Journal of Information Systems Education, Vol. 16(2)

Use of a Technology-Mediated Learning Instructional Approach For Teaching an Introduction to Information Technology Course

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ABSTRACT

Several years ago, Ives and Jarvenpaa (1996, p. 34) suggested: "To many, the Internet technologies resemble the personal computer revolution of the early 1980s, which transformed information management." Today, while educational institutions continue to expand the instructional use of the Internet and web-based technologies, there remains much to be learned about the effectiveness of various technology-mediated learning approaches. Various formats for course designs that use technology are being tried and are commonly referred to today as e-courses. Similarly, student learning constitutes increasing degrees of technology use as part of the course. This paper provides information on using the Internet and web-based technologies as part of an instructional design. The Introduction to Information Technology course upon which the paper is based features an approach that both exemplifies the benefits of using technology while maintaining the richness of a class setting. Student reactions to the course conclude the paper.

Keywords: Technology-mediated Learning, Self-directed Learning, Instructional Design

1. INTRODUCTION

The influx of information technologies, multimedia capabilities and authoring tools spawned by the Internet, has dramatically increased the number of creative opportunities and challenges for education. Today, with an abundance of authoring tools available to create digital content and learning management systems to administer online learning, both universities and companies (Good, 2001) are increasing their learning efforts. In fact, "publishers and software houses are developing multimedia products that will substitute for, rather than complement, traditional classroom education" (Ives and Jarvenpaa 1996, p. 33). Intel has predicted that online learning will be the next "killer" application (Mannion, 2001).

The Internet and web-based technologies have created a number of new options for teaching information technology courses. Possibilities range from using information technology (both sychronously and asychronously) in a traditional classroom setting to a distance education model where there are no formal meetings in an actual classroom. Key themes in IS educational research now include IT-enabled instructional methods in traditional settings, IT-enabled collaborative learning, virtual learning environments and student characteristics that affect outcomes of IT-enabled learning (Alavi and Leidner, 2001). Alavi and Leidner (2001) state that there is a need for much more exploration in terms of depth and breadth with technology-mediated learning (TML).

Technology-mediated learning can be defined (Alavi and Leidner, 2001) as: "an environment in which the learner's interactions with learning materials (readings, assignments, exercises, etc.), peers, and/or instructors are mediated through advanced information technologies." TML contrasts with other instructional approaches where technology augments the students' efforts in the class but is not essential. Since there are a variety of technology tools and instructional strategies available today, the number of course

design possibilities is large. As an example, a course could have students meet regularly in class but conduct class discussions outside of class using a discussion board. Another possibility could involve investigating textbook IT topics on the Internet. Both of these instructional strategies could be part of a course that requires the use of technology in the class. Other examples of TML can be found in Makkonen, (2000) and Piccoli et. al. (2001) while a theoretical discussion of various formats for using technology in the learning process appears in Leidner and Jarvenpaa (1995). A review of TML research is presented in Alavi and Leidner (2001) along with recommendations for research. Further, Alavi and Leidner (2001) stress the need for a better understanding of various TML options.

This paper explores TML by anonymously capturing feedback from students enrolled in a course that employed a TML orientation. It is organized as follows. Section 2 discusses the motivation for the development of the TML orientation described in the paper. This is followed by a description of an "Introduction to Information Technology" graduate level course that was taught using a TML orientation. The next section describes how the Nominal Group Technique (NGT) was used in the evaluation of the course. A byproduct of this evaluation, five instructional design dimensions, is described next. The paper ends with some concluding remarks.

2. MOTIVATION

Just as information technology is used as a competitive weapon in industry, educational institutions are viewing it in a similar way as a result of pressure from stakeholders (students, parents and industry) for an education that better prepares students for being self-sufficient when confronting problems in the workplace. Additionally, it has been suggested: "Where once schools provided a discrete, career-spanning set of concepts and tools, now they will build the skills and motivation for lifelong learning." (Ives and Jarvenpaa 1996, p. 35) Utilization of the Internet and web-based technologies represent a way to translate this into a reality. For example, "In an hypertext world, students will be able to move directly between real-world application and conceptual underpinnings." (Ives and Jarvenpaa 1996, p. 35)

There is a need to supplement the traditional lecture method (Eastman and Swift 2001; Ueltschy 2001; Smart et. al. 1999; Day 1996) with an approach that encourages more student responsibility for their own learning. Increasingly, employers clamor for students educated in a way that allows them to be better prepared for the reality of the workplace where they are expected to solve problems in a self-sufficient manner. Thanks to advances in multimedia and web-based technologies, new opportunities exist to enrich students' learning experience with the use of technology in the performance of their coursework. These technologies offer the promise of an expanded on campus (resident) educational experience in addition to distance learning possibilities for those with logistical constraints. Although some experimentation has been completed using various instructional designs for IS education (Leidner and Jarvenpaa 1995; Alavi and Leidner 2001; Ueltschy 2001; Smith 2001; Piccoli et. al. 2001), little research exists using web-based technologies. Web-based technologies and the Internet can offer flexibility in our learning environments (Bryant et. al. 2003). Further, flexibility has been significantly associated with perceived learning and satisfaction (Arbaugh and Duray 2002). With a host of web-based tools now available (e.g., see Table 1), additional study is needed to gain a better understanding of how these tools can be used to enhance the learning experience of the student.

Alavi (1994, p. 3) notes that there are three attributes that can be associated with effective learning. They include:

Table 1. Learning Management System Tools

Tool	Use	Purpose	
Class Calendar	Used to post notes and links in a calendar	Keeps the class organized and provides a means of accessing news articles that can be posted by the instructor at any time.	*
Bulletin Board	A threaded discussion board for posting topics and comments	Allows the class to conduct asynchoronous discussions	*
Email	Used to send email to other students and instructor	Provides a provision for private correspondence	*
Search Engines (Yahoo, Altavista etc.)	Students use these tools to locate all information on their IT topics	Learning about the vast resources on the Internet and how to find them prepares students for life long knowledge retrieval.	
Presentation Folders	A place for groups or individual students to post documents or presentations	Students can securely maintain their research documents and presentations so they can be read by other students	*
Grade Book	Maintains student grades	Students stay current with their assessments	*
Online Test	Students experience the convenience and expediency of online testing.	This feature offers the opportunity for testing over the Internet should a student be out of town on business and offers all students immediate feedback on their test results.	*

* - denotes a tool built into WebCT

(1) active learning and construction of knowledge, (2) cooperation and teamwork in learning and (3) learning via problem solving. Thus the challenge for instructors is to find ways of engaging students in the emotionally uncertain experience of sustained critical self-reflection, evaluation, and reconstruction (Fisher and Churach 1998). With the prospect that the Internet will have significant implications on the future of business education (Ives and Jarvenpaa 1996), combined with a call for research that considers the interactions of technology, instructional method, and the psychological processes of the student learners (Alavi and Leidner 2001) much work is needed to develop courses with effective instructional strategies. One answer to this call for research involves using the Internet in an integral way within different course designs to determine the most effective design given the learning objectives. This paper takes a first step by describing one web-based course and offering some tools that can be used for subsequent refinement of this and other courses with similar designs.

3. THE COURSE

Thirty-seven part-time MBA students with full-time jobs enrolled in the graduate course, MISB-600 - Managing Information Technology, required by all MBA students at a private midwestern university. The course consisted of fifteen 150-minute class sessions plus a two-hour final exam. During the first two sessions, members of the class organized themselves into six work groups of from five to seven students and a demonstration of the software tools (see Table 1) to be used in the course was given by the instructor. In addition, during the first two sessions, each work group, in consultation with the instructor, chose an information technology to study in depth during the course. Information technology topics selected included enterprise resource planning systems (SAP and PeopleSoft); web technologies (Java and HTML); and communications (MCI and Sprint).

Once each work group had selected its information technology topic, an important objective during the first two class sessions was to define and then allocate subtopics to group members. For example, the group that chose JAVA as its topic divided its work into seven subtopics: JAVA Language, JAVA Platform, JAVA Applets/Servlets, Security/JAVA Card, JINI Technology, JAVA Media & Communications APIs, and JAVA Equipment Devices.

Another important part of the first two class sessions was to provide students with strategies for surfing the Internet and filtering information. Demonstrations were performed using several search engines (e.g., yahoo.com, altavista.com) to locate information on an information technology topic. This demonstration yielded an abundance of links to information located from the search. Browsing through the numerous links, reading and evaluating the levels of information required additional mental processing not needed when reading a textbook, which contains information written at a designated level. By using the Internet, students had to develop a strategy for filtering the information to satisfy their search objectives.

The next five class sessions were each made up of (a) a one-hour discussion of news articles from various Internet sources (e.g., news.com, zdnet.com, eweek.com, infoworld.com) led by the instructor and (b) ninety minutes of work group discussions. During all work group discussions (those held inside and outside of class), students were encouraged to share ideas and solicit feedback and input from group members. In the work group sessions held in class, the instructor spent time talking with each group in an effort to monitor progress, answer questions, and offer guidance. The next six class sessions were devoted to student presentations. At the beginning of this six class session sequence each work group was required to submit (a) a web document that provided coverage of a technology topic suitable for a management audience and (b) an accompanying PowerPoint presentation. Work groups were notified at the beginning of each class as to which group would present that day. This required that each work group be equally prepared and meant that no group would knowingly have more time to prepare than other groups. Typically one group presented their IT topic at each class with each student presentation lasting from fifteen to twenty-five minutes. After all group members had completed their presentation and responded to questions from the class, the instructor offered comments for the class to consider.

Individual assignments required each student to use the Internet exclusively to investigate their part of their work group's information technology topic. Although textbooks are typically used as a primary source for information, the Internet was used exclusively in this course to demonstrate an alternative means of obtaining information that would prove useful and convenient for self-directed learning. Additionally, use of the Internet was particularly appropriate in this course since information technology developments advance at such a rapid pace and the first information concerning these developments often appears on the Internet. Individual assignments provided students with an opportunity to focus on the business value associated with their particular information technology. For each individual assignment, deliverables included a web-based paper on the student's portion of the work group's IT topic and a corresponding PowerPoint presentation both of which were periodically posted in draft form via WebCT throughout the first seven weeks of the semester for access by the students. Suggestions and discussion of how the technology could bring business value to a company constituted an important part of each student's presentation. Each student paper provided a comprehensive overview of one aspect of the group's IT topic. Since it took the form of a web-page, an important component of the paper was links to relevant web resources.

The Internet search process was a significant work requirement for the course. The use of search engines to locate relevant information is not an exact science and typically results in discovering volumes of both useful and useless information. Although search engines make the retrieval process easier for the learner, they are not intended to make learning itself easier (Jonassen et. al., 1998). The information retrieved still must be

carefully read and sorted in order to find the information sought. Synthesizing the selected information into an appropriate form for inclusion in the written assignment and presentation required additional work. During the review process learners have to think more meaningully while constructing their own realities (Jonassen et. al., 1998).

Although the class was divided into work groups for the purpose of allowing the students to offer feedback to the other group members on their work, grades in the course were individually assigned to each student by the instructor. The written work done by each student constituted 40% of the course grade, presentations were worth 30% and the final exam was worth 30%. Preparation for the final exam required students to attend class presentations and discussions of the news articles. In addition, students were encouraged to familiarize themselves with the work of other students in the class as a way to prepare for the final exam.

WebCT served as the learning management system (Kaynama and Keesling 2000) and provided students with a number of helpful tools (see Table 1). These tools included individual provisions for building web pages, plus a discussion board, email, and calendar. The students' papers and presentations were loaded on the server and made accessible to the entire class so students could study all IT topics investigated by the class. Although students could communicate with the instructor outside of class by phone and/or via office visits, the preferred communication was email. Each work group had its own home page with a link to the documents developed by each member for easy access by the entire class. The course used the face to face in-class opportunity for presentations and discussions, as in traditional courses, while using WebCT features gave the course a TML orientation.

4. COURSE EVALUATION

Most courses use some type of standardized course evaluation instrument to assess the learning experience of the student during the course. However, these instruments are commonly designed for a lecture course and therefore have limited applicability to a course where the students were responsible for much of their own construction of knowledge. Due to these limitations, the nominal group technique (NGT) was used to collect anonymous information about the course from the students. This technique was considered to be more useful for gaining insight into the relationships among the technology capabilities, instructional strategy and psychological processes involved in the students' learning experience since it enabled the collection of original responses from the members of the class.

The nominal group technique (Van de Ven and Delbecq 1974) has proven to be useful for generating ideas and has been found to be superior to brainstorming groups (Aiken et. al. 1997; Bouchard et. al. 1974; Vroom et. al. 1969) in producing more ideas of better quality. In addition, it has been found more effective (Lim and Benbasat 1997; Dennis and Valacich 1993; Gallupe et. al. 1991; Gallupe et. al. 1992; Valacich et. al. 1994) when administered electronically. During this class the online testing program "Test Pilot" was used to make the final NGT questionnaire available to students so they could rank their responses online. This technique proved particularly useful since it identified those aspects of the course which were important to the students whereas predesigned instruments are limited for the most part to those aspects of a course addressed by the questions and do not necessarily provide information on important issues as identified by the students themselves.

Use of the nominal group technique began by asking each student to respond anonymously to two requests:

1. List the top three aspects of the course that have helped your learning.
2. List the top three aspects of the course that have hindered your learning.

After the responses were collected, a list of the unique items from the "Helped" request was assembled on one page while a list of those unique items from the "Hindered" request was assembled on a second page. The following week, the thirty seven students were given the two lists and asked to anonymously rank the top five items from each list. In an effort to organize the data collected from the students and subsequently identify areas for improvement, the five instructional design dimensions (IDD) that appear in Table 2 were created.

The first IDD,"Instructional Strategy," represents the learning activities included in the course. Examples include reading assignments, projects, term papers, presentations, homework exercises and class discussions.

The second IDD is "Process." This dimension refers to the approach taken to achieve a learning activity. It entails the specifics of the manner in which the students performed a learning activity. For instance, if the learning activity is

Table 2. Instructional Design Dimensions

Instructional Design Dimension	Definition
Instructional Strategy	Any planned learning activity
Process	The operational manner in which the learning activity is conducted
Content	Both oral and written knowledge and information
Environment	The physical context and resources available during the learning experience
Learner	Individual characteristics of the learner

to discuss an article, one option might be to discuss it during class while another would include performing the discussion using the bulletin board in WebCT. In both instances the discussion takes place but differs in how the activity itself is implemented. Another example includes working on a project when it could be positioned as an individual or group project. The project is the deliverable but there can be differences in how the project would be accomplished.

"Content" is the third IDD and represents information or knowledge provided by the instructor or obtained by the student during the course. "Content" not only includes the target subject matter to be studied but also information such as instructions or tutorials on software tools needed to perform a learning activity. It includes oral as well as written forms of information. Subject matter can include such information as concepts, procedures, experiences, definitions and can be housed in any media form that is appropriate; including text, pictures, graphics, animations, audio and video. Students work with "Content" through a process of receiving or producing it as part of an "Instructional Strategy."

The fourth IDD is the "Educational Environment." This dimension represents the facilities and resources in the learning environment. Examples include classrooms, computer labs, software, hardware, support and accessibility. The educational environment consists largely those aspects of the learning environment that are oftentimes constant for the instructor in the short run. For example, it is possible that some changes in this dimension might require an institutional initiative if they involve plant and facilities.

The fifth IDD, "Learner," represents the target of the learning experience. There are a number of instruments that have been developed to measure learning styles and characteristics of a person (e.g., Myers Briggs Type Indicator (MBTI), Kolb Learning Style Inventory (LSI), Gregorc Style Delineator (GSD), Embedded Figures Test (EFT) and group version (GEFT), Canfield Learning Style Inventory (CLSI), Instructional Styles Inventory (ISI), Grasha Reichmann Learning Style Scales (GRSLSS), and Cognitive Style Inventory (CSI)). These measures help identify differences between people when it comes to learning such as their approach to learning, their preferences for oral, written or visual representations, and hands-on or active learning versus passive learning.

All rankings provided by the students were assembled using weights of from five to one where five was assigned to the highest ranked item out of the five, four for the second highest ranked item, down to one for the fifth ranked item. Table 3 contains a list of the tabulated "Helped" data mapped into the IDD framework while Table 4 contains a list of the "Hindered" data for the course.

The top ranked item in the "Helped" list (see Table 3) was "Creating our own web pages and book was enjoyable and I learned more" with an aggregate score of eighty-four in a class of thirty seven students. Students considered their compilation of papers as a kind of book and seemed to take pride in their work. The item "Having class time to work on projects" was ranked second in the list with an aggregate score of fifty-five. This seemed to indicate that the students prefer to be engaged and involved in active learning as opposed to passive learning. Another interesting result was the fourth ranked item, "The freedom to build our own chapter outlines," with an aggregate score of forty-nine. Students preferred the freedom to choose the information technology topic to investigate. The item, "The instructor's mini-lectures on each topic," ranked thirteenth with an aggregate score of twenty-one. The class enjoyed being engaged and active while in the classroom. It was suggestive that the students in this course prefer a more student driven TML instructional design.

The highest ranked item on the "Hindered" list (see Table 4) was "More direction on what was expected in the book and presentations" with an aggregate score of seventy-two. This may reflect some uneasiness due to the unstructured nature of investigating information technology topics where no outline or exact identification of topics was provided. The second ranked item, "More instruction in the lab on using the web authoring tool," and third item, "Lab hours are too limited," had respective aggregate scores of fifty-eight and fifty. Collectively these items concern tool training and lab availability and constitute areas where improvements can be made. With respect to the instructional approach used in this class versus a lecture-oriented class, the item, "Have more lectures from the instructor," ranked seventeenth with an aggregate score of six. There was no indication that the lack of formal lectures was a problem for this course.

Table 5 contains information used to evaluate the effectiveness of the instructional design dimensions associated with MISB-600. It was compiled by totaling the rank scores for each IDD for each of the "Helped And Hindered" responses. By organizing the findings of the NGT data in the fashion found in Table 5, a score or effectiveness index for each IDD can be produced. Summing the "Helped and Hindered" aggregate ranks by IDD and subtracting the difference between the "Helped" and "Hindered" columns is illustrated in Table 5. This yields a net score for each of the IDDs. Only the learner IDD is absent of scores since it was not part of the scope of this study to capture any individual information about the learner. Table 5 with its IDDs organized in this fashion provides a framework by which to review and make adjustments to the course. Observing the sign and magnitude of the differences, an instructor can readily identify which dimension(s) need further adjustment. Ultimately, the goal should be that all differences are positive and their values as close as possible to the helped totals.

5. SOME CONCLUDING REMARKS

Technology-mediated learning is becoming increasing popular due to the emergence of the Internet and increased interests in distance learning and alternative educational formats. This paper represents an exploration of greater use of the Internet in business education. Although much additional work is needed, this paper provides some insights

into the relationships and effectiveness between the technology capabilities, instructional strategy and psychological processes involved in learning. The technology features used in MISB-600 can been seen in Table 1. These capabilities were used by each student in the course. For example, by working with various search engines as vehicles to locate relevant information, using web authoring tools to compose their documents, conducting discussions on the bulletin board, and taking an on-line final exam, students experienced the use of a number of technology features during their learning experience. By including these technology features in the course, students gained an appreciation for the value of technology within a learning context and the relationship that technology has to the process of learning. Students also realized the benefit of having an instructional strategy that required use of the Internet as a source of information. The learning benefit that followed included psychological processes associated with sorting through various unedited sources of information and using corroborative evidence as a basis for establishing the accuracy of these sources.

Table 3. Items That Aided Learning

Items	IDD	Rank Totals 1(5)	2(4)	3(3)	4(2)	5(1)	
Creating our own web pages and book was enjoyable and I learned more.[1]	IS	10	5	3	2	1	84
Having class time to work on projects.	P	5	4	2	3	2	55
The templates for the book and presentations were helpful.	C	3	3	2	9	2	53
The freedom to build our own chapter outlines.[2]	P	2	2	5	4	8	49
Hearing other groups present.	IS	1	5	4	3	2	45
Progress reviews were helpful.	C	2	2	4	4	2	40
Working in groups helped.	P	1	2	4	2	0	29
Having a flexible class schedule helped.	P	3	0	3	1	2	28
The instructor pointing out some sites for information on particular topics helped.	C	2	3	0	2	0	26
Having interesting topics was motivating.	C	1	1	2	4	3	26
Learning to search internet for resources.	IS	1	2	2	2	2	25
Having to do an individual chapter helped.	P	1	3	1	0	4	24
The instructor's mini-lectures on each topic.	IS	2	2	0	0	3	21
Group sizes were right.	P	0	1	3	1	2	17
Having to research the topics and present them instead of have traditional lectures.	IS	2	1	0	0	0	14
The number of chapters is right.	P	1	0	1	0	3	11
Getting up to date news from the instructor on what was going on in the industry.	IS	0	1	1	0	0	7
Being required to review all topics forced me to learn more.	P	0	0	0	0	1	1

IDD – Instructional Design Dimension (see Table 2)

[1]*The term, "book," refers to the bundling of all of the individual research documents combined in a group folder.*

[2]*A chapter outline is the IT topic outline that each student had to develop as part of planning their research document. The term, "chapter," was used to illustrate how each individual research document would relate to the others in the group folder.*

Table 4. Problem Areas Mentioned By Students

Items	IDD	Rank Totals 1(5)	2(4)	3(3)	4(2)	5(1)	
More direction on what was expected in the book and presentations.[1]	C	7	4	6	1	3	72
More instruction in the lab on using the web authoring tool.	C	6	3	3	3	1	58
Lab hours are too limited.	E	5	5	1	2	2	50
The older PCs in the lab were too slow and dated.	E	3	1	6	3	1	38
Difficulty dialing into campus due to limited number of dial-in lines.	E	2	1	6	0	3	35
Have a better web authoring tool than Composer or AOLPress.	E	1	5	2	1	1	32
Knowing at the beginning of the semester the order of the groups presentations.[3]	C	3	2	1	5	2	28
Each team member should have equal time to present.[4]	P	1	3	2	2	2	25
No evaluation or feedback after each presentation.[5]	C	1	2	2	3	5	24
Having to provide reference links.[7]	IS	2	1	2	1	3	23
The unavailability of authoring tools at other labs on campus.	E	1	2	1	2	2	18
Difficulty in meeting with other group members.	P	1	2	1	0	2	18
More information about the topics from the instructor.[6]	C	1	3	0	5	0	17
Having more than one group present on each chapter. [2]	P	1	0	1	3	5	13
Too many chapters to review. [2]	P	1	1	0	1	1	10
Having to work in groups.	P	1	0	1	0	1	9
Have more lectures from the instructor.	C	0	0	2	2	0	6
Have a book on Web Authoring that is optional.	C	0	1	0	0	1	5
Have a simple web building exercise to build one web page.	P	0	1	0	3	0	4
Have a final review session.	IS	0	0	0	0	2	2

IDD – Instructional Design Dimension (See Table 2)

[1]*The term, "book," refers to the bundling of all of the individual research documents combined in a group folder.*

[2]*A chapter outline is the IT topic outline that each student had to develop as part of planning their research document. The term, "chapter," was used to illustrate how each individual research document would relate to the others in the group folder.*

[3]*Work groups were informed one week in advance as to which would be presenting so that no group would knowingly have more time to prepare than other groups.*

[4]*Presentations differed in length and some students significantly exceeded their alloted time.*

[5]*Students received grades on their presentations within a week of presenting. Each student could inquire about the evaluation of their presentation but there was no formal critique offered automatically on every presentation.*

[6]*Some students were uncomfortable with the flexibility of topic selection and would have preferred that specific topics be assigned.*

[7]*Some students found it difficult to put links in web pages.*

Table 5. Instructional Design Evaluation

Instruction Design Dimension	Helped (Totals)	Hindered (Totals)	Difference
Instructional Strategy	196	25	171
Process	214	79	135
Content	145	210	- 65
Environment	0	173	- 173
Learner	NA	NA	NA

Reliance on the Internet with its almost infinite sources of information places a new burden on the student. Traditional guides (e.g., judgment of the instructor, choice of information to put into a library) are replaced by the responsibility of the student in choosing and evaluating information. This increase in individual choice and judgment is both promising and dangerous. In addition, the role of the instructor changes. Instead of primarily using lectures as a means of delivering information, the instructor functions not only as a subject matter expert but as someone who stimulates active learning through involvement in facilitating communcation in on-line discussions and at times learns along with and from students. The ability for students to enter into discussions both with their group members and online with the class at large constituted a teamwork dimension characterized as desirable learning attribute by Alavi (1994, p. 3).

A byproduct of the course described in this paper was the development of an approach to examining instructional designs by offering a categorical view of a course, through a framework comprised of instructional design dimensions (IDD), in which items of each category can be identifed and scored for effectiveness. The IDD framework with the use of the NGT data gathering technique provides others interested in exploring instructional designs an operational guide. The ability to represent a given course using the IDD framework allows the instructional designer to identify what works and what needs improvement.

A number of refinements could be made to this particular course as a result of the problem areas mentioned by the students in Table 4. As an example, the next time the course is offered students should probably be shown examples of some of the better student work. Additionally, page limits could be implemented so that the students would know how much space they had to address their information technology topic. Other improvements should include spending more time on learning a standardized web authoring tool. Although students were not forced to use a specific tool, standardizing on a particular tool would allow them to help each other in a more effective manner. Steps should be taken to make a web authoring tool available in the lab and classroom to make it easier for students to do their work while providing the instructor with an opportunity to demonstrate its features in class when students have questions. While not as useful as the suggested areas for improvement in Table 4, consideration of the highly ranked items in Table 3 along with those in Table 4 can be used as a basis for refining the design of the course for future classes.

There remains a need to capture learning style information about the students and to examine that information by relating specific learning style attributes with specific instructional strategies and the use of particular technology features.

For all but the last few years of the twentieth century, when students went off to a university, they expected to attend lectures, take notes, read books, and take examinations. Technology-mediated learning has begun to alter this pattern of activities in many courses. The challenge to educators today is to develop new course designs that while using technology to enhance the learning experience for the student will repurpose class time to offer a richer environment for in class activities.

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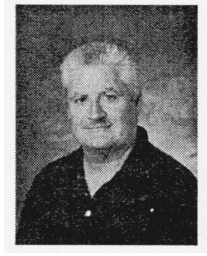

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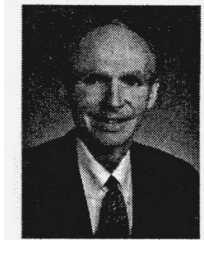

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ISSN 1055-3096