Formative Evaluation of an Online Teaching Strategy:
Using Mixed Methods to Learn From the Student Experience

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Abstract

This study evaluated a theory-driven instructional strategy that was implemented in two sections of the same course, one online and the other in the classroom. Both were compared with a control course that was taught in the traditional lecture format in the classroom. Focusing on the opt-in nature of online learning environments, the innovative instructional strategy gave learners control of the ways they participated in the course. The author/instructor learned important lessons about how similar students could perform differently in teacher-centered and learner-centered environments.

Multiple methods of data gathering and analysis were used to answer questions about what worked well, for whom, and why. Key findings included differing impacts of course structure and delivery mode on student performance and retention, differing reactions of students to individual aspects of an innovative learning environment, and the value of using on-going evaluation to inform practice.

Introduction

The rush to bring a wide array of college courses online raises concerns about the effect of the online learning environment on students. Teachers engage their students in the classroom by virtue of the learning environment they generate. Whether they use active learning strategies with social engagement or deliver more traditional lectures, students are part of a familiar classroom community and generally know how to navigate the learning structure presented to them. Transporting this structure to the virtual classroom, essentially a computer screen, mouse and keyboard, can present many challenges for both teachers and learners.

For the most part, college teachers who teach online must develop their own content and construct an online learning environment from scratch. Even when course management tools such as WebCT (2002) or Blackboard (2002) are available, or when teachers are assisted by instructional technologists, the burden of designing the course content and pedagogy falls on teachers. It would be helpful to know which pedagogies are most effective for online students.

The online learning environment is primarily an opt-in environment. When students choose when and how often to connect to the course they lose some of the supportive scaffolding that is inherent in classroom courses. They must rely on their own sense of responsibility and internal monitoring of their need to "check in" or to participate in the activities of the course. In some ways, student-centered classrooms are also opt-in. When students chose how and to what extent to participate in classroom activities, or when lectures are based on questions posed by students rather than an outline the teacher has prepared in advanced, we might expect similar performance outcomes from online and classroom students.

This study evaluates a student-centered online learning environment grounded in recent learning theory. Formative evaluation questions are asked to determine ways in which the strategy could be improved to increase student performance and reduce attrition.

The Pedagogy

The pedagogy was designed to provide sufficient structure to be supportive of students while providing enough flexibility to meet the diverse needs of today's collegiate population, whether in physical or virtual classrooms. The *Adaptive Instructional Strategy* (A.I.S.) evaluated in this study (Kennedy, May 2000) is grounded in the concept of learner-centered teaching (e.g. Knowle's, 1998; Rogers, 1969), Moore's (1996) theory of transactional distance, and Vygotsky's (1978) theory of social constructivism. In learner-centered teaching the learner is viewed as an integral contributor in determining appropriate learning processes to be employed in a course. Transactional distance theory asserts that achievement is strongly associated with an interaction between learner autonomy and course structure. Less autonomous learners need, or may simply prefer, more teacher direction and formal structure than highly autonomous learners. Social constructivism emphasizes the importance of the learner actively seeking understanding as a strategy to improve learning; it can be contrasted with a teacher-centered approach that emphasizes student mastery of course content provided by lectures and texts. The A.I.S. pedagogy was expected to enhance students' readiness to learn by increasing their perception of course relevance and fostering their responsibility for learning. At the same time, the pedagogy

Student Quality (Variable)	Intended to Measure	Applicable Learning Theory	Instructional Strategy	Expected Benefits/Hindrances
• perception of course relevance	• motivation to learn v. perform	• social constructivism • situated cognition	• teacher as discipline expert and model of learning strategies • group discussions of realistic problems (case studies)	students who believe the course is relevant to them can come to better appreciate the discipline, attribute more value to the time they invest in the course, and become motivated to learn rather than perform
• responsibility for learning	• self-attribution for academic success • metacognitive maturity (learner autonomy) • study habits	• course structure (part of Transactional Distance, TD)	• optional course assignments • ungraded self-tests • optional lecture attendance	students with higher levels of responsibility do better in courses with less structure (more options) than students with lower levels; students with lower levels of responsibility benefit from courses with rigid structure and more interaction with teachers and/or peers; students with higher levels of responsibility dislike courses with extreme structure and interaction requirements
• preference for interacting with teachers	• social inclination • teacher attribution for academic success	• student-teacher interaction (part of TD) • situated cognition	• homework with feedback • teacher available by email • teacher welcomes novices to discipline	students with low preference for interacting with teachers come to appreciate teacher interaction more as a result of high interaction with teacher and community building; those with high preference suffer in courses with low teacher feedback
• preference for interacting with peers	• social inclination • "other" attribution for academic success	• student-student interaction (part of TD) • situated cognition • social constructivism	• group discussion of case studies and preparing for tests • students share experiences related to discipline area	students with low preference for interacting with peers come to appreciate group activities more as a result of community building; those with high preference will perform better with more student interaction

Figure 1. Relationship of Learner Readiness variables to learning theories and expected pedagogical outcomes.

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accommodated individual students' preferences for more or less interaction with their peers and the instructor, as well as their affinity for using technology. A primary aspect of the pedagogy is the flexibility it offers, such as communications alternatives and grading options, to enhance learner control of the course structure. A more detailed description of course features can be found in Appendix A.

Traditional approaches to evaluating the effects of teaching strategies on student outcomes typically rely on the use of demographic information to control for initial differences in students. Many studies control for age or years of schooling as a proxy for "academic preparation." This approach fails to recognize the differences one finds in students of the same age or same year in school. In addition, it fails to consider motivational aspects that may influence the effort a learner will expend in learning. This study utilizes four variables developed by the author to measure learner readiness: perception of course relevance, responsibility for learning, preference for interaction, and affinity for using technology (see Figure 1). The *Collegiate Learner Readiness Questionnaire* used to assess these variables was developed through three pilot tests involving over 800 students over a two year period (Kennedy, Aug. 2000). An IRT (Item Response Theory) analysis was performed to ensure that items fit the 4-variable cognitive model of learner readiness sufficiently well to differentiate students along each variable. Appendix B includes a complete description of each of the variables.
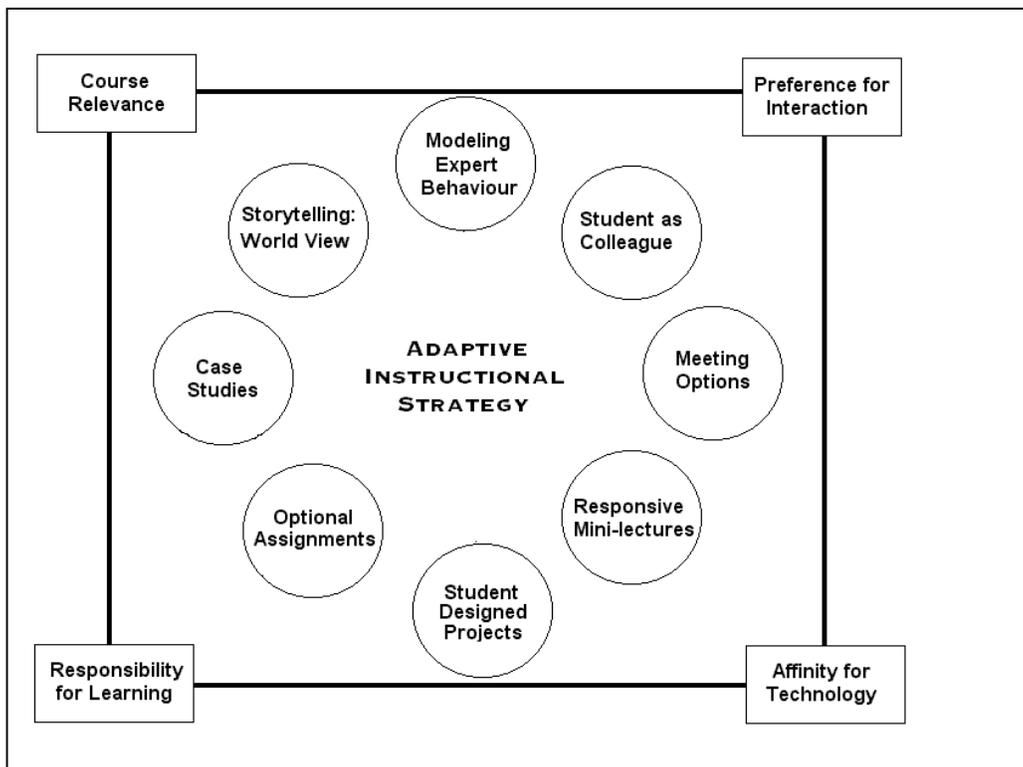

Figure 2. The Adaptive Instructional Strategy with consideration of Learner Readiness.

Figure 2 shows typical A.I.S. strategies, which are framed by consideration of characteristics of learner readiness. The two characteristics in the left corners, *Course Relevance* and *Responsibility for Learning*, are those that are intentionally influenced, or at least targeted, by the

pedagogy, while the two characteristics in the right corners, *Preference for Interaction* and *Affinity for Technology*, may change over the duration of a course but are not a central target of the pedagogy. On the other hand, *Preference for Interaction* and *Affinity for Technology* are expected to influence the choices learners make in participating in the course. For example, a student with a strong preference for interaction but low affinity for using technology may have difficulty in an online course where there is little opportunity for face-to-face meetings, but may participate extensively in group activities in a classroom version of the course. The figure also shows that *Affinity for Technology* may interact with *Responsibility for Learning* and *Preference for Interaction* by limiting or expanding opportunities for students to take advantage of technology-based strategies for learning or communicating. Similarly, perceived *Course Relevance* may also interact with *Preference for Interaction* and *Responsibility for Learning* by affecting the learner's prioritization of activities. If the student considers a course less relevant, he may not expend time in study activities or in interacting with the rest of the class.

One objective of the A.I.S. was to help students realize that the classes they enroll in are not simply hazards along an obstacle course that ends with a degree. By intentionally relating the course to students' lives and careers, by focusing on solving real-world problems instead of memorizing key terms in a textbook, and by introducing students to the culture of the discipline, instructors have the power to re-integrate learning into the student's way of life instead of relegating learning to an external activity that happens "at school."

The example modeled in Figure 3 shows how a student who initially thinks a course is not very relevant can have an improved learning outcome when enrolled in a course that has instructional components that address his or her individual needs and preferences. For example, if the student is already a "good student" who accepts responsibility for learning, he or she will benefit from a course that encourages engagement and active participation in the learning process rather than a course in which the student remains a relatively passive observer. If the student also prefers working independently, then a course that accommodates individual learning, rather than one that forces students to work collaboratively, will encourage the student to complete the course. The figure also suggests that a student who enjoys using technology would benefit from a course that encourages the use of technology for learning activities, because it capitalizes on another interest of the student. Taken together, these course components can improve the student's perception of course relevance and motivation to stay in the course and learn the material. On the other hand, less desirable course components, such as memorization exercises, group learning activities, and no technological learning components could further discourage the student and lead to withdrawal from the course.

For this study, I taught the course "Networks and Data Communications" using the Adaptive Instructional Strategy in a classroom and an online delivery mode. The purpose of the course is to introduce students to the field of networks and data communications, and to develop competence in applying the concepts and practices to a variety of situations students are likely to encounter, such as end-user Internet access, corporate work groups requiring device and document sharing, and e-commerce sites needing secure access to the Web. The most important skills to be developed in students are those of planning and designing a network and
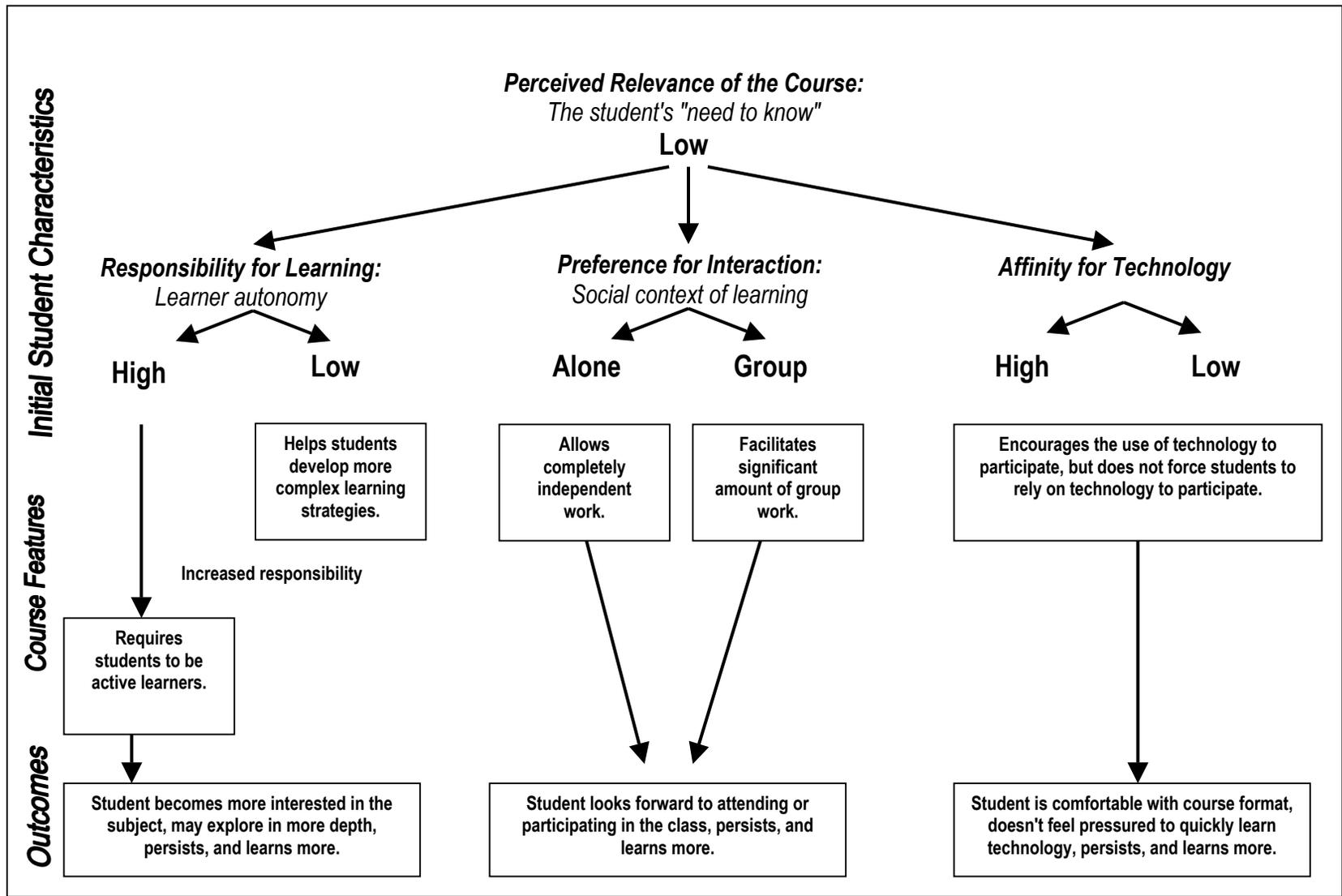
Initial Student Characteristics

Perceived Relevance of the Course:
The student's "need to know"
Low

Responsibility for Learning:
Learner autonomy

Preference for Interaction:
Social context of learning

Affinity for Technology

High   **Low**   **Alone**   **Group**   **High**   **Low**

Course Features

Helps students develop more complex learning strategies.	Allows completely independent work.	Facilitates significant amount of group work.

Encourages the use of technology to participate, but does not force students to rely on technology to participate.

Increased responsibility

Requires students to be active learners.

Outcomes

Student becomes more interested in the subject, may explore in more depth, persists, and learns more.

Student looks forward to attending or participating in the class, persists, and learns more.

Student is comfortable with course format, doesn't feel pressured to quickly learn technology, persists, and learns more.

Figure 3. Theory of student change through the Adaptive Instructional Strategy

troubleshooting common physical and logical problems. The course provides an introduction to the subject for students intending to study network engineering in more depth, for students who plan to develop Internet software applications, and for students who simply want to learn more about networks and the Internet for personal use. See Appendix C for a sample of course documents.

Evaluation Questions

Evaluation questions were grouped under two general questions:

I. Did the A.I.S. work as expected?
1. Did students' perception of course relevance increase more in the A.I.S. sections than in the traditional section?
2. Did students' responsibility for learning increase more in the A.I.S. sections than in the traditional section?
3. Were students with a high preference for interaction more likely to work with others in the classroom?
4. Were students with a high affinity for using technology more likely to interact online?

II. What happened?
5. Which course components were most strongly associated with performance on tests, course grades, and perseverance?
6. Were there differences in the use of the course components by specific groups of students?
7. Were there differences in the association of course components to student outcomes by course structure or delivery mode?
8. Which students were most successful in each type of course?

Methods

An important aspect of this study was development of a method to evaluate a teaching pedagogy in situ. Instead of restricting students to specific learning strategies in an unnatural way, and possibly using online technologies in artificial ways by simply mimicking classroom practices, I explore the strategies students choose when afforded options, and assess how these choices are associated with performance. In addition to traditional questions answering questions about "what happened," I also answered questions intended to develop a better understanding of "why things happened the way they did."

The sample population for the study was students enrolled in three sections of Computer & Information Science (CIS) 150, *Networks and Data Communications*, taught by the same instructor (the author) at College of San Mateo (CSM) in the Fall 2000 semester. One classroom section was taught in the traditional manner, another classroom section used the A.I.S. pedagogy, and the online section used the A.I.S. pedagogy. 190 students were enrolled in the three sections, with 166 students participating in the study.

Data used to answer the evaluation questions was gathered through administration of student questionnaires at the beginning and end of the semester, pre-tests of content knowledge administered at the beginning of the courses, email "interviews" of students conducted at the middle and end of the semester, and post-tests of content knowledge. Data was also gathered from teacher logs of how students interacted during class time, and computer logs of student participation in online chats and conferences. Questionnaires and interview protocols can be found in Appendix D.

166 students completed the initial *Collegiate Learner Readiness Questionnaire* in the second week of the semester. 25 students completed the email interviews in week 10 in response to an email request for an interview sent to 99 students who had provided an email address for this purpose at the time the initial questionnaire was administered (a research associate communicated with students to protect their anonymity). 128 students completed the *Exit Questionnaire* the week before taking their final exam. Participation logs were maintained for 190 students.

The mean values of the learner readiness characteristics of the respondents to the various instruments are shown below (Table 1). The only point of interest is that students who responded to the email interviews had a higher preference for interaction than respondents to the other instruments.

	Initial Quest.	Final Quest.	Email Interview	Std. Dev.
Initial Preference for Interaction	.14	.00	.45	1.10
Initial Responsibility for Learning	.25	.21	.27	1.35
Initial Perception of Course Relevance	.26	.32	.25	0.72
Initial Affinity for Using Technology	.23	.00	.27	0.79

Table 1 - Learner Readiness Characteristics of Instrument Respondents

Findings

1. Did students' perceptions of course relevance increase more in the A.I.S. sections than in the traditional section?

   Students were asked at the beginning of the semester and at the end of the semester why they were taking this course. As shown in Figure 4, at the start of the semester, students in the two classroom sections had similar perceptions of course relevance, while students in the online section had lower expectations of course relevance. This difference is statistically significant at the $\alpha = .01$ level ($p = .003$).

   By the end of the semester, students' perceptions of course relevance had converged somewhat, but students in the traditional course perceived of the course as less relevant to them than when they started, while students in the two A.I.S. courses perceived of the course as more relevant. The differences in mean perception of relevance at the end of the semester were not statistically significant, although the change in relevance was.
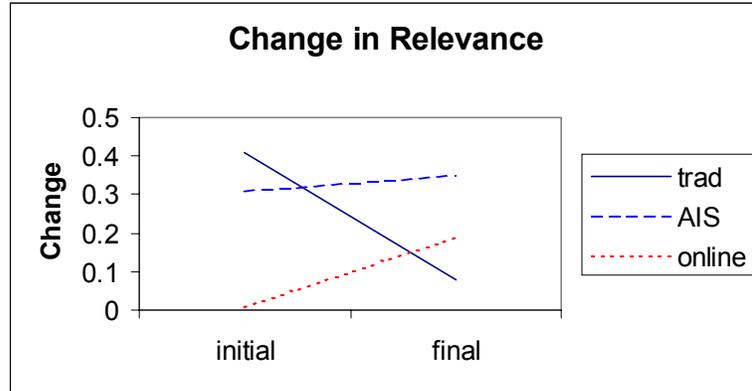
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Change in Relevance

Figure 4. Initial and final measures of student perception of course relevance.

Interview data tells another story, however, as shown in Figure 5. Students were asked how the course had affected their attitude about their course of study or career goals. Of the 25 interviews completed, 80% of the traditional students reported finding the course more relevant than they had expected by the middle of the semester. This compares with about 50% of students in the A.I.S. classroom course and 30% of students in the online course. This implies that for some students, the traditional approach worked well to increase their perceptions of course relevance.

Change in Course Relevance
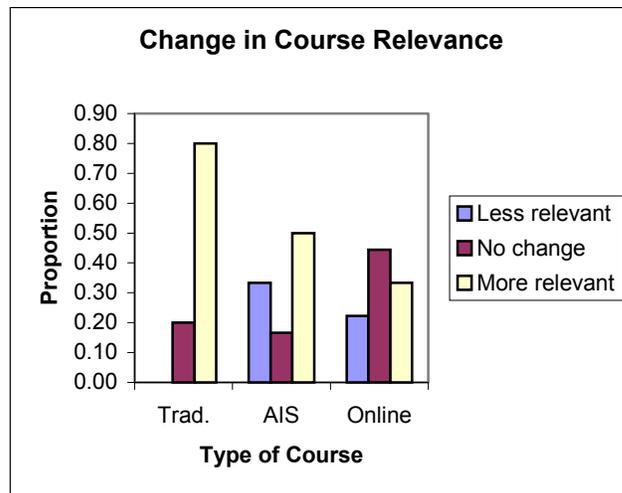
Figure 5. Summary of interview responses by type of change in course relevance.

Students completing the midterm email interviews were statistically different (at the $\alpha = .01$ level) from students who did not with regard to test scores, course grades, and completion rates, suggesting that "better students" completed the interviews.

2. Did students' responsibility for learning increase more in the A.I.S. courses than in the traditional course?

Here, students initially reported how they "usually" studied in courses they had taken in the past, and at the end of the semester they reported on how they had studied for this course. Again, in Figure 6 we see convergence by the end of the semester, but students in the A.I.S. classroom course were reporting higher levels of engagement in their past courses.
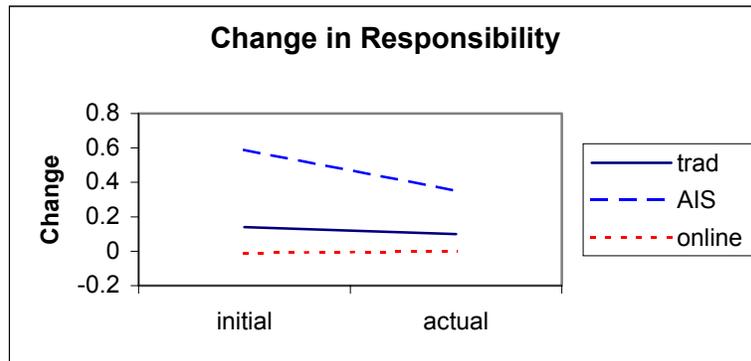
Figure 6. Initial measures of student responsibility for learning v. measures of what students actually reported doing in the course.

This decline for A.I.S. classroom students may be an outcome of extensive participation during class time. Some students may have found that this lightened their "homework" load significantly, so their perception was that they didn't work as hard in this course.

Figures 7 and 8 show student responses to interview questions. As shown in Figure 7, A.I.S. classroom students and online students recognized that the course structure encouraged students to discover information on their own rather than relying on the teacher to disseminate information, but only the A.I.S. classroom students reported that they felt they had improved their study skills during the semester. Figure 8 shows student responses to the
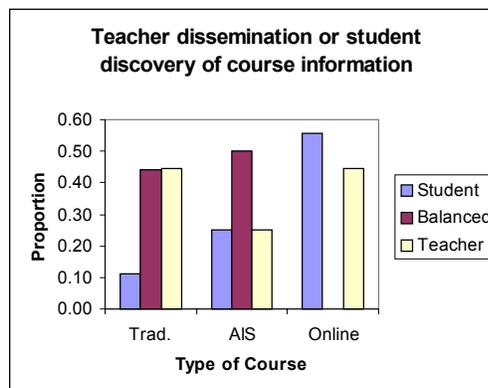
Figure 7. Summary of interview responses about who was responsible for accessing information.

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question of whether they had changed their approach to studying in this course. These findings suggest that student perceptions of how hard they are working may not match their actual activities.

Change in responsibility for learning
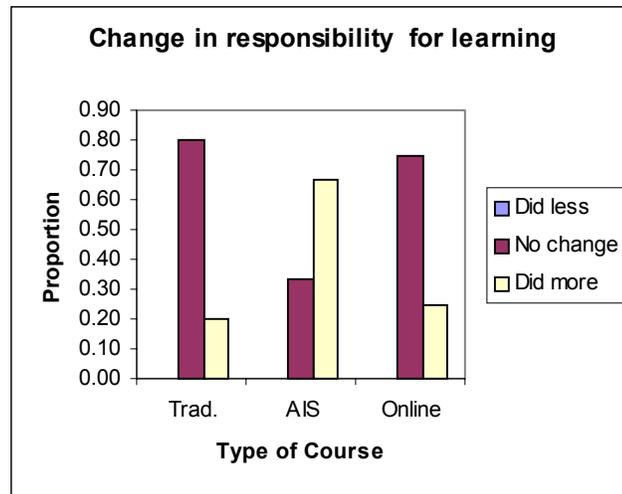
Figure 8. Summary of interview responses regarding how students saw themselves change their study habits.

3. Were students with a preference for interaction more likely to work with other students in the classroom A.I.S. section?

It does appear that students with a higher than average initial preference for working with others spend time doing just that when given the opportunity. On average, students with a high preference for working with others worked in small groups 73% of the time, and worked alone 27% of the time on in-class activities in the A.I.S. classroom section. Students with a preference for working alone worked in small groups 63% of the time and worked alone 37% of the time. These differences are not great, suggesting that students who prefer working alone are still likely to work in small groups when the rest of the class does so.

Indeed, students in the A.I.S. classroom course reported that they studied with others more often than students in the other two sections reported studying with others, but they also reported developing a more positive attitude about studying with others (see Figures 9 and 10).
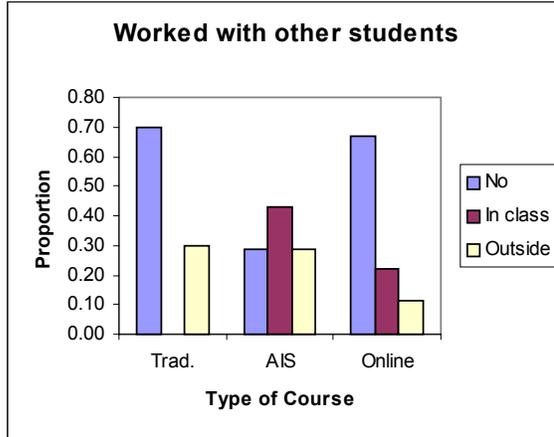
Figure 9. Summary of student interviews regarding where they worked with other students.
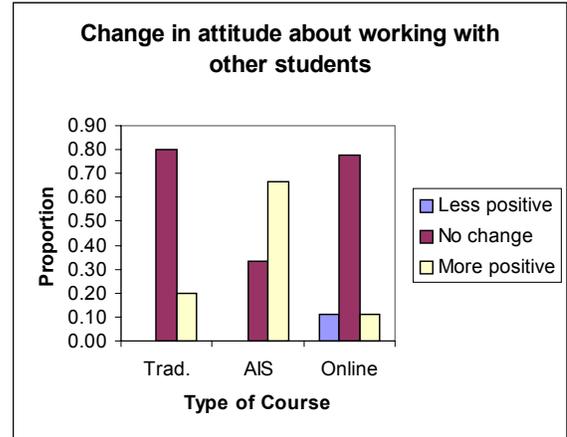
Figure 10. Summary of student interviews regarding how their attitudes changed with respect to working other students.

4. Were students with a high affinity for using technology more likely to interact with others online?

    It does not appear than an affinity for using technology has any influence on how often students interact with others online. Students with above average and below average affinity for using technology participated in online forums and email at about the same rate (and the difference was not statistically significant), and students with the highest affinity for using technology reported the least appreciation for working with other students by the end of the semester. Of course, this is more likely due to the high preference for working alone of most online students.

5. Which course components were most strongly associated with performance on tests, success in the course, and retention?

    The course components that were evaluated across all three sections were:
    1) percentage of quizzes taken
    2) percentage of case studies handed in as homework
    3) completion of the research project

Associations with Test Performance

As shown in Table 2, the percentage of quizzes taken and homework handed in were strongly associated with performance on course tests, both significant at the $\alpha = .01$ level ($p < .001$). Taken together, the three components explained most of the variance in test performance, with an adjusted R^2 of .751. The percentage of quizzes taken appeared to be the strongest indicator, with a standardized coefficient of .565.

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Dependent: Test Performance R² = .755 Std. Err. = .1485 Sig. < .001	Std. Coeff.	t	sig.
Project Completed	.056	1.208	.229
% Quizzes Taken	.565	10.114	< .001
% Homework Submitted	.338	5.836	< .001

Table 2. Test performance by course components.

An important finding for the teacher is that the research project had virtually no association with test performance for students overall. This may be due to the flexible nature of the assignment; students were encouraged to choose any topic of interest and the research and writing activities were not intentionally focused on other course content. In addition, students in the classroom A.I.S. section and in the online section were not required to complete the project. Students reported that they enjoyed this flexibility, and it may have contributed to students overall satisfaction with the course, but not with learning the content expected by the teacher.

Associations with Course Grades

All three components had statistically significant associations with course grades when students in all of the sections were considered together, and completion of homework was the strongest factor with an effect size of .619 (see Table 3). This is not particularly interesting because each of the course components contributed to student course grades.

Dependent: Course Grade R² = .700 Std. Err. = .0996 Sig. < .001	Std. Coeff.	t	sig.
Project Completed	.183	3.492	.001
% Quizzes Taken	.211	3.725	< .001
% Homework Submitted	.619	10.575	< .001

Table 3.Course grade by course components.

Associations with Retention

When all of the students are considered, all three course components are associated with student retention, with taking quizzes having the strongest effect. Students were only considered completers if they took the final exam. This means that walk-aways were not considered course completers.

Dependent: Completion $R^2 = .724$ Std. Err. = .2369 Sig. < .001			
	Std. Coeff.	t	sig.
Project Completed	.127	2.564	.011
% Quizzes Taken	.523	8.806	< .001
% Homework Submitted	.313	5.081	< .001

Table 3.Course grade by course components.

6. Were there differences in the use of the course components by specific groups of students?

   None of the student characteristics we measured (prior GPA, age, gender, employment, pretest performance, learner readiness) appeared to be associated with completing the course project, taking quizzes, or handing in homework when all students were considered together.

   In the traditional section, students who preferred working independently and those who found the course the most relevant were the most likely to complete the homework assignments. Both of these were statistically significant factors, with effects sizes of .73 and .60 respectively.

   There were no other indicators of student groups favoring one course component over another.

7. Were there differences in the association of course components to student outcomes by course structure or delivery mode?

   Taking Quizzes

   Taking quizzes was most important for students in the two A.I.S. sections. For students in the traditional course, the percentage of quizzes taken was not a strong predictor of test scores. This may be because attending teacher-designed lectures helps students differentiate "important" information from less important information in the course, thereby providing hints as to what might appear on the course tests. On the other hand, students in courses that do not have significant teacher participation may be at a disadvantage when course tests still reflect the teacher's interpretation of "key concepts."

   A somewhat surprising finding was that only quiz completion was strongly associated with retention for students in the A.I.S. classroom section. Quiz completion may be associated with attendance, suggesting that students who did not attend regularly were the most inclined to drop the course.

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In the online course we find that completing quizzes and handing in homework were both associated with retention, and they were about equally influential.

Submitting Homework

An interesting difference in the association of the common course components to test performance in the different sections emerged in the classroom A.I.S. section. In that section, completion of homework was not significant at the $\alpha = .01$ level (p = .011), and had a much smaller effect size of .263 (compared with .399 in the online section). This is quite likely due to the pedagogy employed in the classroom, which involved students discussing the case studies in small groups during class time. Since all students who attended class essentially completed the homework, the measure of "handed in" is less distinguishing than in classes where homework is done outside of class time.

For online students, homework completion was the only statistically significant course component associated with course grades, with a relative effect size of .733, significant at the $\alpha = .01$ level (p < .001). Completion of the project and taking quizzes had virtually no effect on course grades for online students, although quizzes did comprise 10% of the course grade.

In the online course we find that completing quizzes and handing in homework were both associated with retention, and they were about equally influential with effect sizes of .485 and .429 respectively.

Research Project

Students in the traditional classroom section were required to complete the research project, while students in the two A.I.S. sections were not. It is not surprising, then, to find that completion of the project was a statistically significant component associated with course grades and retention for students in the traditional section, but not for students in the A.I.S. sections. The effect size for course grades was .397 for course grades and .443 for retention.

The surprising finding was that project completion was also associated with test performance for students in the traditional section, with an effect size of .355. The importance of the research project for students in the traditional course is noteworthy. An earlier finding indicated that the research project had virtually no association with test scores. Apparently that is only true when the project is optional, as was the case for the A.I.S. classroom students and the online students. Students appear to benefit from completing the course project when it is a required component.

8. Which students were most successful in each type of course?

As shown in Figure 11, there is not much difference in success rates on test scores and course grades for students in the three sections. In particular, there is no statistical difference in course grades among the three sections. Although the difference is statistically significant for test scores, the numerical differences are modest, with average test scores for course completers of 80% for traditional students, 79% for online students, and 73% for A.I.S. classroom students.
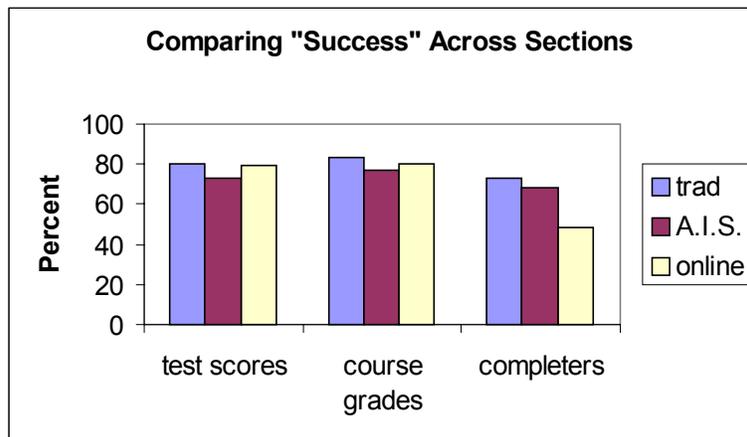
Figure 11. Success rates for students in the three sections.

The differences are much more striking for course completion. Classroom students were much more likely to complete than online students, with 73% completing the traditional section, 68% completing the A.I.S. classroom section, and only 48% completing the online section.

When we control for age, prior grade point average and pretest knowledge, we find that A.I.S. classroom students who preferred to work independently, that is the most autonomous learners, earned the highest course grades, while those who developed the greatest perception of course relevance were the most likely to complete the course. There were no strong predictors of test performance for this group of students.

Online students who interacted more with others during the course earned the highest test scores, but there were no clear indicators for achieving high course grades, or completing the course.

Conclusions

The A.I.S. course structure implemented in the classroom and online does appear to increase students' perceptions of course relevance, but does not necessarily increase the amount of effort students are willing to expend in the course. This is particularly true in the classroom course, where students may not invest as much time outside of the classroom since much of class time is spent on activities students usually associate with "homework."

Self-reliant learners who were also inclined to make the greatest effort in their classes did take the initiative to get what they needed from a class, regardless of whether it was conducted in the classroom or online. In the classroom environment, these students participated in group activities and completed optional projects recommended by the instructor. In the online course, these students made use of discussion boards, chat rooms, and email to communicate with their teachers and classmates in order to optimize their learning; they knew that they needed to make more of an effort in an online course than they would in the classroom.

Less self-reliant learners were not inherently less capable, less motivated, or less responsible learners; they simply preferred learning in an environment where there was ample interaction with teachers and student peers. When such students also had a well-developed sense of responsibility for learning, they tended to do as well as more autonomous learners in both classroom and online environments.

The students we need to be most concerned with in online courses are the less autonomous learners who have not yet developed effective strategies for monitoring their own progress, or who have trouble taking the initiative in engaging in learning activities. In addition, students who have performed poorly in the past do not tend to benefit from simply applying more effort; often, the strategies they use are not effective. Requiring such students to take more initiative, without providing close guidance and feedback, can be highly discouraging to them. Thus, courses in which students are expected to take initiative and expend more effort in learning activities should also include more interaction and personal guidance to support less capable students as they develop the strategies they need to be successful.

When teaching online it is important to foster a sense of community among students to accommodate the learning preference of students who enjoy and benefit from interacting with others. An important aspect of community is teacher presence. Students appear to benefit from and appreciate teacher feedback and interaction. Teachers can use weekly or bi-weekly online announcements as a reminder for students to check in and to reinforce the teacher's enthusiasm for the subject and interest in student success.

Other ways for providing feedback and interaction for students include discussion forums, again with a strong teacher presence, and self-assessment online quizzes or worked-out exercises (i.e. the things you might do in class). In addition, it is useful to get feedback from students about how navigable the online course is. In many instances, students misunderstand the "intuitive" navigation system and miss important aspects of the course.

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Appendix A

The Adaptive Instruction Strategy

Course Feature	Description
Goals of the framework	To improve learner responsibility (metacognitive goal) and clarify relevance of the discipline to the student (motivational goal) to optimize learning.
Underlying educational theories	Social constructivism - cognitive growth comes from enculturation through the practice of activities in social settings (Vygotsky is often associated with this theory) . Transactional distance - "distance" in distance education is a pedagogical phenomenon measured by dialog and structure (Moore is often associated with this theory).
Role of the teacher	Facilitator, models learning strategies, models professional view of the world. Encourages student engagement in the activities of the course. Assesses student competence in the domain. Fulfills obligations to the institution for ensuring student competence at expected levels upon completion of the course.
Role of the student	Shares responsibility for defining course content and student assessment, presents some course content.
Required activities	Leading weekly class discussions; completing case studies; taking course quizzes and exams.
Optional activities	Participating in small group discussions; designing and completing a research project.
Key learning strategies	Asking good questions (to lead to a deeper exploration of the subject and development of a strategy beyond memorization); Discussing the readings (to build reading comprehension skills); and Preparing case studies (to develop synthesizing and evaluative problem-solving skills and build appreciation for the activities of the profession).
Affordances	The objective for having multiple affordances is to provide options so students can customize the course to their needs. Typical affordances , available to both classroom and online students, include: Online resources for the discipline; Online resources for the course (e.g. power-point presentations for each chapter); Online conferences for class and small group discussions; Online chat rooms available for student meetings; Email can be used to communicate with instructor; Letter grade or Credit/No Credit grading; Online students can attend lectures; Research project is designed by students and grading method is negotiated with instructor;

Appendix B

Descriptions of the Student Readiness Variables

Variable	Low	Average	High
Course Relevance	Students with low Relevance estimates are taking a course speculatively or to meet major degree requirements. They report that they may need the course content later, that they are interested in the subject, and that they want to learn more about the subject or profession.	Students with average Relevance estimates are taking the course to prepare for a future career, are taking it in preparation for a more advanced course, need it for GE credit or schedule constraints, and want the benefits of teacher guidance and the structure of a course to learn the material.	Students with high Relevance estimates need the course because it teaches a skill required for a future or current job, want to have interaction with other students working in the subject area, and wanted a particular instructor.
Responsibility for Learning	Students who have relatively lower levels of responsibility for their academic success attribute their success to their study habits and time available for studying, and only report that they do their homework regularly.	Students with average levels of responsibility also keep up with reading assignments, feel that they are self-motivating, and value the kinds of homework and projects they are assigned.	Students with higher levels of responsibility say that they value the feedback and guidance they get from their teachers, they believe their ability to use the Internet to access information is important, and they often check the answers they gave on difficult test questions to see how to do the problems correctly. At the highest level of responsibility, students report that they often enjoy exploring a subject in more depth than required by the teacher. Perhaps we could characterize these latter students as those who *enjoy learning*.
Preference for Interaction	Students with a relatively low preference for teacher guidance and collaboration with other students report that the teacher's lectures and personality are very important for their academic success. They also report that they find that their teachers are interested in their success and that they benefit from working with other students.	Students with an average preference for teacher guidance and collaboration with other students add that the availability of their teachers in their offices or by email is an important factor for academic success, as are the participation and contribution of other students in the class. They tend to ask questions in class, and to communicate with their fellow students by phone or email about homework assignments.	Students with the highest levels of interaction preference also volunteer to answer questions in class, visit their teachers in their offices to discuss the course or other matters, like to let their teachers know about their interests, tend to meet with other students outside of class time to study, and believe that the time they have available for working with other students is a very important factor for their academic success.
Affinity for using Technology	Students with lower levels of computer affinity use email, word processors, and access the Internet for work or school. They are likely to agree that online courses are a good alternative to classroom courses for people who can't get to campus.	Students with average levels of computer affinity access the Internet for their own interests, enjoy online chatting and conferencing with classmates or strangers (although they don't do it very often), and are more likely to use spreadsheet or database programs. They tend to agree that most college students could learn as much in an online course as in a classroom course.	Students with the highest affinity for using computers regularly participate in online chats or conferences.

Appendix C

Sample Course Documents

Asking Questions to Enhance Learning

Asking good questions is frequently overlooked as an important learning strategy. Good questions not only stimulate good discussion, they also stimulate cognitive processes that lead to better learning.

The following descriptions suggest ways to ask questions that stimulate higher levels of thinking than "textbook lookup" questions that rely on memory alone.

Convergent Thinking Questions:

Convergent thinking questions are those which represent the analysis and integration of given or remembered information. They lead you to an expected end result or answer.

- ☆ Require analysis and integration of facts.
- ☆ Often start with: Why, How, In what ways…
- ☆ Poor Example: What do routers do?
- ☆ Good Example: How do routers differ from switches?

Divergent Thinking Questions:

Divergent thinking questions are those which represent intellectual operations wherein you are free to generate independently your own ideas, or to take a new direction or perspective on a given topic.

- ☆ Require hypothesizing, inferring, etc.
- ☆ Often start with: Imagine, Suppose, How might…
- ☆ Poor Example: Who are the clients in case study 1?
- ☆ Good Example: How might the clients in case study 1 need to share documents?

Evaluative Thinking Questions:

Evaluative thinking questions are those which deal with matters of judgment, value, and choice. They are characterized by their judgmental quality.

- ☆ Require judgment, value, choice
- ☆ Often start with: Justify, Defend, Judge…
- ☆ Poor Example: Where will the wiring closets be located in the new building?
- ☆ Good Example: How would you justify locating the wiring closets in these positions in the new building?

Remember, you don't need to know the answer to a question you ask… the point is to stimulate discussion that goes beyond facts and terminology covered in the textbook.

Case Study 1: Human Investment Project

Due _____

You have been asked by Human Investment Project (HIP), a local agency that helps families find affordable housing, to install a network in their San Mateo office.

They currently have 5 PCs with the following configurations:
2 - Pentium 166 MHz with 32 MB Ram and a 3 GB hard drive running Windows 98
3 - 486 66 MHz with 16 MB RAM and a 1 GB hard drive running Windows 95

The agency does not have much money to spend on upgrades or hardware, and are not very concerned about security, but they do need to be able to share documents and devices (especially the one good laser printer).

People come and go in the office, working different shifts. There are currently 7 people who would need access to the documents and printing: Mary, the office manager, would need access to all the documents. Ann, Tom and Mark work together in one department and Tim, Felix and Jim work in another department. The two departments don't need to share documents, but people within a department need to be able to see and update one another's work.

How would you configure their system? Why did you make the decisions you made? (i.e. did you choose client/server or peer-to-peer, where will the shared documents be stored, what kind of rights will be assigned to each person, is any additional hardware needed, etc.)

How to Proceed:

First, assume you are the client. Think about what each employee needs to perform his or her job more efficiently. Try to step into the job of each employee to think about what he or she does now and how things will change with a network.

Now, step back into your own shoes (you're the network engineer!) and design a plan that serves the needs of the client.

Submit a 1 or 2 page (double-spaced) report of your recommendation to HIP.

The case will be graded as follows:
2 points for appropriate application of the concepts and use of the terminology
2 points for completeness

Case Study 2: Friendly Footwear

Due Date: _____

Case Project 1 on page 149 of the text. In addition to determining the best transmission media to use, draw a layout of the cabling system across all the buildings, including the new warehouse and the proposed building for the Sales department. You can assume each building is one story for this project. Label cables with their type, and identify the cabling subsystems (see pg. 125 for an example).

Guiding Questions

1. What is the problem to be solved by your design?

2. What is the current situation?

3. What will the new situation be like?

4. What are some possible solutions?

5. Which is the best solution given that the physical environment won't be changing?

Group/Individual Activity
10/11/00

Group Members:

_____

_____

_____

_____

_____

Design a new enterprise-wide network topology for the Community College district. We have 3 campuses, one here in San Mateo, another in San Bruno, and another in Redwood City. There are about 500 district employees who need varying levels of access to the student database. It is essential that the system is "always up" -- 24 hours a day, 7 days a week. The central database of student records is stored at the CSM campus, since it is the largest campus.

On each campus, computers are clustered in the Admissions and Records office and the Counseling Centers. In addition, each faculty and staff member has a computer on his or her desk. Some computers are PC's and some are Macintoshes.

Decide what kind of backbone to use on each campus and the best WAN topology to interconnect the campuses. Draw diagrams of a sample campus network and the district network, labeling the cables and devices as in the diagrams on pages 165 and 166 (i.e. label buildings such as admin bldg., faculty offices, etc.).

Group/Individual Activity
11/8/00

Group Members:

_____

_____

_____

_____

_____

Design a network for CSM to include the following buildings:
Administration (25 people in finance, counseling, registration)
2 Faculty office buildings (20 people in each building of faculty, counseling, scheduling staff)
1 Classroom building with a student lab (25 student workstations)

Layout the network including relevant workgroups. Show the devices and cabling you would use.
The system has two servers, an "administration" server that maintains the student database and
college financial information, and an "instructional" server that maintains all the compilers and
applications students use to do their class assignments.

Group/Individual Activity
11/29/00

Group Members:

_____

_____

_____

_____

_____

Go over Quiz 4 together and provide:

1. The correct answer to each question ‑‑ and a page reference for the answer.

2. A reason why each of the other options were not correct on that question.

Group/Individual Activity
12/6/00

Group Members:

_____

_____

_____

_____

_____

    1. Answer 3 questions from the Chapter 5 Student Questions

    2. Answer 4 questions from the Chapter 6 Student Questions

    3. Answer 5 questions from the Chapter 7 Student Questions

Appendix D

Data Collection Instruments

The Collegiate Learning Questionnaire

Group Code ___ ___   **Last four digits of your social security number ___ ___ ___ ___**   **Second Course □**

(I need a way to identify you for correlation purposes. None of this information will be shared with the College or your   *Proceed to deciding to*

instructor. On my records, this information will be encoded so it cannot be traced to individual students.)   *take this course section.*

1.	Age category: □ 19 or under □ 20-24 □ 25-29 □ 30-34 □ 35-39 □ 40-49 □ 50-59 □ 60 or over
2.	Gender: □ Male □ Female
3.	Employment Status: □ Not Employed, or Retired □ Work Part Time □ Work full time
4.	You are primarily a: □ Distance Ed. Student □ Evening/Sat. Student □ Day Student
5.	Number of units of college-level coursework you have completed (prior to this semester): □ under 30 □ 30 - 60 □ 60 – 120 □ over 120 (about 4 years)
6.	What is your current GPA on college work completed so far: (□ using high school GPA because this is my first semester in college) □ under 1.5 □ 1.5-2.0 □ 2.1-2.5 □ 2.6-3.0 □ 3.1-3.5 □ over 3.5
7.	What is your major? □ I don't know yet □ Business □ CIS/CSci/CEngr □ Psyc/SocSci □ Science □ Other _____
8.	Is this an online course? □ No □ Yes
9.	Have you completed any "distance" courses prior to this semester? □ No □ Yes-Telecourse □ Yes-Online
10.	Is this the first college-level course you've taken in this subject? □ No □ Yes (If you are repeating this course, answer No)

How important were the following factors in <u>deciding to take this course:</u>	Extremely Important	Very Important	Somewhat Important	Not Important
11. This course provides General Education credit.	□	□	□	□
12. I am interested in this subject.	□	□	□	□
13. I wanted to take a course from this instructor.	□	□	□	□
14. I wanted to take this section because of when it is scheduled.	□	□	□	□
15. This course is necessary for my current job.	□	□	□	□
16. This course is necessary for my future career.	□	□	□	□
17. I want to get teacher guidance and feedback in this subject.	□	□	□	□
18. I want to have interaction with other students to discuss this subject.	□	□	□	□
19. I need the formal structure of a class to learn the material.	□	□	□	□
20. This course provides credit toward a degree or certificate.	□	□	□	□
21. I want to learn more about this subject or profession.	□	□	□	□
22. I need this course for my resume.	□	□	□	□
23. I need to pass this course so I can take a more advanced course in this subject.	□	□	□	□

How do you use computers?	Daily	Weekly	Seldom	Never
24. I check my email.	□	□	□	□
25. I use a word processor.	□	□	□	□
26. I use a spreadsheet or database program.	□	□	□	□
27. I play computer games on my own computer (or a friend's).	□	□	□	□
28. I play games on the Internet.	□	□	□	□
29. I access the Internet for school or work.	□	□	□	□
30. I access news, weather, sports, stocks, etc. online.	□	□	□	□
31. I access the Internet for fun (other than games).	□	□	□	□
32. I participate in online chats.	□	□	□	□
33. I participate in online conferences or bulletin boards.	□	□	□	□

How have the following factors <u>contributed to your success</u> in previous courses?

	Extremely Important	Very Important	Somewhat Important	Not Important
34. The teacher's lectures.	☐	☐	☐	☐
35. The types of homework and projects assigned.	☐	☐	☐	☐
36. Feedback and guidance from the teacher.	☐	☐	☐	☐
37. The availability of the teacher in his or her office or by email.	☐	☐	☐	☐
38. The participation/contributions of other students in the class.	☐	☐	☐	☐
39. My study habits.	☐	☐	☐	☐
40. The time I had available to study on my own.	☐	☐	☐	☐
41. The time I had available to meet with other students to study.	☐	☐	☐	☐
42. My knowledge of using the Internet to access information.	☐	☐	☐	☐

How do you usually <u>interact with your teachers</u>?

	Always	Often	Seldom	Never
43. I ask questions in class.	☐	☐	☐	☐
44. I volunteer to answer questions in class.	☐	☐	☐	☐
45. I meet with my teachers during office hours about the class.	☐	☐	☐	☐
46. I try to let my teachers know something about me as a person, such as my goals, my background, or what I hope to get from the course.	☐	☐	☐	☐
47. I communicate (talk, email, etc.) with my teachers about things not related to the specific course I'm taking with him or her.	☐	☐	☐	☐
48. My teachers are interested in me and my success in the class.	☐	☐	☐	☐

What are your usual <u>study habits</u>?

	Always	Often	Seldom	Never
49. I do my homework regularly.	☐	☐	☐	☐
50. I keep up with the reading assignments for my courses.	☐	☐	☐	☐
51. I am good at motivating myself to study regularly without being reminded by my teacher or someone else.	☐	☐	☐	☐
52. After taking a test, I like to check the book to see if I did some of the difficult problems correctly.	☐	☐	☐	☐
53. I benefit from working with other students in the class.	☐	☐	☐	☐
54. I meet with other students outside of class time to study.	☐	☐	☐	☐
55. I communicate with other students by phone or email about the homework.	☐	☐	☐	☐
56. I like to explore a subject in more depth than what is required by my teachers (extra reading, online study, talk to other teachers, etc.).	☐	☐	☐	☐

How do you feel about the following uses of computers?

	Strongly Agree	Agree	Disagree	Strongly Disagree	Never Tried
57. I enjoy participating in online chats or conferences with other students from my classes.	☐	☐	☐	☐	☐
58. I enjoy participating in online chats or conferences with people I may not know.	☐	☐	☐	☐	☐
59. Online courses are a good alternative to classroom-based courses for people who can't get to a college campus.	☐	☐	☐	☐	
60. Most college students could learn as much in an online course as in a classroom course.	☐	☐	☐	☐	

Any other comments about what works best for you for doing well in college? Do you have any advice for new students?

_____

_____

The Collegiate Learning Follow-Up

We may want to contact you to follow up on your experience in college this semester, or to clarify any of your answers on the questionnaire. This research is very important as we try to design courses to meet your needs as a student.

Please consider giving us the opportunity to contact you briefly if we need to. Thanks!

For Official Use Only:

Group Code ___ ___   **ID** ___ ___ ___ ___

Researcher may contact me to clarify or follow up on my answers on this questionnaire:

□ Yes   □ Prefer Contact by Email Email Address: _____

□ Prefer Contact by Phone Number: _____ Best Time: _____

First Name (optional) _____
(*if you do not provide a name, we will refer to you as
"a CSM student" when we try to contact you.*)

□ Either Email or Phone is OK

□ No - I do not want to answer any more questions about this research.

NOTE: This page will be removed from the questionnaire after it is encoded by the researcher.

Thank you VERY MUCH for participating in this research.

The Collegiate Learning Exit Questionnaire

This survey is for students who completed or withdrew from courses under study at CSM in Fall 2000. Your participation is very important in helping us determine how we can best meet your needs in future courses. Thank you!

□ **Withdrew**
□ Completed

Group Code ___ ___   **Last four digits of your social security number** ___ ___ ___ ___

How important were the following factors in <u>continuing to take this course for as long as you were enrolled:</u>	Extremely Important	Very Important	Somewhat Important	Not Important
1. This course provides General Education credit.	□	□	□	□
2. My interest in this subject.	□	□	□	□
3. The instructor.	□	□	□	□
4. The time the course was scheduled.	□	□	□	□
5. I needed the course for my current job.	□	□	□	□
6. I needed the course for my future career.	□	□	□	□
7. The guidance and feedback I got from the teacher.	□	□	□	□
8. The interaction with other students in the class.	□	□	□	□
9. The structure of the course (class activities, assignments, etc.).	□	□	□	□
10. This course provides credit toward a degree or certificate.	□	□	□	□
11. I wanted to learn more about this subject or profession.	□	□	□	□
12. I needed this course for my resume.	□	□	□	□
13. I needed this course so I could take a more advanced course in the subject.	□	□	□	□

14. **If you did not complete the course**, which of the factors above influenced your decision to withdraw? Why did you finally decide to withdraw from the course?

_____

_____

_____

_____

How do you use computers <u>now</u>?	Daily	Weekly	Seldom	Never
15. I check my email.	□	□	□	□
16. I use a word processor.	□	□	□	□
17. I use a spreadsheet or database program.	□	□	□	□
18. I play computer games on my own computer (or a friend's).	□	□	□	□
19. I play games on the Internet.	□	□	□	□
20. I access the Internet for school or work.	□	□	□	□
21. I access news, weather, sports, stocks, etc. online.	□	□	□	□
22. I access the Internet for fun (other than games).	□	□	□	□
23. I participate in online chats.	□	□	□	□
24. I participate in online conferences or bulletin boards.	□	□	□	□

How did the following factors contribute to your performance in this course?

	Extremely Important	Very Important	Somewhat Important	Not Important
25. The teacher's lectures OR the online content in online courses.	☐	☐	☐	☐
26. The types of homework and projects assigned.	☐	☐	☐	☐
27. Feedback and guidance from the teacher.	☐	☐	☐	☐
28. The availability of the teacher in his or her office or by email.	☐	☐	☐	☐
29. The participation/contributions of other students in the class.	☐	☐	☐	☐
30. My study habits.	☐	☐	☐	☐
31. The time I had available to study on my own.	☐	☐	☐	☐
32. The time I had available to meet with other students to study.	☐	☐	☐	☐
33. My knowledge of using the Internet to access information.	☐	☐	☐	☐

How did you interact with the teacher in this course?

	Always	Often	Seldom	Never
34. I asked questions in class OR in online discussions.	☐	☐	☐	☐
35. I volunteered to answer questions in class OR in online discussions.	☐	☐	☐	☐
36. I met with my teacher during office hours or by email about the class.	☐	☐	☐	☐
37. I tried to let my teacher know something about me as a person, such as my goals, my background, or what I hoped to get from the course.	☐	☐	☐	☐
38. I communicated (talk, email, etc.) with my teacher about things not related to the specific course I was taking with him or her.	☐	☐	☐	☐
39. My teacher was interested in me and my success in the class.	☐	☐	☐	☐

What study activities did you use for this course?

	Always	Often	Seldom	Never
40. I did my homework regularly.	☐	☐	☐	☐
41. I kept up with the reading assignments.	☐	☐	☐	☐
42. I was good at motivating myself to study regularly without being reminded by my teacher or someone else.	☐	☐	☐	☐
43. After taking a test, I liked to check the book to see if I did some of the difficult problems correctly.	☐	☐	☐	☐
44. I benefited from working with other students in the class.	☐	☐	☐	☐
45. I met with other students outside of class time to study.	☐	☐	☐	☐
46. I communicated with other students by phone or email about the homework.	☐	☐	☐	☐
47. I liked exploring the subject in more depth than was required by my teacher (extra reading, online study, talk to other teachers, etc.).	☐	☐	☐	☐

How do you feel about the following uses of computers?

	Strongly Agree	Agree	Disagree	Strongly Disagree	Never Tried
48. I enjoy participating in online chats or conferences with other students from my classes.	☐	☐	☐	☐	☐
49. I enjoy participating in online chats or conferences with people I may not know.	☐	☐	☐	☐	☐
50. Online courses are a good alternative to classroom-based courses for people who can't get to a college campus.	☐	☐	☐	☐	
51. Most college students could learn as much in an online course as in a classroom course.	☐	☐	☐	☐	

52. Do you have any other comments about what works best for you for doing well in college? Do you have any advice for new students or your professors?

_____

_____

Course Participation Survey
Administered to students in the middle of the semester online.

Group Code: __ __   Last four digits of your social security number: __ __ __ __ Date: _____

1. How has this course been different from what you expected so far?

2. Have you studied with any other students in class, outside of class, or online? If so, what did you do and how did it go? If not, why not?

3. How effective have the course assignments been in helping you learn the material?

4. How has this course affected your attitude about your course of study or career goals?

5. How has this course affected your attitude about working with other students?

6. How has this course affected your approach to studying?

7. How would you compare this course with other courses you've taken in this subject (anywhere)?

8. What would make this course more enjoyable for you?