BAYWOOD REPRINTS

Journal of
Educational Computing Research

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BUILDING KNOWLEDGE BUILDING COMMUNITIES: CONSISTENCY, CONTACT AND COMMUNICATION IN THE VIRTUAL CLASSROOM*

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ABSTRACT

This article looks at factors affecting the success of asynchronous online learning both through a review of the research literature and through an empirical investigation of student perceptions and course design factors in one of the largest asynchronous learning networks in the country. It finds that three such factors—consistency in course design, contact with course instructors, and active discussion—have been consistently shown to significantly influence the success of online courses. It is posited that the reason for these findings relates to the importance of building knowledge building communities in asynchronous online learning environments.

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Among the many and various possibilities occasioned by the growth of the Internet and the World Wide Web (WWW), one of the most promising is the virtual classroom. Indeed, asynchronous online learning is so promising that most institutions of higher education, as well as some corporate newcomers, are rushing to mount WWW- and Internet-based courses. In the rush to create such courses, however, the major focus has too often been on technological issues, whereas, as Mason argues, "Social and pedagogical issues play by far the bigger part in the creation of a successful [online] learning environment [1, p. 52]."

Two kinds of social/pedagogical questions, it seems, must be considered:

- Questions about learners, such as: Can all learners benefit from online learning? Do all learners benefit equally? What kinds of learners are best suited to the asynchronous online learning experience?; and
- Questions about course design, such as: Are particular subject areas and/or topics more or less suited for online learning? What pedagogical strategies are most effective in asynchronous online courses? What course design factors most influence learning online?

In this article, we examine such questions. We first review the literature on the effects of learner characteristics and course design features on student satisfaction and learning online. We then report our own findings on these topics from data collected in the spring of 1999 from the 3,800 students enrolled in 264 courses through the SUNY Learning Network (SLN). Finally, we discuss these findings in the light of social constructivist theory.

LEARNER CHARACTERISTICS

Studies of computer-mediated communication and online learning report that most students are very satisfied with the medium [2-4], although Kearsley reports some dissatisfaction among students taking online courses at the Universities of Utah and Oregon [5]. Similarly, most studies report no difference in learning achievement between students taking courses online and students enrolled in traditional, face-to-face classes [2, 5-9]. Kearsley reports higher exam scores among the same students at the University of Oregon who were dissatisfied with computer-mediated communication [5].

At the same time, the demographics for students pursuing online learning tend to differ from those of traditional college students. Students taking courses online tend to be older, more motivated, and have a more serious attitude than traditional students [5]. Such findings have led researchers to posit that the students most likely to both take and succeed in asynchronous online courses share particular characteristics.

One characteristic that might be a prerequisite for success online is computer experience. Martinez and Sweger, for example, found that students without a certain level of computer skills had trouble taking advantage of

computer-mediated communication [10], and Sturgill, et al. note that students without adequate computer skills experienced frustration trying to work collaboratively over distance [11]. As interfaces become friendlier and the general population becomes more computer literate, computer skill may cease to be an issue.

Another characteristic that has been investigated relative to success with online learning is gender. Females tend to outnumber males in online courses by two to one [4]. Some have suggested that this is no accident, that women are better suited to the medium than men [12]. Others argue the opposite. Blum, for example, reports that men tend to silence women in online discussion in much the same way they do in face-to-face communication [13]. Still others report no differences among genders in success in online learning or attitudes toward it [14].

Perhaps a more interesting line of research concerning student characteristics and online learning involves learning styles. Becker and Dwyer, for example, compared students using groupware for online collaboration [15]. They found that more visual learners tended to prefer the use of the groupware, while more verbal learners preferred face-to-face communication. Dille and Mezack tested for locus of control and found that students who were more internal were also more successful online [16]. Douzenis gave both the Kolb Learning Style Inventory and the Group Embedded Figures Test (GEFT) to students involved with online learning at Georgia Southern University [17]. Using multiple regression techniques, she found that higher achievement in online classes was linked to field independence and both divergence and accommodation as indicated on the Learning Styles Inventory. Miller similarly reports that field independent students are more satisfied with online learning than field dependent students [18]. On the other hand, Kearsley reports that neither learning styles nor learning strategies affected Iowa State students' achievement in an online zoology course.

The findings concerning relationships between student characteristics and success with online learning are thus, various and often contradictory. They are also quite interesting. Perhaps the most intriguing findings are the common demographics for students involved. It may be that these are a proxy for motivational factors that predict success with learning online. Perhaps students for whom time and/or distance are problematic give courses that solve such problems the serious attention they need. In any case, questions concerning learner characteristics for success in online courses clearly deserve further investigation.

COURSE DESIGN FACTORS

In the previous section, online learning was approached as a singular phenomenon, and indeed all asynchronous online courses have important features in common. Kearsley, for example, asserts that the virtual classroom is a "unique social context, much different from that of a regular classroom" [5]. On the other hand, online classes can be as various as face-to-face classes.

In addition, online course interfaces are students' sole connection to instructors, peers, and the course materials, so their impact is magnified. Indeed, researchers have argued that the structure [19], transparency [20], and communication potential [21] of course interfaces heavily impact students' satisfaction, learning, and retention in online courses. Of particular importance, it seems, is the ability of the interface to facilitate interactions between students and between teachers and students.

The relationship between student-teacher interactions and learning outcomes has been well documented in traditional classrooms [22, 23]. It stands to reason that interactions with instructors would be equally important online. Indeed, Picciano found that instructors' activity was related to students' perceived learning in online education courses [24]. Richardson and Ting compared the perceptions of two groups of students involved in asynchronous learning [25]. 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. Jiang and Ting found correlations between perceived interactions with instructors and the average number of responses per student that instructors made and the average numbers of responses students themselves made in course discussions [4].

Indeed, course discussions seem to be one of the most influential features of online courses. Wells asserts that subjects that involve discussion, brainstorming, and reflection are best suited to the online format [26]. 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 [27-30]. 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 it. This tends to create a certain mindfulness among students and a culture of reflection in the course.

However, as Eastmond reminds us [20], computer-mediated communication is not inherently interactive, but depends on the frequency, timeliness, and nature of the messages posted. Indeed, Hawisher and Pemberton relate the success of the online courses they reviewed to the value instructors placed on discussion [31]. Students in these courses were required to participate twice weekly and 15 percent of their grades were based on their contributions. Picciano found that students' perceived learning from online courses was related to the amount of discussion actually taking place in them [24]. Likewise, Jiang and Ting report correlations between perceived learning and the percent of course grades based on discussion, and between perceived learning and the specificity of instructors' discussion instructions [4].

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 [11, 27, 31]. 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.

In any case, research thus far indicates that online courses that are both well structured and easy to use and that take advantage of increased access to instructors and 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 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 from a student survey and a content analysis of selected SLN courses.

THE SUNY LEARNING NETWORK

The SUNY Learning Network is the infrastructure created to support asynchronous online courses for the sixty-four institutions and nearly 400,000 students of the State University of New York (SUNY) system. It's 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 1995-1996 school year. With generous support from the Alfred P. Sloan Foundation SUNY System Administration and participating campuses, it has grown from offering eight courses to 119 students in its initial year to offering more than 1,000 courses to over 11,000 students in the 1999-2000 school year.

SLN is not a replacement for campus-based courses; rather it is another option for students enrolled in SUNY programs. What SLN does is provide 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 keep in mind the requirements of the slower Internet access capabilities that students may have in their homes, and so to keep resources 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 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-organized 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.

Fourteen hundred and six (1,406) students returned the survey. The findings reported here are thus based on a 38 percent return rate. 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. Because we were interested in factors that might affect student perceptions concerning online learning, we performed a series of one-way analyses of variance to look for significant differences in student satisfaction and perceived learning relative to other factors measured. A complete breakdown of survey responses and findings from these analyses are given in the results section which follows.

Because we were especially interested in actual course designs and the relationship between course design features and student perceptions, we also looked at certain 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 percent or greater rate of return on the student satisfaction survey. While such a methodology favors 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 seventy-three courses, or 28 percent of the total courses offered. Eleven hundred and eight (1,108) students were enrolled in the courses we examined.

Two of the researchers separately examined each of the seventy-three 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. These findings as well as breakdown of course ratings are given in the results section which follows.

STUDENT SURVEY RESULTS

The Spring 1999 SLN online survey consisted of eight demographic questions and twelve questions concerned with students' satisfaction, perceived learning, and activity in the courses they were taking. Table 1 summarizes demographic findings from the survey; Table 2 summarizes findings concerning student perceptions of SLN courses.

Table 1 shows that the demographics for students taking SLN courses in the spring of 1999 are consistent with profiles reported in the literature. Two findings that stand out and perhaps deserve mention involve students' proximity to campus and prior computing skills.

It was expected that distance would be a major factor in decisions to take courses online. Almost half the respondents (48%), however, lived within thirty minutes of the campuses offering the courses they were taking. Although the results show that for at least some SLN students distance was a factor, they clearly indicate that time may be equally important. Indeed, when asked to choose their primary reason for taking an online course, only 12 percent of the respondents chose "distance or lack of transportation," while the majority chose either "conflicts in personal schedule" (37%) or "family responsibilities" (15%).

We were also surprised by the very large numbers of students reporting confidence in their computer skills (88%). This may seem unimportant, as Internet connectivity is a requirement for enrollment, but considering the numbers of enrollments in SLN courses, it may be indicative of changing patterns of computer literacy.

Table 2 summarizes student perceptions concerning SLN courses. It shows very high levels of satisfaction and perceived learning. Of particular interest in this regard are the high numbers of students who believed the technology had a positive effect on their learning.

The findings also indicate that most students believed their level of interaction with their instructor, with their peers, and with the course materials was as high or higher than in traditional face-to-face courses. Student comments show that in many cases respondents felt that the asynchronous format actually supported interactivity and involvement:

> 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.

Table 1. Spring, 1999 Student Satisfaction Survey
Demographic Data ($N = 1,406$)

Age	16 to 25	36%
	26 to 35	28%
	36 to 45	26%
	45 to 55	9%
	> 55	1%
Gender	Male	33%
	Female	67%
Academic level	Freshman/Sophomore	37%
	Junior/Senior	36%
	Graduate Student	14%
	Non-Matriculated	13%
Employment	Full-time	52%
	Part-time	31%
	Not Employed	17%
Proximity to campus	< 30 minutes away	48%
	30 minutes to 1 hour away	25%
	1 to 2 hours away	9%
	> 2 hours away	18%
Online experience	1st online course	73%
	2nd online course	14%
	3rd or more online course	13%
Prior computer skills	No skills	2%
	Low skills	10%
	Average skills	38%
	High skills	50%
Reason for taking course online	Distance or lack of transportation	12%
	Conflicts in personal schedule	37%
	Course not offered on campus	13%
	Family responsibilities	15%
	Interest in technology/Internet	10%
	Other	13%

Table 2. Spring 1999 Student Satisfaction Survey
Student Perceptions Data ($N = 1,406$)

Satisfied 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 peers	A great deal	20%
	Sufficient	56%
	Insufficient	16%
	None	8%
Personal Activity*	Much higher	20%
	Higher	25%
	About the same	35%
	Less	20%
Satisfied with SLN	Very satisfied	43%
	Satisfied	50%
	Not very satisfied	6%
	Not satisfied	1%
Satisfied with online learning	Very satisfied	63%
	Satisfied	28%
	Not very satisfied	6%
	Not satisfied	3%
Positive effect of technology**	Strongly agree	34%
	Agree	51%
	Disagree	13%
	Strongly disagree	2%
Future online course?	Yes, as many as possible	44%
	Yes, some additional courses	37%
	Undecided	11%
	No, not unless it was necessary	5%
	Never	3%

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

**Do you think that the technology involved had a positive effect on your learning the course content?

> I feel that I had many opportunities to be 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.

> 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.

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 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, et al.'s findings that students believed the technology had a negative effect on their learning [11].

Relationships among Survey Variables

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 in this section. For the most part, only significant findings are reported. One lack of significance, however, surprised us enough to be considered meaningful. It is reported first.

Students who reported higher levels of computer skills before taking an online course were no more satisfied with the course than students reporting little or no computer experience. Similarly, students who reported higher levels of computer skills before taking an online course reported levels of learning similar to those who reported having little or no computer experience prior to taking the course.

Previous research led us to believe that students with greater computer skills would be more satisfied with online courses and perceive that they were learning more from them than students with little or no computer experience [10, 11]. To test the assumption, one-way analyses of variance were run with computer skill as the independent variable and student satisfaction and perceived learning as the dependent variables. No significant results were found ($p > .05$). In fact, mean satisfaction and perceived learning ratings for students who reported higher computer skills before taking courses were actually lower than those of students who reported less initial skill. Students who rated themselves as having the lowest levels of computer skills had the highest levels of satisfaction with the courses and

reported the highest levels of learning from them. Perhaps these perceptions are related to what these students learned about computers in addition to the regular course content. In any case, the data thus do not support the hypothesized relationships between computer skills and course satisfaction, or between computer skills and perceived learning. These findings do, however, support our earlier contention that the technology has evolved to a point where even students with little or no computer skills can successfully complete online courses.

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 [22, 23] and online [24, 25]. Our results indicate that student-teacher interaction was indeed strongly related to students satisfaction and perceived learning in SLN online courses. One-way analyses of variance showed 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. Conversely, 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 or learning effectiveness, these factors are none-the-less important in themselves. They show, for example, that it may not be possible to "automate" teaching and learning online. 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 future research should explore the relationship between students and teachers online.

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

Interaction with classmates is another important part of learning in regular classroom. The importance of peer interaction online is suggested by research findings concerning discussion [4, 24, 31]. We hypothesized that perceived interaction with classmates would affect student satisfaction and perceived learning in SLN courses as well. Analysis of variance bore this out. 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 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 is also suggests that future research might well investigate the efficacy of differing methods for building and maintaining peer interaction.

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

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. Opportunities for frequent and engaging participation thus were shown to be important course design features. These results, taken together with findings concerning interaction with instructors and peers, point to the importance of building scholarly communities in online courses. Future research should examine such issues in depth.

Gender affected course satisfaction and perceived learning. Women were more likely than men to be satisfied with the courses they took and to report higher levels of learning from them.

Pilot testing of the student survey led us to believe that few gender differences would be found. We were surprised, therefore, to see significant gender differences in student satisfaction ($F_{(1,1404)} = 20.27, p < .01$) and perceived learning ($F_{(1,1404)} = 13.72, p < .01$). Women reported significantly higher levels of satisfaction and perceived learning than did men. In examining these findings, we found small but reliable differences suggesting that the women responding to our survey were also more likely to feel that they participated at higher levels online than they did in traditional classrooms. We think perhaps that because online discussion cannot be dominated by anyone, women felt more freedom to participate, and so were more satisfied and felt they learned more. Their comments support such possibility:

> I am one of those students who probably wouldn't said Boo in class. I think that I have learned much more in this course than I have in the other 4 courses I have taken. It is nice to read what others are thinking and express yourself. It's more open and I really think you get more out of this type of class.

> I am someone who is shy and often has a difficult time speaking in class. I am one of those people who would like to share, or thinks that they have a good answer, yet does not share. This made it a lot easier for me to state my actual feelings about what I thought, because I did not have 20 people staring at me as I spoke.

Such notions deserve further investigation.

Students' direct and indirect motivation for taking courses affected their satisfaction with them and their perceived learning from them.

Common sense suggests that students who are more motivated to take courses will learn more from them and be more satisfied with their learning. This notion, also suggested by online student demographics [4, 5, 12], was supported by analyses of variance that examined relationships between both students' reason for taking courses and their age, and the dependent variables of satisfaction and perceived learning.

Significant differences were found in students' satisfaction ($F_{(5,1400)} = 3.52$, $p < .01$) and perceived learning ($F_{(5,1400)} = 2.99$, $p < .05$) SLN among students having differing reasons for taking them. Students who reported taking courses because of space and time constraints were more likely to express their satisfaction with them and to believe they learned more from them than students who reported enrolling in online courses for other reasons. Perhaps students who have a real need for the greater flexibility afforded by online learning are both more appreciative of their benefits and more motivated to learn.

Significant differences were also found between students of differing ages in both their satisfaction with online classes ($F_{(5,1400)} = 8.13$, $p < .01$) and their perceived learning from them ($F_{5,1400} = 9.52$, $p < .01$). Students in the thirty-six to forty-five year-old range were the most likely to report high levels of satisfaction and perceived learning from their courses. Students in this age range often have both familial and professional responsibilities. Many are seeking education to keep their jobs or obtain better ones. They may, then, have higher expectations and a more serious attitude toward their learning, and so may be more motivated than younger or older students. In any case, motivation seems to have an influence on online learning and deserves further investigation.

COURSE DESIGN RESULTS

The SLN Spring 1999 student survey produced and supported, as we have seen, some interesting findings. 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 percent or greater return rate. Two of the researchers separately examined the seventy-three courses that met inclusion

criteria. Ratings on twenty-two variables for each course were checked for agreement, and disagreements were resolved by consensus with reference to the courses themselves. Tables 3 and 5 summarize the course variables examined and percentages of courses given particular ratings. 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 3 summarizes findings concerning the ways in which the courses we examined were structured. One interesting finding is 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 eleven and twenty students. Only 4 percent of the courses had enrollments greater than thirty, a typical size for undergraduate study. We don't believe these findings are an anomaly. Rather we believe that class sizes of eleven to twenty students are probably 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 percent of them had fewer than ten links and 41 percent had no links at all. Thus, fully two-thirds of the courses we examined made virtually no use of what many scholars [32-34] consider a defining characteristic of the World Wide Web—linking by association [35]. Such findings may indicate that course designers have been more influenced by the constraints of online environments than by their affordances.

Table 4 shows findings concerning the six aspects of interactivity that were explored in the selected courses. In general, our findings 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 5 summarizes assessment data. The vast majority of the courses we looked at (74%) had assignments due weekly, and only eight percent 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.

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 fifty percent 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

Table 3. 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 models	1 to 5	22%
	6 to 10	59%
	11 to 15	14%
	16 to 20	5%
Consistency	All mods. have similar structure	10%
	Most mods. have similar structure	48%
	Some Mods. have similar structure	34%
	No consistency among mods.	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	Dense text only	10%
	Text only	20%
	Text and graphic organization	44%
	Text, graphics and images	26%

*Percentages indicate percentage of courses.

Table 4. Spring 1999 Course Design Features:
Interactivity Frequency Data* ($N = 73$)

Instructor Interaction	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%
Student-Student Interaction	Every 1 to 3 days	7%
	Every 4 to 8 days	41%
	Every 9 to 15 days	22%
	< Every 15 days	19%
	Never	11%
Req. 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

collectives activities [36, 37] and constructivist pedagogies [38]. Further research should investigate such responses to the material characteristics of online teaching and learning [39].

Correlations between Course Design Features and Student Perceptions

Correlations were run to test for relationships between course design features and four student perception variables—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.

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 shown in some of the correlations with course design variables that were significant for one but not for the other. Correlational analyses also show 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 ($r = .707$). 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 ($r = .437$, $p < .01$). It is interesting to note in this regard, that interaction with instructors seemed to have a much larger effect on satisfaction and perceived learning than did interaction with peers. This finding lends further support to our contention that interactions with instructors are critical factors in the success or failure of online learning [35]. Perceived interaction with course instructors and perceived interaction with peers were also highly correlated ($r = .517$, $p < .01$).

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

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 that shared discourse among students and instructors has a positive effect on student satisfaction with courses. They support previous findings linking the valuing of discussion to student

Table 5. Spring 1999 Course Design Features:
Assessment Frequency Data* (*N* = 73)

Assignment due	> Every 15 days	8%
	Every 9 to 15 days	18%
	Every 4 to 8 days	73%
	Every 1 to 3 days	1%
% Grade based on discussion	None	18%
	< 10%	7%
	10% to 25%	49%
	26% to 50%	25%
	51% to 75%	1%
	> 75%	0%
% Grade based on papers	None	63%
	< 10%	1%
	10% to 25%	14%
	26% to 50%	11%
	51% to 75%	3%
	> 75%	8%
% Grade based on other written assignments	None	42%
	< 10%	6%
	10% to 25%	18%
	26% to 50%	23%
	51% to 75%	10%
	> 75%	1%
% Grade based on projects	None	71%
	< 10%	0%
	10% to 25%	11%
	26% to 50%	12%
	51% to 75%	4%
	> 75%	2%
% Grade based on quizzes and tests	None	43%
	< 10%	0%
	10% to 25%	16%
	26% to 50%	27%
	51% to 75%	7%
	> 75%	7%

Table 5. (Cont'd.)

% Grade based on coop/group work	None	87%
	< 10%	4%
	10% to 25%	7%
	26% to 50%	1%
	51% to 75%	1%
	> 75%	0%
% 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

satisfaction and learning [4, 24, 31], and further demonstrate the importance of discussion online.

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 [11, 27, 31]. 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. On the other hand, it may stem from instructor naivete concerning collaborative work. None of the nine courses which utilized collaboration employed such factors as interdependency and individual responsibility to maximize the collaborative experience [40]. Future research clearly should explore this issue further and look for ways to successfully employ collaborative strategies online.

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 ($r = .333$, $p < .05$), perceived learning ($r = .474$, $p < .01$), and interaction with instructor ($r = .451$, $p < .01$). All of these correlations favored 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. They support previous findings that link course structure to student satisfaction, learning , and retention [19-21]. Taken together, these findings highlight the fact that, lacking face-to-face communication, it is easy for students to get confused or lost in complex course structures. Course designers should keep this in mind and strive for both simplicity and redundancy.

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 ($r = .353, p < .01$). The results replicate previous findings [4, 24, 31]. Taken together, they suggest that discussion fosters interactivity among students and that several factors contribute to successful online discussions. Some 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.

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 ($r = .307, p < .05$). Students' perceived interaction with their instructor and the actual frequency of instructor feedback approached significance ($r = .269, p < .10$). 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 Jiang and Ting [4]. They again indicate that instructors' activity is an important factor in the success of online learning. The notion clearly deserves further investigation to explore just what sorts of instructor activity are most productive.

Sometimes it is also interesting to look at factors that didn't seem to make a difference. For example, the negative results concerning the many kinds of assessment that didn't seem to affect student perceptions suggest that any of these work reasonably well and are acceptable to students in online classes. It is probably the case that they function much the same online as off, and so went relatively unnoticed by students. Other interesting non-result concern students' achievement levels and class size. Achievement level and class size tend to affect student perceptions in face-to-face classes. That they didn't affect the perceptions of online students suggests that other factors may be at work there. It might be, for example, that while instructors give the members of smaller face-to-face classes more attention, they do not do the same, or appear to do the same, online. We are also puzzled by the lack of effects for external links, instructor voice, and graphical interfaces. These are all factors that anecdotal reports suggest matter in students' satisfaction with online courses. It is possible that our rating scales for the latter two were imprecise and so corrupted results. The lack of findings concerning external links suggests that students as well as designers may be more sensitive to the constraints of online formats than to their affordances. Finally, the lack of findings highlights the importance of the findings that were significant. They point to the importance of course designs with consistent structures, which value discussion, and which provide frequent opportunities for interaction with and feedback from instructors. These three factors, as we have seen, were repeatedly shown to be related to student satisfaction and perceived learning.

DISCUSSION

The research findings on computer-mediated communication and asynchronous online learning, both those reported in the literature and the findings reported in this article, are quite consistent. They point to three (and only three) factors that contribute significantly to the success of online courses. These are a transparent interface, an instructor who interacts frequently and constructively with students, and a valued and dynamic discussion. It is our believe that this combination of factors is not an accident, but rather that they jointly support the growth of what Scardamalia and Bereiter call "knowledge building communities [41]. We agree with many in the online education field that the development of such communities is critical to the success of online courses [29, 42]. Wegerif, 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 [43]. Romiszowski and Corso indeed suggest that computer-mediated communication is essentially social constructivist in nature [44]. It may be uniquely so [5]. The three factors consistently identified in the research as significantly affecting the success of online courses—transparency, instructor activity, and active discussion—may

thus represent three necessary steps in the evolution of online knowledge building communities.

The first step has to do with the design of the course interface. Students should feel comfortable with it; they should know where things are and what they need to do when. Because it takes some time to figure this out, course interfaces should be as consistent as possible. Learners need to feel at ease with an online learning environment before community building can take place.

The second step has to do with the activity of the course instructor. Students should feel connected to online community, and their first line of contact is through the course instructor. Instructors, particularly at the beginning of courses, need to welcome students, to encourage and guide their participation, to interact with them. Instructors also facilitate the development of online communities by modeling responsiveness and appropriate communication. It has been our experience that online students at all levels also need reassurance that they "are doing the right thing," perhaps because they do not have the nonverbal cues they would have in a face-to-face classroom. Only instructors can provide this. Active instructors thus play a critical, connecting role in the development of knowledge building communities.

The real heavy lifting in the development of knowledge building communities, however, is the knowledge building itself. This takes place through discussion. In active discussion, meanings are agreed upon, ideas negotiated, concepts evolved, knowledge constructed. For students to involve themselves in this time-consuming activity they must believe it is both valued and authentic. Thus, asynchronous online courses in which discussion counts for a significant percentage of the course grade, in which frequent participation in discussion is required, and in which discussion topics are both open and well specified are more successful than those in which it is not.

The identification through empirical research of these three factors—consistency in course design, contact with course instructors, and real communication through discussion—is both supported by social constructivist theory and supports social constructivist notions of the importance of the development of knowledge building communities. It also can guide the development of asynchronous online courses. It very well may be that other theoretical approaches can be successfully instantiated online. At present, however, the efficacy of social constructivist designs has been clearly demonstrated and surely deserves further, in-depth investigation.

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