiltz 1994; Moller 1998). Wegerif (1998), for example, relates the success or failure of individuals enrolled in Open University courses to the extent to which they can 'cross the threshold' from feeling like outsiders to becoming a part of the community. Romiszowski & Corso (1990) suggest that computer mediated communication is essentially social constructivist in nature. It may be uniquely so (Kearsley 2000). Support for students' interactions with content, instructors, and classmates clearly deserves the attention of online developers and instructors alike, and further investigation by the educational research community.

References

Anderson, J. & Reiser, B. 1985, 'The LISP tutor', *Byte Magazine*, vol. 10, no. 4, pp. 159–75.

Anderson, T., Rourke, L., Garrison, D.R. & Archer, W. 2001, Assessing teaching presence in a computer conferencing context, paper presented at the Annual Meeting of the American Educational Research Association, Seattle, WA.

Bolter, J.D. 1991, *The Writing Space: The Computer, Hypertext and the History of Writing*. University of North Carolina Press, Chapel Hill, NC.

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Bork, A. 1986, 'Advantages of computer-based learning', *Journal of Structured Learning*, vol. 9, no. 1, pp. 63–76.

Bush, V. 1945, 'As we may think', *The Atlantic Monthly*, July, pp. 101–08.

Christophel, D. 1990, 'The relationship among teacher immediacy behaviors, student motivation, and learning', *Communication Education*, vol. 39, no. 4, pp. 323–40.

Coppola, N.W., Hiltz, S.R. & Rotter, N. 2001, Becoming a virtual professor: Pedagogical roles and ALN, HICSS 2001 Proceedings, *IEEE Press*, January.

Eastmond, D.V. 1995, *Alone But Together: Adult Distance Study Through Computer Conferencing*, Hampton Press, Cresskill, NJ.

Fuller, D., Norby, R.F., Pearce, K. & Strand, S. 2000, 'Internet teaching by style: Profiling the on-line professor', *Educational Technology and Society*, vol. 3, no. 2, pp. 75–89.

Gagne, R., Briggs, L. & Wager, W. 1988, *Principles of Instructional Design*, Holt Reinhardt & Winston, New York.

Gorham, J. 1988, 'The relationship between verbal teacher immediacy behaviors and student learning', *Communication Education*, vol. 37, no. 1, pp. 40–53.

Gunawardena, C.N., Lowe, C.A. & Anderson, T. 1997, 'Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing', *Journal of Educational Computing Research*, vol. 17, no. 4, pp. 397–431.

Gunawardena, C. & Zittle, F. 1997, 'Social presence as a predictor of satisfaction within a computer mediated conferencing environment', *American Journal of Distance Education*, vol. 11, no. 3, pp. 8–26.

Haas, C. 1996, *Writing Technology: Studies on the Materiality of Literacy*, Erlbaum, Mahwah, NJ.

Hannafin, M. & Peck, K. 1988, *The Design, Development, and Evaluation of Instructional Software*, MacMillan Publishing, New York.

Harasim, L. 1990, *On-line Education: Perspectives on a New Environment*, Praeger, New York.

Hawisher, G.E. & Pemberton, M.A. 1997, 'Writing across the curriculum encounters asynchronous learning networks or WAC meets up with ALN', *Jounal of Asynchronous Learning Networks*, vol. 1, no. 1 [Online].

Hiltz, S.R. 1994, *The Virtual Classroom: Learning Without Limits via Computer Networks*, Ablex, Norwood, NJ.

Hmelo, C.E., Guzdial, M. & Turns, J. 1998, 'Computer support for collaborative learning: Learning to support student engagement', *Journal of Interactive Learning Research*, vol. 9, no. 2, pp. 107–29.

Irani, T. 1998, 'Communication potential, information richness and attitude: A study of computer mediated communication in the ALN classroom', *ALN Magazine*, vol. 2, no. 1 [Online].

Janicki, T. & Liegle, J.O. 2001, 'Development and evaluation of a framework for creating Web-based learning modules: A pedagogical and systems approach', *Journal of Asynchronous Learning Networks*, vol. 5, no. 1 [Online].

Jiang, M. & Ting, E. 2000, 'A study of factors influencing students' perceived learning in a Web-based course environment', *International Journal of Educational Telecommunications*, vol. 6, no. 4, pp. 317–38.

Johnson, D.W. & Johnson, R. 1992, *Positive Interdependence: The Heart of Cooperative Learning*, Interaction, Edina, MN.

Jonassen, D., Davidson, M., Collins, M., Campbell, J. & Haag, B. 1995, 'Constructivism and computer mediated communication in distance education', *American Journal of Distance Education*, vol. 9, no. 2, pp. 7–25.

Kearsley, G. 2000, *Online Education: Learning and Teaching in Cyberspace*, Wadsworth, Belmont, CA.

Kelley, D. & Gorham, J. 1988, 'Effects of immediacy on recall of information', *Communication Education*, vol. 37, no. 2, pp. 198–207.

Landow, G. P. 1992, *Hypertext: The Convergence of Contemporary Critical Theory and Technology*, Johns Hopkins University Press, Baltimore, MD.

Lanham, R. A. 1993, *The Electronic Word: Democracy, Technology, and the Arts*, University of Chicago Press, Chicago.

LaRose, R. & Whitten, P. 2000, Re-thinking instructional immediacy for Web courses: A social cognitive exploration, *Communication Education*, no. 49, pp. 320–38.

Levin, J.A., Kim, H. & Riel, M.M. 1990, 'Analyzing instructional interactions on electronic message networks', in *On-line Education: Perspectives on a New Environment*, ed. L. Harasim, Praeger, New York, pp. 16–38.

Madden, M. & Carli, L. 1981, *Students' satisfaction with graduate school and attributions of control and responsibility*, paper presented at the Annual Meeting of the Eastern Psychological Association, New York, March.

Moller, L. 1998, 'Designing communities of learners for asynchronous distance education', *Educational Technology Research and Development*, vol. 46, no. 4, pp. 115–22.

Moore, M.G. 1989, 'Three types of interaction', *American Journal of Distance Education*, vol. 3, no. 2, pp. 1–6.

Murray, J.H. 1997, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace*, The Free Press, New York.

Palincsar, A. 1998, 'Social constructivist perspectives on teaching and learning', *1998 Annual Review of Psychology*, no. 49, p. 345.

Picciano, A. 1998, 'Developing an asynchronous course model at a large, urban university', *Journal of Asynchronous Learning Networks*, vol. 2, no. 1 [Online].

Powers, S. & Rossman, M. 1985, 'Student satisfaction with graduate education: Dimensionality and assessment in college education', *Psychology: A Quarterly Journal of Human Behavior*, vol. 22, no. 2, pp. 46–9.

Poole, D.M. 2000, 'Student participation in a discussion-oriented online course: A case study', *Journal of Research on Computing in Education*, vol. 33, no. 2, pp. 162–77.

Richardson, J. & Swan, K. 2001, An examination of social presence in online learning: Students' perceived learning and satisfaction, paper presented at the annual meeting of the American Educational Research Association, Seattle, WA, April.

Richardson J. & E. Ting, E. 1999, Making the most of interaction: What instructors do that most affect students' perceptions of their learning, paper presented at the 5th International Conference on Asynchronous Learning, College Park, MD, October.

Rodriguez, J.L., Plax, T.G. & Kearney, P. 1996, 'Clarifying the relationship between teacher nonverbal immediacy and student cognitive learning: Affective learning as the central causal mediator', *Communication Education*, no. 45, pp. 293–305.

Romiszowski, A.J. & Cheng, E. 1992, 'Hypertext's contribution to computer-mediated communication: In search of an instructional model', in *Interactive Multimedia Learning Environments*, ed. M. Giardina, Springer, Berlin, pp. 174–91.

Romiszowski, A.J. & Corso, M. 1990, Computer mediated seminars and case studies, paper presented at the 15th World Conference on Distance Education, Caracas, Venezuela, August.

Rourke, L., Anderson, T., Garrison, D.R. & Archer, W. 2001, 'Assessing social presence in asynchronous text-based computer conferencing', *Journal of Distance Education*, vol. 14, no. 2 [Online].

Ruberg, L.F., Moore, D.M. & Taylor, C.D. 1996, 'Student participation, interaction, and regulation in a computer-mediated communication environment: A qualitative study', *Journal of Educational Computing Research*, vol. 14, no. 3, pp. 243–68.

Shank, R. 1998, 'Horses for courses', *Communication of the ACM*, vol. 41, no. 7, pp. 23–5.

Short, J., Williams, E. & Christie, B. 1976, *The Social Psychology of Telecommunications*, Wiley, Toronto.

Sturgill, A., Martin, W. & Gay, G. 1999, 'Surviving technology: A study of student use of computer-mediated communication to support technology education', *International Journal of Educational Telecommunications*, vol. 5, no. 3, pp. 239–59.

Swan, K., Shea, P., Fredericksen, E., Pickett, A, Pelz, W. & Maher, G. 2000, 'Building knowledge building communities: Consistency, contact and communication in the virtual classroom,' *Journal of Educational Computing Research*, vol. 23, no. 4, pp. 389–413.

Tennyson, R. 1989, 'Cognitive science and instructional technology: Improvements in higher order thinking strategies', *Proceedings of the Association of Educational Communication and Technology*, AECT, Dallas, TX, pp. 168–72.

Turkle, S. 1997, *Life on the Screen: Identity in the Age of the Internet*, Simon & Schuster, New York.

Walther, J. 1994, 'Interpersonal effects in computer mediated interaction', *Communication Research*, vol. 21, no. 4, pp. 460–87.

Ward, E. & Lee, J. 1995, 'An instructors' guide to distance learning', *Training and Development*, vol. 29, no. 1, pp. 40–4.

Wegerif, R. 1998, 'The social dimension of asynchronous learning networks', *Jounal of Asynchronous Learning Networks*, vol. 2, no. 1, [Online].

Weiner, M. & Mehrabian, A. 1968, *Language Within Language: Immediacy, A Channel in Verbal Communication*, Appleton-Century-Crofts, New York.

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