TOWSON UNIVERSITY
COLLEGE OF GRADUATE STUDIES AND RESEARCH

INTEGRATION OF USABILITY FACTORS INTO EVALUATION OF STUDENT LEARNING OUTCOMES IN ONLINE LEARNING ENVIRONMENTS

by

Gabriele H. Meiselwitz

A dissertation

Presented to the faculty of

Towson University

In partial fulfillment of the requirements for the degree

Doctor of Education in Instructional Technology

September, 2005

Towson University
Towson, Maryland 21252

TOWSON UNIVERSITY
COLLEGE OF GRADUATE STUDIES AND RESEARCH

DISSERTATION APPROVAL PAGE

This is to certify that the dissertation prepared by Gabriele H. Meiselwitz, entitled Integration of Usability Factors into Evaluation of Student Learning Outcomes in Online Learning Environments has been approved by this committee as satisfactory completion of the requirement for the degree Doctor of Education in **Instructional Technology** in the department of Reading, Special Education and Instructional Technology.

_____ _____
Chair, Dissertation Committee Date

Dr. William Sadera

_____ _____
Committee Member Date

Dr. Paul Jones

_____ _____
Committee Member Date

Dr. Jonathan Lazar

_____ _____
Committee Member Date

Dr. Chao Lu

_____ _____
Dean, College of Graduate Studies and Research Date

ACKNOWLEDGEMENTS

I would like to thank the following persons:

- My advisor and dissertation chair, Dr. William Sadera, for his time and guidance during the planning and completion of this dissertation
- My dissertation committee, Dr. Paul Jones, Dr. Jonathan Lazar, and Dr. Chao Lu, for their advice and support with the development of this dissertation
- Dr. Doris Lidtke for her advice, support and encouragement to conduct and complete my graduate work
- My family, Jeffrey, Sandra, and Andrew, for their support and encouragement throughout the process of completing my graduate work

ABSTRACT

INTEGRATION OF USABILITY FACTORS INTO EVALUATION OF STUDENT LEARNING OUTCOMES IN ONLINE LEARNING ENVIRONMENTS

Gabriele Meiselwitz

Many institutions in higher education are offering at least some of their curriculum online and use a course management system (CMS) to support these online learning environments. Usability evaluation tools are often used to measure the quality of a user's experience when interacting with a web site. The purpose of this study was to evaluate the relationships between usability factors and learning outcomes in an online learning environment as well as to investigate differences in learning outcomes and system usability between several selected student groups (selected groups were: gender, age, student standing, student computer competency scores). Subject of evaluation were eight sections of an introductory computer science course taught in hybrid format using a CMS. A survey instrument, integrating usability research into evaluation of student learning outcomes in online learning environments, was developed. Results of the study have direct implications on the design and development of online instruction.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I. INTRODUCTION

Internet technologies have enabled many institutions of higher education to offer some or all of their curricula online and many educators are now using Internet and World Wide Web technologies to conduct coursework online. Online courses, or online components used in hybrid instruction, allow academic institutions to overcome time and location restrictions and offer a number of other advantages for the institution and the student. Currently, 80% of institutions in higher education extended their curriculum to include online components and 49% offered complete online degrees (Sloan Consortium, 2003).

Online learning requires technology, adding a new dimension to traditional higher education. The integration of technology into learning environments necessitates that instructors expand instructional methods to include technology and related computing tools. Many educators in higher education have little training regarding the potential and limitations of online learning environments and often have to learn how to use these technologies and tools and how to teach effectively using these systems through trial and error (Moore & Kearsley, 2005).

Computer science provides usability tools and guidelines that can assist in use and assessment of online learning technologies and tools. Usability, a common research practice in the computer science field, measures the quality of a user's experience when interacting with a product or system and is an essential element of web design and development. It is standard practice for professional web developers to apply usability guidelines to improve the user experience with Internet and World

Wide Web technologies. Successful interaction with an online environment increases user satisfaction and productivity; and it strengthens acceptance of the product. Many initiatives promote research to encourage a higher level of usability (Koohang, 2004; Shneiderman, 1998; U.S. Department of Health and Human Services, 2004). Usability research and implementation of usability principles assist instructors in enhancing the learning experience for students in online learning environments, and can influence student learning process and learner effectiveness (Koohang, 2004). However, little research has been done to investigate these relationships between usability and online learning (Feldstein, 2002; Quigley, 2002).

This research examined the application of usability research in online learning environments and the effects of usability research on student learning outcomes including student achievement, communication and collaboration. This dissertation is composed of the following chapters: Introduction, Literature Review, Methodology, Results, and Discussion. Chapter 1, specifically, contains the following sections: Overview, Background, Statement of the Problem, Purpose of Research, Significance, Research Design, Research Questions, Limitations, and Definition of Terms.

Background

Online learning is transforming higher education and many institutions have expanded their traditional in-class course offerings to include online components. A national survey of over 900 higher education institutions conducted by the Sloan Consortium (2003) predicted the number of students taking online courses to grow by 20% in the year following the study. Further analysis showed that 80% of all

surveyed organizations offered at least some of their courses online, and 49% offered complete online programs (Sloan Consortium, 2003).

This growth in online learning also requires re-evaluation of traditional assessment methods (Moore & Kearsley, 2005). Assessment of learning environments is necessary to document successful learning experiences and learning outcomes for students; and it must include assessment methods to ensure quality in online learning environments. Since online learning is conducted using technology, assessment must consider not only pedagogy, but also technology (Moore & Kearsley, 2005). A number of studies (Fredericksen, E., Picket, A., Pelz, W. Swan, K. & Shea, P., 1999; Oliver & Herrington, 2003; Valenta, Therrieault, Dieter & Mrtek, 2001) have been conducted to assess learning outcomes in online learning environments and many note the importance of the relationship between technology use and student achievement in online courses.

Along with the technologies being used to build the environment, communications technologies are significant contributors to learning outcomes (Fredericksen et al., 1999). In an environment where learning is independent of time and physical location, technology is vital for learning and student-student as well as student-instructor interaction. Fredericksen et al. (1999) observed that technology in online learning environments influenced the learning outcomes for students. Students who reported that technical difficulties impeded their learning reported significantly lower learning outcomes overall when compared to students who did not report technical difficulties (Fredericksen et al., 1999).

Many studies supported Fredericksen's (1999) observation and identified technology as an important factor for student success in online learning environments (Grice & Hart-Davidson, 2002; Oliver & Herrington, 2003; Valenta et al., 2001). However, data on technology use was often not disaggregated, thus making it problematic to analyze technical difficulties that influence learning outcomes in more detail. Considering the important role of technology and web technology specifically in online learning, several studies supported the inclusion of usability research in assessment of online learning (Feldstein, 2002; Grice & Hart-Davidson, 2002; Nelson & Wayne, 1999).

Although successful web design includes usability research, unfortunately little usability research is performed with a focus on online learning environments (Feldstein, 2002; Quigley, 2002). Several researchers emphasized the necessity to include pedagogical guidelines for usability research in online learning, standards identification, and user-based testing in the user environment to effectively evaluate these online environments (Association of Computing Machinery [ACM], 2001; Nelson & Wayne, 1999).

In summary, evaluation of learning outcomes in online instruction should include usability research and needs to examine the complexity and interconnection of educational and technology indicators (ACM, 2002; Grice & Hart-Davidson, 2002). Assessment should address the multidisciplinary, larger social group and should be situated into a framework within the user environment including ancillary conditions (Nelson &Wayne, 1999).

Statement of the Problem

Online learning environments are complex, technology rich environments. Many studies have revealed relationships between technology and learning outcomes in online learning (Grice & Hart-Davidson, 2002; Nelson & Wayne, 1999; Oliver & Herrington, 2003), but unfortunately, provide only limited disaggregated data on the elements of technology and do not consider the interconnection of educational and usability indicators.

Purpose of Research

It was the purpose of this research to investigate both relationships and differences between student learning outcomes, and usability factors in online learning environments. This study examined relationships between system usability and learning outcomes. Additionally, this research focused on differences in learning outcomes and system usability between several selected student groups (i.e., gender, age, student standing, student computer competency scores). To conduct this research, a survey instrument, integrating usability research and evaluation of student learning outcomes in online learning environments, was developed.

Significance

A relationship between system usability and learning outcomes would demonstrate that when overall system usability increases, overall student learning experience also increases or vice versa. Disaggregated data provides indicators to assist in identification of possible causes for relationships.

The instrument used in this research will provide an easy to use tool for instructors and/or companies to assess their online or hybrid courses regarding usability and student learning outcomes. Improving usability may improve the online learning environment and could positively influence student learning outcomes in a multitude of online learning environments and settings.

Research Design

This research study used a sample of convenience. The participants in this study were 240 students attending a mid-sized comprehensive university in the Mid-Atlantic. The course, from which this sample was drawn, was a 15-week, three-credit course and consisted of a lecture and a laboratory component. This was a general education course in computer science titled "Creativity and Creative Development". A survey instrument was developed and pilot tested for this study.

The survey was administered during the last week of the course after students had finished the majority of class work and had used the online learning environment for the complete duration of the course. Study approval by Towson University's Institutional Review Board (IRB) for Research Involving the Use of Human Participants was granted under Exemption Number 04-1X09 on June 03, 2004 (Appendix A).

Research Questions

To more specifically understand the implications of usability research in online learning environments, this research was guided by the following detailed research questions:

1. Is there a statistically significant correlation ($p < 0.05$) between online learning system usability and student learning outcomes?
2. Is there a statistically significant difference ($p < 0.05$) between selected student groups (computer competency scores) and both student learning outcomes and online learning system usability?
3. Is there a statistically significant difference ($p < 0.05$) between selected student groups (selected groups were: gender, age, and student standing) and both student learning outcomes and online learning system usability?
4. Is there a statistically significant difference ($p < 0.05$) between selected student groups (degree of face-to-face/online instruction) and both student learning outcomes and online learning system usability?

Comment [BS1]: (p=<.05)??

Limitations

This research was conducted with the acknowledgment of the following limitations:

1. The selection of subjects was limited to 240 eligible students in a hybrid, general education computer science course at Towson University during the Fall 2004 semester. The sample was a sample of convenience and introduced bias. Results of this study are not generalizable beyond this sample of 240 eligible students in an introductory computer science course.
2. The course used a course management system (CMS), and was limited to the design and functions of this system. Limitations of the system consisted in the

way information was organized and presented, in the navigation structure of the system and communication options and methods.

~~4.~~3. The course was designed for a large group and all assignments were shared online. Interactive online discussion was encouraged, but was limited due to the size of the class. Discussions of this size are very complex to handle and structure, and difficult to respond to and track.

4. The course was taught by one instructor and two teaching assistants, and although all sessions were conducted according to the same lesson plan, the study was limited due to possible variances in teaching style of the instructor and the two teaching assistants.

5. This research used student self assessed reports. Although it is assumed that students answered questions truthfully and honestly, this study was limited due to the individual differences in student self-assessment.

Formatted: Bullets and Numbering

Comment [MSOffice2]: Didn't we discuss adding a sentence explaining each of these limitations?

Definition of Terms

The following definition of terms includes terms relevant to usability and online learning environments. The definitions as listed in the following paragraph provide an understanding on how these terms are used in this dissertation, so that boundaries and components of the problems are well understood. It is not the intention to provide these definitions as final, ultimate definitions and it is possible that other explanations are used in various contexts.

Course Management System (CMS). Software designed specifically for use in an online or hybrid educational setting. Contains instructional material, educational software, or audiovisual materials.

Learnability. Elements of a system supporting the learning experience, assisting or easing the learning experience.

Online learning. Learning where instructor and students are separated physically and in time. In this research, online learning is asynchronous and is supported by Internet/WWW technologies.

Online learning environment. Instructional systems supporting and facilitating online learning, including educational resources and technologies. In this context it also includes communication, organization, and administration of online learning.

Learning outcomes. Final result of the learning experience, newly built or changed knowledge of students.

System usability. The user-friendliness of a system, including the effectiveness, efficiency, and satisfaction with which users can achieve tasks in a particular environment (system).

Usability factors. Design features influencing system usability.

Comment [MSOffice3]: Include page numbers on te top center only, not both top and bottom

CHAPTER II. LITERATURE REVIEW

Many institutions of higher education have expanded their traditional in-class course schedule to include some offerings of online courses. Online courses, or online components used in hybrid courses, allow academic institutions to overcome time and location restrictions and offer a number of other advantages for the institution and the student. In online learning environments teaching is conducted through web-based technologies and these technologies often influence student learning outcomes (Koohang, 2004; Moore & Kearsley, 2005).

This literature review focused on research evaluating online learning environments and usability issues in online learning. Including a general overview of usability and online learning environments, literature was reviewed in the following areas: research comparing online learning and face-to-face learning, research within the online learning environment, and research employing student perspectives in online learning environments.

A number of studies have been conducted to assess student learning outcomes in online learning environments. Various assessments compared online learning with face-to-face learning while others focused on identifying predictors for success in distance learning (Dutton, 2002; Johnson, Aragon, Shaik & Palma-Rivas, 2000; O'Malley, 1999; Rovai, 2003; Shih & Gamon, 2001).

Several studies included technology factors in their evaluation, but technology includes a wide field of tools, methods, or technologies; and many studies evaluated some facet of technology, but did not incorporate usability research as it is used in

computer science (Fredericksen et al., 1999; Johnson et al., 2000; Valenta et al., 2001). Usability research assesses the effects of technology systems on the user and is used in computer science to evaluate and improve the user experience when interacting with a system. This type of research could provide a valuable tool to assist in evaluation of online learning environments and learning outcomes and to improve learning outcomes for students. Unfortunately, little research has been conducted considering usability factors in online learning environments (Feldstein, 2002; Quigley, 2002).

Usability

Usability research focuses on the quality of user experience when interacting with a system and evaluates the ease of use of specific technologies for users. In computer science, it is common to test efficiency, effectiveness, and user satisfaction of newly developed system according to usability guidelines (Nielsen, 2003; Shneiderman, 1998; Tognazzini, 2002). Shneiderman (1998) described the serious consequences of ignoring usability research, and stated that it must definitely be included in web design and development.

Usability testing focuses on the ease of use of specific technologies for users and requires considerable time commitments and resources. Lazar (2001) described the ideal situation of usability testing with hundreds of users in an advanced usability laboratory, but also pointed out that the real world is different. Time and resources for this type of testing are often limited, but any usability testing is better than no usability testing. Lazar (2001) described a more practical approach where usability

testing is defined as trying to find and fix as many problems as possible as quickly as possible, with as little cost as possible, and does not require an extensive laboratory setting.

Usability research is often approached from two directions, expert-based testing or user-based testing. In expert-based testing, the testing person is a subject expert, representing a specialist from the engineering and/or usability team. In user-based testing, the testing person is the actual user, representing the target population of the product. User-based usability testing evaluates the project in a real-world environment with actual user tasks to complete. Both methods can provide valuable information about the usability of the system, and often testing is performed using a mixture of both methods (Lazar, 2001).

The decision about which approach to use is often determined by the point in the process where usability testing is to be employed. Expert-based testing is often conducted when the project is still in the development phase or when the product is close to launch. User-based testing can be conducted at any time in the process. It can supplement expert-based testing during the development phase, and it also can be used to validate the success of a site after the actual launch (Human Factors Research Group [HFRG], 2003).

User-based usability research can be conducted by observing users in usability laboratories, but this type of usability testing is very time and resource intensive. Often usability research employs questionnaires to evaluate projects in real-world environments with actual user tasks to complete. A questionnaire that is reliable, and

presents feedback from the point of view of the user, is a trustworthy sample of the whole user population (HFRG, 2003).

Online Learning Environments

Many institutions of higher education have expanded their traditional in-class course schedule to include some offerings of online courses. Online courses, or online components used in hybrid courses, allow academic institutions to overcome time and location restrictions and offer a number of other advantages for the institution and the student.

In an attempt to measure the growth of online learning in higher education, the Sloan Consortium (2003) surveyed over 900 higher education institutions to evaluate the quality and extent of online education in the United States during the 2002 and 2003 academic year. The results of this research showed that institutions expected the number of students taking online courses to grow by 20% in the year following the study. At the time the study was conducted, over 80% of all institutions in higher education offered at least some of their courses online and institutions in the public sector even surpassed this number with 97% offering online courses and an astonishing 49% were offering complete online degree programs.

Growth in the field of online learning has inspired growth in online pedagogy and it is important to consider learning theories and indicators for successful online learning environments. Literature on learning theory and cognitive development is extensive, and successful learning environments (online and face-to-face) are often connected with the concept of learner-centered education. Quality web-based

teaching and learning is based on the following characteristics (American Distance Education Consortium [ADEC], 2004):

- Fosters meaning-making
- Moves from knowledge transmission to learner-controlled systems
- Provides for reciprocal teaching
- Is learner-centered
- Encourages active participation, knowledge construction
- Based on higher level thinking skills -- analysis, synthesis, and evaluation
- Promotes active learning
- Allows group collaboration and cooperative learning
- Provides multiple levels of interaction
- Focuses on real-world, problem solving

These pedagogical guidelines are representative for a learner-centered, constructivist framework and apply to online teaching and learning environments as well as to face-to-face environments.

Research Comparing Online Learning and Face-to-Face Learning

Based on the similarity of pedagogical goals for online and face-to-face learning environments, several researchers compared quality and learning outcomes of online learning environments with the quality and learning outcomes of face-to-face learning environments. Many studies concluded that students in online learning environments learn as well as students in face-to-face learning environments. Learning outcomes of students in online learning environments showed no significant

difference (meaning that the learning outcomes are roughly comparable) when compared to face-to-face learning environments (Dutton, 2002; Johnson, et al., 2002; Rovai, 2002).

Rovai (2002) conducted a large study of 413 subjects comparing online learning and face-to-face learning and reported no significant difference between courses taught using Blackboard's course management system (CMS) and traditional face-to-face methodologies. Research conducted by Johnson et al. (2000) showed similar findings, and also pointed out a number of causal connections. In a comparative analysis of learner satisfaction and learning outcomes in online and face-to-face environments, findings showed only a slightly more positive perception about the instructor and overall course quality from students in the face-to-face environment (Johnson et al., 2000). Johnson's (2000) study was performed in a controlled setting; learning outcomes were measured using student self-assessments, course grades and projects, and results showed no significant difference in learning outcomes. Online learning was shown to be as effective as face-to-face learning, but students in online courses were less satisfied. Johnson et al. (2002) suggested that this may be partially caused by technologies, especially when used in courses that require high degrees of student instructor interaction, feedback and real-time interaction.

Dutton's (2002) research confirmed that online students performed as well or better than students in a face-to-face setting. Dutton (2002) used a large computer science class in a controlled environment for comparison and noted some distinct demographic differences between the groups. Compared to the lecture students, most

online students were older, were not enrolled in a degree program and had higher work commitments. Dutton's (2002) study used course grade, exam grades and the course completion rate to measure student success in the course. Performance of online and face-to-face students was roughly equal with two variables significantly affecting performance. Work commitments lowered the grade performance and prior computing experience improved grade performance (Dutton, 2002).

Online learning environments use a myriad of tools, technologies, software and hardware that are integrated into the learning process. Unfortunately, technology in all of the reviewed research was often used in a very broad context. For example, some research concentrated only on technology delivery modes or communication tools, and some research referred to all technology used only under the umbrella term technology (Johnson, 2002; Oliver & Herrington, 2003; Valenta et al., 2001). Data was not disaggregated into sub categories so that no further conclusions could be made regarding usability of tools, online CMS or user interface. This lack of consistency in evaluation methods and lack of standardized entities in technology assessment made it difficult to relate or apply results between environments.

Research within the Online Learning Environment

A more recent trend in the research is to evaluate relationships within the online learning environment. In a review of literature on learner achievement in online learning environments, Moore and Kearsley (2005) concluded that instruction at a distance can be as effective as classroom instruction in bringing about learning and that the absence of face-to-face contact itself is not detrimental to the learning

process. Moore and Kearsley (2005) stated that current and future research should move beyond the statement of "no significant difference" and evaluate differences not between groups, but instead within the group. Differences within the system can provide important information on what student types learn best in a particular environment and from which particular technologies or teaching strategies (Moore & Kearsley, 2005).

A growing number of recent researchers identified technology supporting online courses as an important measure for success (Fredericksen et al., 1999; Oliver & Herrington, 2003; Valenta et al., 2001). Oliver and Herrington (2003) discussed factors influencing the quality of the online experience. Due to the increased use of online learning as a delivery medium for higher education, Oliver and Herrington (2003) observed a shift in methods used to determine quality and success. This research showed that two main areas emerge as factors that most influence the student learning experience: technology delivery to the remote learner and the quality of facilitation (Oliver & Herrington, 2003). Problems with technology delivery and students' experiences with technology delivery caused dissatisfaction with the learning experience and created perceptions of diminished learning (Oliver & Herrington, 2003). This research highlighted the necessity, that in addition to ensuring quality materials for the online courses, institutions also needed to focus on ensuring quality in the technology delivery process and in administration and facilitation of the learning setting (Oliver & Herrington, 2003).

Valenta et al. (2001) were also supporting the request for more studies regarding technology use and tool design in online learning. Valenta et al. (2001) studied student attitudes and learning styles with a special focus of making online learning more attractive and viable for different populations and documented the lack of data on the use of technology and its effectiveness in distance education. Consequently, Valenta et al. (2003) addressed the field of human-computer interaction and asked that educators and researchers apply computer interface design to the interaction of students in online courses to build better online communities and to address the needs of the learner.

Fredericksen et al. (1999) provided further evidence for the connection between technology use and student learning outcomes. In this project, Fredericksen et al. (1999) surveyed sixty-four colleges with nearly 400,000 students regarding evaluation of student satisfaction and perceived learning with online courses. It was observed that interaction (student-student and student-instructor) was a significant contributor to student perceived learning outcomes (Fredericksen et al., 1999). The second most important factor was technical difficulties. Fredericksen et al. (1999) stated that students who reported that technical difficulties impeded their learning also reported significantly less learning overall than students who did not report that technical difficulties impeded their learning. This was also transferred to student experience with the helpdesk. Students who reported a higher satisfaction with the helpdesk also reported a significantly higher level of learning that students who were less satisfied with the helpdesk (Fredericksen et al., 1999). An interesting observation

regarding technology was made by Fredericksen et al. (1999): the prior computer skill level of the student did not seem to matter in the overall assessment of the student perceived learning outcomes. Students who had the least prior computer knowledge reported the highest levels of learning. Unfortunately, data on technology use in this study of online learning environments was not disaggregated. It was not possible to conclude which technology elements (delivery, tools, or CMS) were included in this survey.

A definite connection between communication tools and the overall success and satisfaction of students in an online course was established by Johnson et al. (2000). Although software provided examples and illustrations within the online content to explain and support the environment, it was noted that designers of online environments needed to devote much more effort to supporting documentation and help functions in online learning environments (Johnson et al., 2000).

Because information technology has become more pervasive and sophisticated, usability research needs to be situated in the actual user environments (Grice & Hart-Davidson, 2002). Usability research today includes both the modelling of cognitive function and the ethnographic description of user behavior. Often a narrow focus on small operational details in usability research ignores the complexities of the broader context of use, and, consequently, will fail (Grice & Hart-Davidson, 2002). Any usability research must include the social context, and must be situated into a framework that includes the backgrounds, understandings, and expectations of those who will review and use the results (Grice & Hart-Davidson,

2002). Through their research, Grice and Hart-Davidson (2002) concluded that higher complexity led to more opportunities for usability to go astray and that often the control of circumstances was beyond the control of any individual or group. The importance of the user was emphasized; what mattered for the user was if the final process and the entire system worked well (Grice & Hart-Davidson, 2002).

Increasingly complex learning environments were also discussed by Nelson and Wayne (1999) in their description of the process of integrating usability engineering into the design and development process of educational software. Most importantly, Nelson and Wayne (1999) noted, that it was not foreseeable how one particular student would use the tool, especially in a learner-centred, constructivist environment. Learners did not always use the features of the software in the way that designers anticipated and adapted or invented a variety of learning strategies that were idiosyncratic to the capability of the interface as well as the learning styles of the individual. The results of Nelson and Wayne's research (1999) underlined again the importance of user-based testing, and furthermore testing in the user environment considering ancillary conditions.

Student Perspectives in Learning Outcome Evaluation

User-based testing in the user environment reflects the perspective of the learner. O'Malley (1999) pointed out the importance using student perceptions of learning when studying the impact of online delivery modes. O'Malley (1999) selected to employ the perceived effectiveness of learning because:

- the difficulties of measuring learning (must have a control and experimental group over time in a controlled setting),
- student perceptions may be more important than instructor measured outcome, i.e. decisions, many times, are based on perceptions,
- perceived learning will contribute to our knowledge of learning effectiveness (O'Malley, 1999).

O'Malley (1999) observed that students perceived online learning to have more logistical benefits over traditional methodologies, especially when it came to time, location and scheduling issues. However, students did not perceive that there was a difference in how much they learned and in the quality of their communication with the instructor, when compared to traditional learning environments (O'Malley, 1999).

Although online education offers many benefits, adoption of online education has been slower than anticipated (Zemsky & Massy, 2004). Zemsky and Massy (2004) argued that this was a result of too many untested products and the lack of detailed knowledge about how to use online learning in context. They also stated the need for a more realistic mapping of technical obstacles that must be overcome and strongly recommended the integration of student expectations into the design, development, and evaluation of online learning environments (Zemsky & Massy, 2004).

Online learning environments are complex systems and many institutions, even local governments, use student feedback as a prime quality indicator in system

evaluations (Oliver & Herrington, 2003). Student perceptions are often used as the principal data source for quality assurance processes associated with teaching and the approach of using student perceptions is well grounded in practice and policy (Oliver & Herrington, 2003).

Student feedback is also a good reflection of the individual student learning process. Fredericksen et al. (1999) observed that students noted significantly reduced learning outcomes when technical difficulties arose during the course of the study, but this relationship was not reported for prior computing skills. Students with low prior computing skills actually reported higher learning outcomes than students with high prior computing skills, concluding that difficulties related to computer skill building were not experienced as reducing the learning experience (Fredericksen et al., 1999). Perceived learning outcomes can be a good measure to reflect the complexity of the learning process of the individual student. Had the learning outcomes only be assessed with success indicators as typically recorded by the instructor (grades), this discovery would have likely been unreported and unnoticed (Fredericksen et al., 1999). However, the discovery was very important, because it showed that students experience learning in context and that self-reported learning outcomes make it possible to integrate this complex learning experience into the evaluation of the online learning environment.

Usability Research in Online Learning

Several studies supported the need for research of usability issues in online learning environments considering the actual user environment including ancillary

conditions (Grice & Hart-Davidson, 2002; Nelson & Wayne, 1999; O'Malley, 1999). Successful web engineering includes usability research, but unfortunately not much usability research is performed in the area of online learning. Quigley (2002) suspected that the lack of funding for usability research in education environments was the main reason why it was not integrated into online learning. Quigley (2002) also pointed out that the lack of principles or standards available to identify "what works" in online learning were reasons why usability is not incorporated in online learning in the same way it is in web design and development in industry. Feldstein (2002) echoed Quigley's (2002) observations and recommended that, considering the limited funds available in education, at least basic usability research using a low-cost method should be implemented. The cost of *not* performing usability research can be surprisingly high, because if students have had a bad experience once, they may be turned away from online learning for many years to come (Feldstein, 2002). Feldstein (2002) was in agreement with Quigley (2002) that it is necessary to identify best practices in online learning and incorporate these best practices with usability research for successful teaching and learning in online learning environments.

Participants at an online learning special interest group at the Computer Human Interaction Conference in Seattle, Washington, 2001 also supported the need for standards identification in the unique combination of usability research including pedagogical guidelines in online learning to effectively evaluate and improve these types of environments. It was emphasized that usability research in online learning must include pedagogical guidelines to foster learnability (ACM, 2004).

Comment [m4]: This referenced twice?

Summary

Many research projects strived to identify differences between face-to-face learning environments and online learning environments (Dutton, 2002; Johnson et al., 2000; Rovai, 2002). These studies are often difficult to perform, since they need to be conducted in a controlled setting over time. Findings are also not easily generalizable, because most settings are particular in their composition of institution, instructors, student population, support structure, course content and many other variables. In many cases, courses are not offered online and in a traditional setting at the same time, and students may not always have the freedom to select their preferred learning environment and thus results may be skewed.

Research evaluating differences and relationships within online learning systems can provide important indicators on what student types learn best in a particular environment and from which particular technologies or teaching strategies within the online learning environment. Results from studies within the environment can also provide guidelines for instructors to enhance the learning process and increase the learning outcomes in particular, unique online learning environments.

This literature review presented current research showing that online learning environments are complex environments and that pedagogical approach of the course and difficulties with the technology that was employed are strongly related to student learning outcomes.

A number of researchers identified technology as an important factor, however, did not disaggregate the data on technical difficulties (Dutton, 2002;

Fredericksen et al., 1999; Johnson et al., 2000), highlighting a need in research to evaluate online learning environments by integrating usability research to obtain further details about the nature of these technical difficulties and the need to use standardized entities for evaluation. Literature also pointed out that much of the learning experience is a complex, social phenomenon and that research is best performed in the actual user environment (Grice & Hart-Davidson, 2002; Nelson & Wayne, 1999).

In summary, research evaluating online learning environments should include technology using usability factors as well as factors describing quality and effective online learning environments. Assessment can be based on student perceptions and evaluation should be user-based, and be performed in the authentic user environment as much as possible.

Comment [MSOffice5]: Very nice

CHAPTER III. METHODOLOGY

Online learning environments are complex environments, allowing instructors to use a myriad of tools and technologies to help student learn from a distance. To assess the relationship between these tools and student learning outcome, evaluation of online learning environments should include both pedagogical factors and usability factors (Quigley, 2002). This research investigated relationships between online learning system usability and student learning outcomes as well as differences in online learning system usability and student learning outcomes within selected student demographics. This chapter describes the research methods used and includes the following sections: sample, research setting and procedures, research questions, selection of subjects, instrument, limitations and assumptions, pilot study, data collection and analysis, IRB approval, and summary.

Sample

This research study used a sample of convenience. The participants in this study were 240 students who were attending a mid-sized, comprehensive university in the Mid-Atlantic. Data collected in this study was obtained from students enrolled in eight sections of an introductory computer science course. The majority of students in the course were sophomores and juniors, and represented all colleges of the university. Participation in the study was completely voluntary and had no effect on student grades.

Research Setting and Procedures

The course, from which this sample was drawn, was open to all students, computer science majors and non-majors; and contained eight sections with a total of 240 students. The course was a 15-week, three-credit course in the general education category "Creativity and Creative Development" and consisted of a lecture and a laboratory component. Topics included computer-based animation, sound editing, Web-publishing and an extensive term project. The course used a hybrid approach to online instruction; approximately 50% of class material was taught using the World Wide Web, approximately 50% was taught using face-to-face instruction. A course management system (CMS) was used to provide online lecture notes, assignment instructions, submit and discuss student work, and record student grades.

Students in all eight sections were enrolled in the same online class. All eight sections were taught by one instructor and two teaching assistants. Class and laboratory meetings were scheduled to offer students the opportunity for face-to-face contact. All eight sections participated in one large group lecture meeting with eight separate laboratory meetings for each of the sections.

All lecture notes, PowerPoint presentations and laboratory instructions were posted online and were accessible through the CMS. Weekly assignments completed by students were posted online using the discussion board. This allowed students to share their work with the class and also encouraged online discussion about the work and the learning process. The course also contained four quizzes, all of which were conducted in class. All grades were submitted to the online grade book. Students

could access this online grade book at any time during the duration of the course to determine their standing in the course. A copy of the course syllabus is included in Appendix B.

The survey used to collect data for this study was administered during the last week of the course after students had finished the majority of class work and had used the CMS for the complete duration of the course. The survey was anonymous and voluntary, and was administered online. Students had the option to complete the survey on their own time or in class. Completing this survey had no effect on student grade or status as a student athlete. The survey was available until the final day of the semester.

Research Questions

To more specifically understand the implications of usability research in online learning environments, this research was guided by the following detailed research questions:

1. Is there a statistically significant relationship ($p < 0.05$) between online learning system usability and student learning outcomes?
2. Is there a statistically significant difference ($p < 0.05$) between selected student groups (computer competency scores) and both student learning outcomes and online learning system usability?
3. Is there a statistically significant difference ($p < 0.05$) between selected student groups (selected groups were: gender, age, and student standing) and both student learning outcomes and online learning system usability?

Comment [BS6]: (p=<.05)??

4. Is there a statistically significant difference ($p < 0.05$) between selected student groups (degree of face-to-face/online instruction) and both student learning outcomes and online learning system usability?

Instrument

The study evaluated student perceptions of the online learning environment usability and how it related to student learning outcomes. This assessment was reported by the student. The user questionnaire for this study had the following goals:

- employ a user-based testing approach
- be free of charge
- have established reliability and validity
- provide open ended questions
- be of reasonable length

In preparation for this study, a new questionnaire, the Web-based Learning and Usability Questionnaire (WLUQ) was developed. For the development of WLUQ appropriate usability and online learning outcomes questionnaires were evaluated. The new instrument was constructed based on existing questionnaires.

Requirements for the questionnaire defined that any instrument must be of low or no cost, must have established reliability and validity, should provide for open ended questions, and should be of reasonable length. Although only few survey instruments allowed for open ended questions, space for comments could easily be

added without influencing the overall reliability and validity. Reasonable length of the questionnaire was established to be between 20 and 50 questions for this research.

Taking into account all factors for evaluation, the survey instrument was developed based on two existing instruments: Post-Study System Usability Questionnaire (PSSUQ) and Web-based Learning Environment Instrument (WLEI). PSSUQ is intended primarily for assessment of user satisfaction with the usability of a system (Lewis, 1995). WLEI specifically targets user satisfaction in web-based learning environments (Chang, 1999).

PSSUQ was developed in 1995 for IBM, contains 19 questions and provides opportunity for open ended user comments (Lewis, 1995). Items selected from this questionnaire assess three areas of usability: (a) system usefulness (questions 13-16), (b) information quality (questions 17-19), and (c) interface quality (questions 20-21). System usefulness inquires about the usefulness of the tool for the task. Information quality addresses system support information and error handling; interface quality targets the general quality and functionality of the system interface.

WLEI specifically targets user satisfaction in web-based learning environments (Chang, 1999). It consists of 32 questions, provides open-ended comments and targets the effectiveness of web-based learning environment from a student's perspective. Items selected from this questionnaire address four areas important for the learning experience: (a) learner control and self-direction of the learning process (questions 25-27), (b) communication and collaboration (questions

28-30), (c) student achievement (questions 31-33), and (d) structure and organization of the learning environment (questions 34-36).

Both instruments have established reliability and validity, PSSUQ has a Cronbach alpha of 0.97, WLEI has a Cronbach alpha of 0.87. The authors of the two instruments were contacted to obtain copies and permission to use their instruments.

The newly created instrument, Web-based Learning and Usability Questionnaire (WLUQ) consisted of selected items from both questionnaires and was tested for reliability in an pilot study and in this study. WLUQ is organized in four sections and consists of 40 questions including three open-ended questions. Section I is designed to collect demographic data, section II is designed to collect data regarding computer competency, section III is designed to collect system usability data, and section IV is designed to collect data regarding student learning outcomes.

Comment [BS7]: nice

The purpose of section I is to collect demographic information as well as information about computer usage. Section I consists of seven items and is designed to collect information such as gender, age, student standing, and computer use.

The purpose of section II is to collect information about student computer competency such as email competency, word processing competency, or web-browsing competency. It consists of five questions and uses a five point Likert-type rating scale: 1=Poor, 2=Below Average, 3=Average, 4=Above Average, 5=Excellent. The level of the scale was defined as follows:

- 1=Poor (I have never heard of the software and don't know how to use it)
- 2=Below Average (I have heard of the software, but have little or no knowledge how to use it)
- 3=Average (I use the software sometimes, but only for basic operations)
- 4=Above Average (I use the software all the time and know most of its features)
- 5=Excellent (I know the software very well and could teach my peers).

Section III is designed to collect information about student perceptions of the usability of the system, such as usefulness of the tool for the task, interface- and information quality. It consists of ten items and uses a five point Likert-type rating scale: 1=Strongly Disagree, 2=Somewhat Disagree, 3=Neutral, 4=Somewhat Agree, 5=Strongly Agree. In addition there is a rating of N/A (not applicable) outside of the five point rating scale to provide for cases where the question is not applicable.

The purpose of section IV is to collect information about student perceptions of learning outcomes and the degree of online/face-to-face lectures and laboratories attended, for example learner control and self direction of the learning process and communication and collaboration. This section of the survey consists of 15 items, 13 items are designed to collect the learning outcomes information and 2 items are designed to collect the degree of online/face-to-face instruction. A five point Likert-type rating scale is used for the learning outcomes: 1=Strongly Disagree, 2=Somewhat Disagree, 3=Neutral, 4=Somewhat Agree, 5=Strongly Agree. In addition there is a rating of N/A (not applicable) outside of the five point rating scale to provide for cases

where the question is not applicable. A five point rating scale is used for the degree of online/face-to-face instruction: 1=Never Attended, 2=Attended less than Half, 3=Attended Half, 4=Attended more than Half, 5=Attended almost All or All Sessions.

In this study, the instrument tested for overall reliability for all three sections of competency, usability and learning experience (28 items total) with a value of 0.9177 (Cronbach alpha). Reliability for the competency section (5 items) reported 0.8427; reliability for the usability section (10 items) showed 0.9428 and reliability for the learning outcomes section (12 items) tested 0.9677. A copy of the WLUQ can be found in Appendix C.

Limitations and Assumptions

This research was conducted with the acknowledgment of the following limitations:

1. The selection of subjects was limited to 240 eligible students in a hybrid, general education computer science course at Towson University during the Fall 2004 semester. The sample was a sample of convenience and introduced bias. Results of this study are not generalizable beyond this sample of 240 eligible students in an introductory computer science course.
2. The course used a CMS, and was limited to the design and functions of this system. Limitations of the system existed in the way information was organized and presented, in the navigation structure of the system and communication options and methods.
3. The course was designed for a large group and all assignments were shared online. Interactive online discussion was encouraged, but was limited due to

Formatted: Bullets and Numbering

the size of the class. Discussions of this size are very complex to handle and structure, and difficult to respond to and track and are unsuitable for a course this size.

4. The course was taught by one instructor and two teaching assistants, and although all sessions were conducted according to the same lesson plan, the study was limited due to possible variances in teaching style of the instructor and the two teaching assistants.
5. This research used student self assessed reports. Although it is assumed that students answered questions truthfully and honestly, this study was limited due to the individual differences in student self-assessment.

Comment [MSOffice8]: Didn't we discuss adding a sentence explaining each of these limitations?

Pilot Study

A pilot study using the WLUQ was conducted in the summer of 2004. Data collected in this pilot study was obtained from students enrolled in two sections of the "Computers and Creativity" course taught during the 2004 summer semester. Both sections were taught by the same instructor and used the same online material and CMS. The course used a hybrid approach to teaching with approximately 50% o the material taught online. Enrolment in the course consisted of 51 students completing the course. The survey had a 55% response rate.

The WLUQ tested for overall reliability for all three sections of competency, usability and learning experience (27 items total) with a value of 0.793 (Cronbach alpha). Reliability for section II (competency section, five items) reported 0.6877, reliability for section III (usability section, ten items) showed 0.7552, reliability for

section IV (learning outcomes section, twelve items) tested 0.9357. The usability of the instrument was tested and reported an overall usability score of 4.77 on a scale of 1 to 5, with 1 representing poor usability rating and 5 representing excellent usability rating.

Study approval by Towson University's Institutional Review Board (IRB) for Research Involving the Use of Human Participants was granted under Exemption Number 04-1X09 on June 03, 2004. The research was exempt from general Human Participants requirements according to 45 CFR 46.101(b)(2). As noted earlier, participation in this study was strictly voluntary, anonymity of the participant was insured, and the participant was fully informed of the research project. A copy of the IRB approval can be found in Appendix A.

Data Collection and Analysis

Data was collected using a database driven World Wide Web instrument and was entered into a statistical analysis package (SPSS) for later analysis. Relationships between usability and learning experience were analyzed using Pearson r. Differences between selected student groups (selected independent variables were: gender, age, student standing, computer competency scores, degree of face-to-face/online participation) on both student learning outcomes and online learning environment usability were analyzed using analysis of variance (ANOVA). The level of significance for each ANOVA was predetermined to be 0.05.

Summary

This study evaluated correlations and differences in an introductory computer science course based on evaluation of usability factors and learning outcomes. A new instrument combining usability factors and learning outcomes evaluation, the Web-based Learning and Usability Questionnaire (WLUQ), was developed for the study. A pilot study was conducted and the instrument was tested for reliability and usability. Reliability testing was also performed in the actual study and confirmed results of the pilot study. In this actual study, the instrument tested for overall reliability for all three sections of competency, usability and learning experience (28 items total) with a value of 0.9177 (Cronbach alpha). Study approval by Towson University's Institutional Review Board (IRB) for Research Involving the Use of Human Participants was granted under Exemption Number 04-1X09 on June 03, 2004 (Appendix A). Participation in the study was voluntary, and out of 240 enrolled students, 221 students completed the course, and 181 students participated in the survey.

CHAPTER IV. RESULTS AND FINDINGS

This research investigated correlations between usability factors and student learning outcomes in online learning environments. In addition, differences among several student groups and both usability and learning outcomes were evaluated. The following results include descriptive statistics about the sample as well as statistical results pertaining to the research questions. This chapter consists of the following sections: descriptive statistics, research question 1, research question 2, research question 3, research question 4, and summary.

Descriptive Statistics

Several questions were designed to collect general information. Data for descriptive statistics was collected in section I of the survey. Descriptive Statistics consist of a description of the respondents, student prior experience with the course management system (CMS) and student computer use, computer competency, computer usability, and student learning outcomes.

Description of Respondents

Out of a total of 240 students enrolled in the course, 221 students completed the course and 181 students participated in the survey, yielding a 82% response rate. A total of 45.3% of the student population were male, 54.7% were female. The majority of students were traditional age students under the age of 25. A total of 75.7% students were 20 years or younger, 23.3% were between 21 and 25 years old, no students were between 26 and 30 years old and only 1.1 % were older than 30 years.

Although “Computers and Creativity” is an introduction course, only 2.2% of participating students were freshmen. The majority of students were sophomores (50.3%), the second largest student group were juniors (37%), and 10.5% were seniors. Of all participating students, 98.9% were full-time students.

Student Computer Use and Experience with CMS

To assess the student prior experience with CMS, students were asked to report the number of courses they have taken in which CMS was used. Most students had low to moderate experience with courses using CMS, 76% had taken between 2 and 5 courses using CMS, 15.5% of students had taken more than 6 courses using CMS, and 8.3% had no or limited CMS experience (1 or no course using CMS).

Students were also asked to report about the time they use their computer for fun/play and for work related activities. The amount of time students reported using their computer for fun/play was evenly distributed. A total of 17.7% of students reported using their computer for fun/play for more than 20 hours per week, and 21.5% of students reported computer use for fun/play between 10 and 20 hours per week. The majority of students (35.4%) used the computer for fun/play between 5 and 10 hours per week, and 25.4% reported less than 5 hours for computer use for fun/play.

Similar results of evenly distributed computer use were observed for the time computers were used for work. The largest group, 46.4%, stated that they use the computer between 5 and 10 hours per week for work and 26.0% report less than 5

hours of computer use for work related activity. 19.3% report between 10 and 20 hours and 8.3% report more than 20 hours per week of computer use for work.

Computer Competency

The survey assessed student computer competency levels in the following five categories: (a) searching/browsing WWW, (b) E-mail, (c) electronic discussion boards, (d) writing (word processing), and (e) web development. Ratings were assessed on a five level scale:

- 1=Poor (I have never heard of the software and don't know how to use it)
- 2=Below Average (I have heard of the software, but have little or no knowledge how to use it)
- 3=Average (I use the software sometimes, but only for basic operations)
- 4=Above Average (I use the software all the time and know most of its features)
- 5=Excellent (I know the software very well and could teach my peers).

Students reported their computer competency level with a mean of 4.3 (SD=0.59). Elementary tasks like word processing, web browsing and E-mail had the highest means. E-mail listed with a mean of 4.61 (SD=0.62), word processing showed a mean of 4.52 (SD=0.66), and web browsing had a mean competency level of 4.50 (SD=0.66). Tasks associated with online learning (electronic discussion board mastery) were rated with a slightly lower mean of 4.4 (SD=0.84) and advanced web tasks (web development) had the lowest rating with a mean of 3.4 (SD=0.95). The higher standard deviation for these two tasks also documented the highest variance in the group. Table

1 summarizes the descriptive statistics of competency scores, including minimum and maximum values, mean and standard deviation.

Table 1

Descriptive Statistics Competency Scores

Competency	N	Min	Max	Mean	SD
Search/Browse WWW	181	2	5	4.50	0.664
Email	181	2	5	4.61	0.619
Electronic Discussion Boards	181	1	5	4.40	0.842
Word Processing	181	2	5	4.52	0.663
Web Development	181	1	5	3.40	0.947

Note. Competencies were rated on 5-point scales (1=Poor, 5=Excellent).

Usability and Learning Outcomes

Usability and learning outcomes were rated using a 5-point Likert-type scale. Each student indicated how strongly they agree or disagree with the statement using the following scale 1=Strongly Disagree, 2=Somewhat Disagree, 3=Neutral, 4=Somewhat Agree, 5=Strongly Agree. If a statement did not apply, students were asked to select N/A (not applicable).

The distribution of usability scores showed that overall, participants rated the usability of the Blackboard system very positively. The summary of all usability items was rated with a mean of 4.35 (SD=0.74). System usefulness was rated with a mean of 4.62 (SD=0.76). Interface quality was assessed with a mean of 4.18 (SD=0.89), and information quality was rated with a mean of 4.00 (SD=0.92). Table

2 summarizes the descriptive statistics for usability scores, including minimum and maximum values, mean and standard deviation.

Table 2

Descriptive Statistics Usability Scores

Usability	N	Min	Max	Mean	SD
Usefulness	181	1	5	4.62	0.759
Information Quality	161	1	5	4.00	0.924
Interface Quality	180	1	5	4.18	0.885

Note. Usability was rated using 5-point scales (1=Strongly Disagree, 5=Strongly Agree). For statements that did not apply, an additional rating of N/A was available.

Overall, students also rated the learning outcomes in this hybrid course using the Blackboard system positively. The summary of all learning outcomes items was rated with a mean of 4.37 (SD=0.76). Structure and organization of the learning environment was assessed with a mean of 4.49 (SD=0.81). Learner control was rated with a mean of 4.48 (SD=0.77), communication and collaboration were assessed with a mean of 4.24 (SD=0.89), student achievement was rated with a mean of 4.23 (SD=0.86). Table 3 summarizes descriptive statistics for learning outcomes scores, including minimum and maximum values, mean and standard deviation.

Table 3

Descriptive Statistics Learning Outcomes

Learning Outcomes	N	Min	Max	Mean	SD
Learner control	180	1	5	4.48	0.774
Communication/collaboration	175	1	5	4.24	0.888
Student achievement	180	1	5	4.23	0.858
Organization	179	1	5	4.49	0.812

Note. Usability was rated using 5-point scales (1=Strongly Disagree, 5=Strongly Agree). For statements that did not apply, an additional rating of N/A was available.

Summary Descriptive Statistics

The student sample was taken from an introductory computer science class, consisting of eight sections at a mid-sized, comprehensive university in the Mid-Atlantic. Student gender was divided into 54.7% female students and 45.3% male students. The majority of students were sophomores and juniors (87.3%). Prior experience with CMS was moderate for most students, 76% had taken between 2 and 5 courses using CMS. Participants self-rated their computer competency level, and on a 5-point scale (1=poor, 5=excellent), students reported an overall computer competency score of 4.29. Usability scores were self-reported on a 5-point scale (1=strongly disagree, 5=strongly agree), and students rated the overall usability of the online learning system with 4.27. Scores for learning outcomes were also self-reported on a 5-point scale (1=strongly disagree, 5=strongly agree), and students rated their overall learning outcomes 4.36.

Research Questions

This study focused on correlations between usability factors and student learning outcomes in online learning environments as well as differences among several student groups and both usability and learning outcomes. Following are the results pertaining to the research questions used to guide this study.

Research Question 1

~~1.~~ This section reports results pertaining to the following research question: Is there a significant relationship ($p < 0.05$) between online learning system usability and student learning outcomes? Data for this research question was collected in sections III and IV of the survey. Data from section III contained questions designed to collect usability information, data from section IV contained questions designed to collect learning outcomes information. Results in each section were summarized for this evaluation.

Formatted: Bullets and Numbering

Correlation Usability – Learning Outcomes

In order to investigate the correlation between usability and learning outcomes data from section III, the usability section, and section IV, the learning outcomes section was evaluated. A relationship between system usability and learning outcomes would demonstrate that when overall system usability increases, overall student learning experience also increases or vice versa. Results in both sections were summarized and evaluated using Pearson r. The correlation between overall system usability and overall student learning outcomes showed a significant positive

correlation (r=0.83, n=181, p< 0.05, two-tailed). Figure 1 illustrates the correlation using a scatter plot.

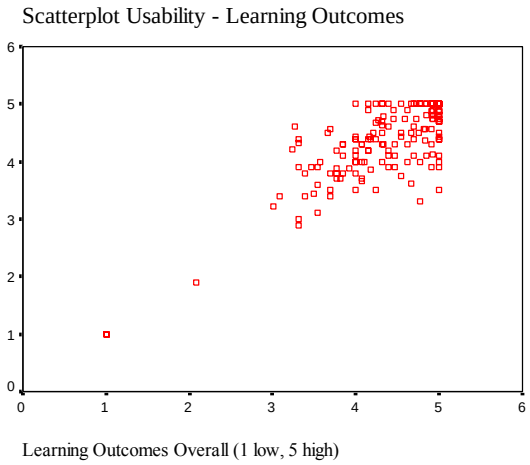


Figure 1. Scatter plot Usability / Learning Outcomes

Intercorrelations between subscales for usability and learning outcomes are displayed in table 4. All intercorrelations are significant positive correlations and support the result of the overall significant correlation between usability and learning outcomes.

Table 4

Intercorrelations between Subscales for Usability and Learning Outcomes

	System usefulness	Inform. quality	Interface quality	Learner control	Comm./ Coll.	Student achievmt.	Org.
System usefulness	-	.63**	.69**	.77**	.66**	.67**	.77**
Inform. Quality		-	.69**	.63**	.64**	.61**	.67**
Interface Quality			-	.69**	.61**	.68**	.60**
Learner control				-	.75**	.79**	.81**
Comm./ Coll.					-	.79**	.76**
Student achievement						-	.79*
Org.							-

Note. ** = Correlation is significant at the 0.01 level (2-tailed)

Regression Analysis

To assess the relevance of the correlation between usability and learning outcomes, a stepwise multiple regression was performed. Learning outcomes was the dependent variable; system usefulness, interface quality, and information quality were the predictor variables. Results confirmed the relevance of the correlation between system usability and student learning outcomes and showed adjusted R square = 0.680; $F(3,156)=113.46$, $p<0.005$ (using the stepwise method). These findings

explained the impact of the measured usability factors on the student learning outcomes. Usability variables system usefulness, interface quality, and information quality accounted for 68% of the variance in student learning outcomes in this model, an important contribution to the variance in learning outcomes in the model. Table 5 presents the results of multiple regression using the stepwise method.

Table 5

Stepwise Regression Analysis for Usability Variables predicting Learning Outcomes

Variable	B	SE B	β
Step 1			
System usefulness	.78	.05	.78
Step 2			
System usefulness	.55	.06	.55
Interface quality	.30	.05	.34
Step 3			
System usefulness	.50	.06	.49
Interface quality	.22	.06	.25
Information quality	.15	.05	.18

Summary Research Question 1

Analysis of the relationship between usability and learning outcomes showed a significant positive correlation (r=0.83). This supported a linear relationship that when the overall system usability increased, the overall student learning outcomes

also increased or vice versa. Intercorrelations between subscales of the two variables confirmed the correlation between usability factors and learning outcomes and displayed significant positive correlations at the 0.01 level. The importance of this relationship was confirmed through a multiple regression model using learning outcomes as the dependent variable and system usefulness, information quality, and interface quality as predictor variables. This regression model showed that the measured usability factors in this study accounted for 68% of the variance in student learning outcomes in this model.

Research Question 2

This section reports results pertaining to the following research question: Is there a statistically significant difference ($p < 0.05$) between computer competency scores and both online learning system usability and student learning outcomes? Data for this research question was collected through section II (competency), section III (usability), and section IV (learning outcomes) of the survey. A series of one-way ANOVAs was performed to analyze these differences.

Comment [BS9]: (p=<.05)??

When evaluating the overall competency (summarized competency scores), results of one-way ANOVA revealed that there were no significant differences among the levels of overall competency with the overall usability rating ($F(11,169) = 1.444$, $p= 0.158$). A one-way ANOVA among the levels of overall competency with overall learning outcomes also revealed no significant differences ($F(11,168) = 0.915$, $p= 0.527$).

However, results of a series of one-way ANOVAs for the disaggregated computer competency areas revealed significant differences for some of the groups which are discussed below. The computer competency section of the survey consisted of five areas: searching/browsing WWW, email, electronic discussion boards, word processing, and web development.

Regarding usability one-way ANOVAs disclosed significant differences among the levels of competency for searching/browsing WWW, email, and word processing with overall usability. However, no significant difference among the level of competency for both electronic discussion boards and web development was displayed. Regarding learning outcomes one-way ANOVAs disclosed significant differences among the levels of competency for searching/browsing WWW and email with overall learning outcomes. However, no significant difference among the level of competency for word processing, electronic discussions, or web development with overall learning outcomes was displayed. Table 6 summarizes the results for this series of one-way ANOVAs. Detailed analysis for each one-way ANOVA regarding competency levels and both usability and learning outcomes can be found in Appendix D.

Table 6

Summary of one-way ANOVA Series among Levels of Competency

	Search/browse WWW	Email	Word processing	Electronic discussions	Web page development
Usability	F=4.81 *	F=5.91 *	F=4.66 *	F=1.88 NS	F=1.20 NS
Learning outcomes	F=2.83 *	F=4.16 *	F=1.99 NS	F=.92 NS	F=1.49 NS

Note. * = Significant at 0.05, NS = Not Significant

In this study, significant differences among the levels of competency with overall usability were shown for elementary computer competency tasks. Students who rated their level of competency higher for searching/browsing the WWW, email, or word processing rated the level of system usability higher. Surprisingly, this was not the case for students who rated their level of competency high for electronic discussion boards or web development.

Evaluation of results for competency levels with learning outcomes revealed significant differences among levels of basic internet competency or basic electronic communication competency with overall student learning outcomes. Students who rated their competency higher for searching/browsing WWW or email rated their overall learning outcomes higher. Again, significant differences among competency levels for advanced knowledge of the online learning environment or advanced internet knowledge with overall student learning outcomes were not discovered.

Results showed that abilities and skills like simple electronic communication and basic internet knowledge seemed sufficient to increase a user's view of higher system usability and higher learning outcomes. In this study, it was not necessary for students to have advanced knowledge about online learning environments or web applications to increase the view of high system usability or high learning outcomes.

Interestingly, levels of competency for the basic task of word processing did show significant differences with usability, but did not show significant differences with learning outcomes. Higher competency in keyboarding did not increase the student view of higher learning outcomes, but higher competency in keyboarding did increase the student view of higher system usability. However, since a linear correlation between usability and learning outcomes was discovered, keyboarding may indirectly influence the view of high learning outcomes.

~~2.~~*Research Question 3*

Formatted: Bullets and Numbering

~~3.~~ This section reports results pertaining to the following research question: Is there a statistically significant difference ($p < 0.05$) between student gender, age, and student standing and both student learning outcomes and online learning system usability? Analysis for this research question was based on data collected in section I (demographics), section III (usability), and section IV (learning outcomes) of the survey. A series of one-way ANOVAs was performed to analyze these differences.

Formatted: Bullets and Numbering

Results showed that no significant differences were reported among gender, age, and student standing with both usability and learning outcomes. Table 7 summarizes the results for this series of one-way ANOVAs. Detailed analysis for

each one-way ANOVA regarding gender, age, and student standing with both usability and learning outcomes can be found in Appendix E.

Table 7

Summary of one-way ANOVA Series among Gender, Age, and Student Standing

	Gender	Age	Student standing
Usability	F=0.75 NS	F=0.03 NS	F=0.14 NS
Learning outcomes	F=3.68 NS	F=0.23 NS	F=0.55 NS

Note. * = Significant at 0.05, NS = Not Significant

No significant differences among demographic groups such as gender, age, and student standing with usability or learning outcomes were discovered in this study. However, when evaluating results for these demographic groups it should be considered that the student group in this study was relatively homogeneous and represented the student population of a mid-sized, comprehensive university in the Mid-Atlantic. Although 181 students participated in this study, more than 75% of all students were 20 years or younger and over 50% of all students were sophomores.

Research Question 4

~~3.~~ This section reports results pertaining to the following research question: Is there a statistically significant difference ($p < 0.05$) between selected student groups (degree of face-to-face/online instruction) and both student learning outcomes and online learning system usability? Analysis for this research question was based on

Formatted: Bullets and Numbering

data collected in section III (usability) and section IV (learning outcomes) of the survey. To measure the degree of face-to-face and online instruction students were asked to answer how many times overall they attended laboratory and lecture meetings. Regular, scheduled, face-to-face laboratory and lecture meetings were scheduled for this course, however, attendance was not mandatory. Attendance was measured using a 5-point scale: 1=never attended, 2=attended less than half, 3=attended half, 4=attended more than half, 5=attended all or almost all sessions.

It is noteworthy that lecture meetings were not traditional lecture sessions, but rather class meetings that discussed a variety of issues. These lecture meeting not only discussed theoretical concepts, but also discussed assignments that were due, gave practical pointers for completing assignments and also covered a general question and answer session. A series of one-way ANOVAs was performed to analyze the differences.

~~4.~~ Results showed that no significant differences were reported among lecture and laboratory attendance and both usability and learning outcomes except in one case. Analysis disclosed a significant difference among the level of lecture attendance with usability. Table 8 summarizes the results for this series of one-way ANOVAs. Detailed results for each category of lecture and laboratory can be found in Appendix F.

Formatted: Bullets and Numbering

Table 8

Summary of one-way ANOVA Series among Level of Lecture and Lab Attendance

	Lecture Attendance	Lab Attendance
Usability	F=2.48 *	F=1.10 NS
Learning outcomes	F=2.14 NS	F=0.53 NS

Note. * = Significant at 0.05, NS = Not Significant

In summary, data evaluating the lecture and lab attendance rate revealed no significant differences among the rate of lecture or lab attendance with overall usability or overall learning outcomes except in one case. This study revealed a significant difference among student lecture attendance and overall usability. The data indicated that students who attended approximately half of the lectures rated the system usability the lowest. All other usability ratings are very high and did not reflect a large difference in the usability ratings. A possible explanation could be that students who attended approximately one half of the lectures were not clear about their abilities and were not clear about how much attendance would be beneficial for them. It seems that students who either attended very little or very much had a better result in the overall usability of the course, and possibly a more realistic mapping of how many and which lectures they should attend. Students in this group could also have been uncomfortable with the use of the online material and may not have had enough knowledge on how to use the online material efficiently. This could possibly be linked to the inability to judge which and how many meetings to attend for the particular level of expertise and competency.

It should also be noted that lectures for this course represented a very comprehensive weekly overview including material relevant for laboratory assignments. The lower usability rating for students who attended approximately half of the lectures could be due to students not having realistic expectations and misjudging how many and which lectures they should attend. Missing important information in lecture about laboratory assignments could have contributed to this lower rating. Noteworthy was also the large deviation (SD=1.12) for this group and it would be interesting to observe if this trend also surfaced in future studies.

Summary

Students participating in this research were predominantly traditional age students (75.7 % were 20 years or younger). The majority were sophomores and juniors (87.3%). Prior experience with Blackboard was moderate for most students, 76% had taken between 2 and 5 courses using Blackboard. Competency, usability and learning outcomes were self-reported on a 5-point scale (1 being the lowest, 5 being the highest rating). Students reported their overall competency score with 4.29. The overall usability of the system was rated with 4.27. Overall learning outcomes were rated with 4.36.

Analysis of the relationship between usability and learning outcomes showed a significant correlation (r=0.83) and supported a linear relationship that when the overall system usability increased, the overall student learning outcomes also increased or vice versa. The relevance of this relationship was confirmed with a multiple regression model using learning outcomes as the dependent variable and

system usefulness, information quality, and interface quality as predictor variables. This regression model showed that the measured usability factors in this study accounted for 68% of the variance in student learning outcomes.

In this study, significant differences among the levels of competency with overall usability and learning outcomes were shown for elementary computer competency tasks. Students who rated their level of competency higher for searching/browsing the WWW or email, rated the level of system usability and learning outcomes higher. In addition, significant differences were revealed among levels of word processing for usability. Students who rated their level of word processing competency higher reported higher levels of system usability. No significant differences were reported for competency levels of electronic discussion boards or web development with system usability and learning outcomes.

Additionally, no significant differences among demographic factors of gender, age, and student standing with usability or learning outcomes were discovered in this study, indicating that demographic factors did not influence the perceived level of usability or learning outcomes.

Evaluation of the level of face-to-face and online instruction revealed significant differences among the level of lecture attendance and usability. The data indicated that students who attended approximately half of the lectures rated the system usability the lowest. This could possibly point to students having difficulty in judging realistically how many and which lectures they should attend. No significant differences were reported among lab attendance and both usability and learning

outcomes, also no significant differences were reported among lecture attendance and learning outcomes.

CHAPTER V. DISCUSSION

Many institutions of higher education have extended their course offerings to include online instruction supported by Internet/WWW technologies. Continued increase of these online courses makes it necessary for educators to integrate these technologies into their instruction. Computer science offers usability tools and guidelines that can assist in use and assessment of technology in online learning environments, but unfortunately little research has been done to investigate these relationships between usability and online learning (Feldstein, 2002; Quigley, 2002). As the numbers of students taking online courses grow and it becomes essential to improve learner interaction with online technologies, the integration of usability research into online learning environments must be examined. This chapter contains the following sections: a summary of this research, discussion of results, recommendations, and conclusion.

Summary

This study examined the impact of usability in evaluation of student learning outcomes in online learning environments. Relationships between usability factors and learning outcomes were assessed, and differences in usability and learning outcomes between several selected student groups were investigated. Selected factors examined were student computer competency, gender, age, student standing, and lecture/laboratory attendance.

The student sample in this research is representative of the student population at a mid-sized, comprehensive university in the Mid-Atlantic and was taken from

students in an introductory computer science class. The course was based upon the general education curriculum and consisted of eight sections. A total of 181 students participated in the study. Student gender was divided into 55% female students and 45% male students. The majority of students were traditional, full-time students. Over 75% of students who participated in this study were 20 years or younger, and most students were sophomores or juniors. Most students had low to moderate experience (less than 5 courses using online components) with online learning environments. Overall, participants were a homogeneous group (75.7% were 20 years or younger, 87.3% were sophomores and juniors), and this may have introduced some level of bias into the study. This study employed a newly developed survey instrument (WLUQ) which used self-assessed reports. Following is a summary of the results of this research.

Students reported their computer competency was rated with a mean of 4.30, online learning environment system usability was reported with a mean of 4.35, and learning outcomes was reported with a mean of 4.37.

A correlation analysis was performed to assess the relationship between online learning system usability and student learning outcomes. A significant, positive correlation ($r=0.83$, $n=181$, $p<0.005$, two-tailed) was discovered between usability factors and learning outcomes. All intercorrelations with subscales of usability factors and learning outcomes also showed significant, positive correlations. A stepwise multiple regression analysis confirmed the importance of this relationship. Using learning outcomes as the dependent variable and system usefulness, information

quality, and interface quality as predictor variables, the regression model showed that the measured usability factors in this study accounted for 68% of the variance in student learning outcomes.

Significant differences were discovered among reported levels of email competency and Internet/WWW browsing competency with both usability and learning outcomes. Also, significant differences were disclosed among reported levels of word processing competency and usability. Students reporting high computer competency levels in these areas also reported higher levels of usability and learning outcomes. No significant differences were discovered among age, gender, student standing and both usability and learning outcomes. Significant differences among levels of lecture and lab attendance were shown in only one case, lecture attendance and usability.

Discussion

This study showed that usability factors are important elements in assessment of student learning outcomes in online learning environments. Results of the study showed high ratings for both system usability and learning outcomes. High ratings for learning outcomes (M=4.37) revealed that students clearly emphasized learner control as well as structure and organization. Student comments supported conclusions drawn from the statistical results. Over 30% of all students remarked how much they liked the online grade book that was used to provide grade-based feedback on their work. Through this immediate grade-based feedback students felt enabled to exercise better control over their learning process and felt empowered to take responsibility for their

learning. Students also appreciated the convenience and availability of online material. This finding underscored that students in this course seemed to be task oriented; they clearly valued the increased independence of this online learning environment, especially the asynchronous nature, allowing for more flexibility in time and place required to attend class and complete assignments.

Overall system usability also showed a high rating (M=4.35). Students seemed to be focused on "getting the job done" and appreciated the usefulness of the tool for the task, easy navigation and the low learning curve. However, students also readily expressed their dissatisfaction with error messages, error recovery, and the online help system, thus supporting statistical results that identified information quality as the weakest area of online learning usability (M=4.0). Students mentioned that the system was sometimes slow to load, especially when many students were logged into the system concurrently. It was also reported that the login process was slow, cumbersome and contained too many screens; often it took too many steps to get to their destination point.

Correlation

The strong, significant relationship between usability factors and learning outcomes expressed that, when system usability increased, learning outcomes also increased, or vice versa. A regression analysis confirmed the importance of this result and showed that the student learning outcomes were largely influenced by system usability. This finding supported existing research (Fredericksen et al., 1999; Oliver and Herrington, 2003; Valenta et al., 2001), confirming that tool design and use of the

tool indeed significantly influence student learning outcomes and attitudes. It further supported existing regarding the demand for integration of usability research into the evaluation of online learning environments and student learning outcomes (Feldstein, 2002; Quigley, 2002).

Competency

Literature investigating the role of computer competency scores and learning outcomes or usability in online learning environments is not entirely consistent. Fredericksen et al. (1999) reported no significant differences in learning outcomes among computer competency levels; however, this was contradicted by Dutton (2002) and Koohang (2004), whose studies found that prior computing experience improved learning outcomes.

This study discovered differences among certain areas of computer competency with usability and learning outcomes. Disaggregated data was evaluated and confirmed results noted by Dutton (2002) and Koohang (2004). Students with high levels of basic Internet/WWW tasks such as browsing, basic communication tasks such as email, and basic word processing tasks also reported high ratings for usability. Students with high levels of basic Internet/WWW tasks such as browsing, and basic communication tasks like email also reported high ratings for learning outcomes.

Interestingly, advanced experience of web design or advanced communication interfaces such as electronic discussion boards, did not show significant differences for system usability or learning outcomes. These findings demonstrated that

competency in basic computer tasks is sufficient to increase perceived system usability and learning outcomes in this online learning environment, and that advanced knowledge is not necessary to raise usability ratings or learning outcomes. These results are important since they not only discovered the level of basic computer competency tasks as the cause for perceived higher usability and learning outcomes; these findings also provided indicators to possible training or preparation that could be offered to increase learning outcomes and system usability for students in online learning environments.

Gender, Age, and Student Standing

No significant differences for system usability or learning outcomes were identified among various levels of gender, age, or student standing. This study supported observations of Koohang (2004) and Dutton (2002) who also reported no significant differences among gender or age and system usability. It should be noted that the evaluated student group was very homogeneous (75.7% were 20 years or younger, 87.3% were sophomores and juniors) and that this may be partially responsible for the results regarding gender, age, and student standing. Further evaluation in less homogeneous student groups or non-traditional learning environments would be beneficial to strengthen these results.

Lecture and Laboratory Attendance

This study discovered no significant differences for system usability or learning outcomes among the level of laboratory attendance, confirming results of existing research (Johnson et. al, 2000). However, significant differences for system

usability among the level of lecture attendance were revealed. The results showed that students attending approximately half of the lectures rated the system usability significantly lower. These findings may be caused by the fact that this group may not have had realistic expectations and may have misjudged which lectures and how many lectures to attend or possibly did not feel comfortable with the online material or course structure. This result may also simply represent an artifact significant only to this sample. It would certainly be of interest to observe if this trend would be replicable in other sections, other courses, or other institutions.

Recommendations

Results of this study showed a clear connection between usability and student learning outcomes and suggest that usability factors must be considered in learning environments in order to improve student learning. Training in usability and availability of methods and tools for instructors in these learning environments could significantly improve the application of usability research in online learning environments.

In addition to the correlation of system usability and learning outcomes, this study also revealed important differences among various levels of student computer competency. This suggests that possible training or prior competency assessment could assist students in improving their online learning experience. Further research should be designed to evaluate the effects of a pre-assessment or pre-training seminar to confirm the findings of this study.

The course was a general education course for computer science majors and non-majors at a traditional, comprehensive university in the Mid-Atlantic. Due to the homogeneity of the group, further studies should be performed with a more heterogeneous student group or an upper level course to evaluate correlations and allow further conclusions on the correlation of system usability and online learning environments.

The nature of the course also had a large focus on skills development and sharing of individual, creative work. Further research in a course that is more discussion based, collaborative, and cooperative may also provide additional insight into the importance of usability in online learning environments.

A longitudinal study considering instructor input may also be of interest. Data from this study regarding successful learning outcomes was self-reported by students and collected at the end of the course. A study considering instructor-based learning outcomes (e.g. grades) over time could provide additional insight on the correlation between system usability and online learning outcome and differences among certain student groups.

In addition to evaluating correlations and differences, this study also focused on the design and implementation of a newly created evaluation instrument (WLUQ). It would be of great interest to use the survey instrument in further studies and in a variety of environments to support the continued use of WLUQ as a measure of online learning environment usability and student learning outcomes.

Conclusion

This study in conjunction with existing research suggests that usability factors are vital elements in online learning environments. Usability guidelines must be considered for design and development of online learning environments. Instructors should implement usability guidelines when creating content for online learning environments. A significant relationship documented the importance of the correlation between system usability and student learning outcomes. Students clearly valued structure, organization and the increased control and flexibility that these learning environments provide. Considering the growing presence of online learning environments and hybrid learning environments in traditional institutions of higher education, it is vital to increase awareness about the role of usability in online learning. Many instructors are novices with regard to web design and development and it is imperative to provide information and training on how to implement usability guidelines into the creation of online educational content or design and creation of online learning environments. Shneiderman's "Eight golden rules of interface design" (1998) or Nielsen's "Top ten guidelines for homepage usability" (2003) could provide easy to use and easy to implement guidelines that can assist instructors in enhancing the learning process and the learning outcome by increasing the system usability.

Unfortunately instructors often have little influence on the choice of tool and the design of the actual shell of the CMS used in online instruction, but can in most cases control the content that is posted within their classes. As a result, it is even more

important to provide instructors with tools to analyze and improve the online or hybrid learning environment. The web-based learning and usability questionnaire (WLUQ) employed in this study can provide an easy to use tool for instructors to assess relationships between usability and student learning outcomes in an individual course considering the particular modes of presentation and operation of the course as well as the goals of the course. The instrument allows for further analysis of disaggregated data on several factors affecting system usability and learning outcomes and provides indicators for improvement of the learning environment.

Integration of usability factors into online learning environments improves learning outcomes for students. Through the implementation of usability principles in online instruction, instructors can improve usability, the online learning environment and student learning.

APPENDICES

APPENDIX A - Institutional Review Board

TOWSON
UNIVERSITY

APPROVED
JUN - 3 2004
TOWSON

EXEMPTION NUMBER: 04-1X09

To: Gabriele Meiselwitz

From: Institutional Review Board for the Protection of Human Subjects, Marcie Weinstein, Member

Date: Thursday, June 03, 2004

RE: Application for Approval of Research Involving the Use of Human Participants

Office of University
Research Services

Towson University
8000 York Road
Towson, MD 21252-0001

t. 410 704-2236
f. 410 704-4494

Thank you for submitting an application for approval of the research titled,

Student Perceptions of Courseware Usability and Learning Experience

to the Institutional Review Board for the Protection of Human Participants (IRB) at Towson University.

Your research is exempt from general Human Participants requirements according to 45 CFR 46.101(b)(2). No further review of this project is required from year to year provided it does not deviate from the submitted research design.

If you substantially change your research project or your survey instrument, please notify the Board immediately.

We wish you every success in your research project.

CC: W. Sadera
File

TOWSON
UNIVERSITY

June 7, 2004

Dear Participant,

Department of Reading,
Special Education and
Instructional Technology

Towson University
8000 York Road
Towson, MD 21252-0001

t: 410 704-2576
f: 410 704-2733

The purpose of this survey is to evaluate student perceptions of courseware (Blackboard) usability and student learning experience. Courseware is an important element in many courses and the data collected will contribute to a better understanding of student satisfaction and courseware usability issues in this type of learning environment. This research is being conducted in partial completion of my doctoral studies.

Participation in this study is voluntary. If you choose to participate in my project, you will be asked to complete a short web survey. You may respond to the web survey on your own time or in class. It is not necessary to answer every question, and you may discontinue your participation in the survey at any time. Your decision whether or not to participate in the survey or to withdraw from the project at any time will in no way affect your class standing, or if you are an athlete, your status as an athlete. If you do choose to participate in the study, your participation will be completely anonymous. Neither anyone reading the results of the survey nor I will be able to identify you. Please do not put your name or any other identifying marks on the survey form.

If you have any questions about the project, you may contact Gabriele Meiselwitz (410) 704-2835, my research advisor Dr. Bill Sadera (410) 704-2731 or the Chairperson of Towson University's Institutional Review Board for the Protection of Human Participants, Dr. Patricia M. Alt, at (410) 704-2236. A copy of the survey results, reported in aggregate form, will be available to you upon request.

The survey can be accessed through our class Blackboard site, a link is posted in announcements.

Thank you for your time and willingness to participate in this survey.

Sincerely,

Gabriele Meiselwitz
Principal Investigator

Dr. William Sadera
Research Advisor

APPENDIX B - COSC 109 Sample Course Syllabus

Course Syllabus

COSC 109 Computers and Creativity (3)
Creative activities involving symbolic manipulation and computer graphics; animation, dynamic story-telling, computer music, visual effects, Web publishing, computer games, artwork, and multimedia. Additional lab time required.
Prerequisite: None. GenEd I.E. (UG)

Professor
Gabriele Meiselwitz
Phone: 410-704-2835
Email: gmeiselwitz@towson.edu
Office: YR 7800, Office 443
Office Hours: M, W 10 am - 11 am, F 9 am - 10 am

Course Objectives
To provide the environment and tools so that the computer can be used to express and enhance creativity. Traditional creative forms such as drawing, painting, photography, and writing will be explored as well as creative forms unique to computer technology such as computer graphics, multimedia, dynamic presentations, computer-based animation, world-wide-web publishing, digital photography and movies, virtual reality, three-dimensional modeling, and the use of computers for music publishing and performance. Computer concepts which are relevant to the use of the computer as a creative tool will be studied.

Textbooks

Required

Exploring the digital domain
by Abernethy and Allen
(Course Technology, 2004)

Recommended

Macromedia Flash MX 2004
by Katherine Ulrich
(Pearson Education, 2003)

Required Materials

- **Two 3.5 inch diskettes**, formatted for PC, high-density (HD) with stick-on label and dust jacket. Use the stick-on label to write your name on the diskettes.
- **Towson University Email Account with Microsoft FrontPage extensions enabled**
  Students who **do not already have a TU email account** must apply for one. This can be done by visiting the TU helpcenter in the basement of Cook Library (CK 5). Special terminals are available in room CK 5 for entering your account request. You can pick up your email account ID in the same room within minutes by showing your TU ID card. Please **also request** that your account will be **enabled for Microsoft FrontPage extensions**.

  Students **who already have a TU email account** must ensure that their existing email account is **enabled for Microsoft FrontPage extensions**. This can be done by contacting the TU helpcenter: at **ext. 5151** (phone) or **helpcenter@towson.edu** (email)**.**

  More information can be found on the TU Office of Technology Services (OTS) Frequently Asked Questions reference page.

Attendance Policy
Students are expected to attend each class meeting and laboratory meeting as required. Students are required to notify the instructor via email if they are unable to attend a class meeting. Written documentation of the reason for the absence may be requested by the instructor and must be submitted for the absence to be excused. Students are responsible to obtain any missed information.

Lecture Policy
One 50-minute class period per will meet in Smith 326 for large group lecture. The purpose of the lectures will be to provide an overall-view of the weekly laboratory tasks, and to demonstrate the specific tasks and techniques the students will be responsible in performing. Attendance will be taken during lecture. Please sign your name next to your printed name.

Laboratory Requirement
One 50-minute class period per week will meet in the computer laboratory in YR 7800, Rooms 302 and 303. Attendance will be taken during lab. Sign your name next to your printed name. In addition to the regularly scheduled class laboratory periods, students will be expected to spend additional time using the COSC laboratory. Students should schedule

definite times each week for working on their laboratory assignments. Students may use a PC at home if it suitable, but our course will use special, licensed multimedia software, which will not normally be available to you at home. All laboratory assignments are due on the date specified on the schedule. **No late assignments will be accepted.**

Web Component
This course is taught in a new format with 50 minutes of weekly lecture and 50 minutes of weekly lab. All resources for this course are available on the World Wide Web and students are expected to spend additional time each week to study these online resources.

Assignments and Grading

Grade	% of Total Points
A	92-100
A-	90-91.9
B+	87-89.9
B	82-86.9
B-	80-81.9
C+	77-79.9
C	72-76.9
C-	70-71.9
D+	67-69.9
D	60-66.9
F	59.9 and below

All work MUST be turned in by the assigned deadlines or a grade of zero will be assigned. Assignments will be turned in online using the LearnOnline website, and all grades will be available through the LearnOnline website. Students are required to check their grade online.

Final Examination Requirement
Final examination is a comprehensive exam. The final examination will meet in the lecture room. Students are expected to attend the final examination scheduled for the section for which they are officially registered.

Students in sections which meet for lecture **F at 8 AM:**
Students in these sections attend the final examination on **Wednesday, May 18 from 8:00 AM to 10:00 AM**

Examination makeup policy
If a student is absent from an exam during the scheduled time for that exam, the student will automatically receive a grade of 0 for the exam unless: (a) the student notifies the instructor of the absence prior to the exam and supplies a written doctor's excuse explaining the absence or (b) there is an extraordinary situation which the instructor allows as an acceptable excuse (instructor needs to be notified within 24 hrs of the exam). If (a) or (b) applies, arrangements for a makeup exam will be made.
It will be the responsibility of the student to show written documentation supporting the absence, from your team coach, physician, or other relevant authority.

Policy on Academic Integrity
Academic honesty according to the Academic Integrity Policy of Towson University is expected in this class for all work submitted for a grade. This policy will be strictly followed. Students are responsible for reading, understanding, and following this policy.

Policy on Repeating the Course
Towson State University policy states that a course may not be repeated more than once without prior permission from the Academic Standards Committee.

COSC 109 Fall 2004 - Schedule

Unit 1: Introduction, Aug 30 - Sep 24

Week	Subject	Additional Reading	Points	Due
1 Aug 30 - Sep 3	Course Introduction (Syllabus)			
	Creativity			
	DD - Ch 1: Introduction: Understanding Information Technology	Notes		
	Lab: Lab Introduction			
	Towson University Email			
2 Sep 6 - Sep 10	DD - Ch 2: Information and the Digital Domain	Notes		
	DD - Ch 3: Computing Basics	Notes		
	Lab: LearnOnline Account Creation		10	Sep 10
	Lab: LearnOnline Email		10	Sep 10
3 Sep 13 - Sep 17	DD Ch 12: Storing Data on Your Computer	Notes		
	DD Ch 13: Input and Output	Notes		
	Lab: Digital Photography		10	Sep 17
4 Sep 20 - Sep 24	Quiz Unit 1		50	Sep 24
	Lab: LearnOnline Home Page		10	Sep 24
	Lab: LearnOnline Discussion Board		10	Sep 24
	Total Points Unit 1		**100**	

Unit 2: Animation using Flash, Sep 27 - Oct 22

Week	Subject	Additional Resources	Points	Due
5 Sep 27 - Oct 1	DD - Ch 8: Digital Images	Notes		
	Flash: Introducing Macromedia Flash			
	Lab: Flash Tutorial			Oct 1
	Lab: Personal Illustration		10	Oct 1

6 **Oct 4 - Oct 8**	DD - Ch 9: Making Pictures with Computers	Notes		
	Lab: Flash Animation 1		20	Oct 8
7 **Oct 11 - Oct 15**	DD - Ch 10: The Sound and the Fury	Notes		
	Lab: Flash Animation 2		20	Oct 15
8 **Oct 18 - Oct 22**	Quiz Unit 2		50	Oct 22
	Lab: Holiday Greeting Card		20	Oct 22
	Total Points Unit 2		**120**	

Unit 3: Public Web and Sound Editing, Oct 25 - Nov 26

Week	Subject	Additional Resources	Points	Due
9 **Oct 25 - Oct 29**	DD - Ch 4: Connecting to the Digital Domain	Notes		
	Lab: Scanner Story		10	Oct 29
10 **Nov 1 - Nov 5**	DD - Ch 16: Data Communications	Notes		
	Lab: Public Web Home Page		20	Nov 5
	Lab: Term Project Proposal		10	Nov 12
11 **Nov 8 - Nov 12**	DD - Ch 18: The Internet	Notes		
	DD - Ch 19: Internet Applications	Notes		
	Lab: Extending Home Page - Recipe		20	Nov 12
	Lab: Term Project Story Board			Nov 22
12 **Nov 15 - Nov 19**	Quiz Unit 3		50	Nov 19
	Lab: Audio Greeting		20	Nov 26
13 **Nov 22 - Nov 26**	Thanksgiving - No lecture			
	Lab: Term Project			Dec 10
	Total Points Unit 3		**130**	

Unit 4: Project Completion and Final Exam, Nov 29 - Dec 17

Week	Subject	Additional Resources	Points	Due

14 **Nov 29 - Dec 3**	DD - Ch 20: Data Compression and Security	Notes		
	Lab: Term Project			Dec 10
15 **Dec 6 - Dec 10**	DD - Ch 21: Emerging Digital Technologies	Notes		
	Lab: Term Project Due		100	Dec 10
16/17 **Dec 13 - Dec 17**	Final Exam		50	Dec 13
	Total Points Unit 4		**150**	

Overall Course	
Quiz Points	**200**
Assignment Points	**300**
Total Points	**500**

APPENDIX C - Web-Based Learning and Usability Questionnaire (WLUQ)

Course Management System Usability and Student Learning Outcomes

The purpose of this survey is to evaluate student perceptions of a course management system (Blackboard) usability and student learning outcomes. Course management systems are an important element in many courses and the data collected will contribute to a better understanding of student satisfaction and course management systems usability issues in this type of learning environment.

The survey contains a total of 40 questions in four sections. Section I is designed to collect general information, section II is designed to collect computer competency information, section III is designed to collect Blackboard course management systems usability information and section IV is designed to collect information about your learning experience.

There are no 'right' or 'wrong' answers. Some statements in this questionnaire are fairly similar to other statements. This is purposely part of the design. Please answer all questions as best as you can.

Your decision whether or not to participate in the survey or to withdraw from the survey at any time will in no way affect your class standing, or if you are an athlete, your status as an athlete. If you do choose to participate in the study, your participation will be completely anonymous. Neither anyone reading the results of the survey nor I will be able to identify you. Please do not put your name or any other identifying marks on the survey form.

If you like to elaborate on your answers, please write comments in the provided space.

Your time and effort in completing this survey is very much appreciated. Thank you.

Section I - Demographics

This section is designed to collect general information about you. Please answer the questions by checking he appropriate box.

1. What is your gender?

- Male
- Female

2. What is your age?

- 20 years or younger
- 21-25 years
- 26-30 years
- 31 years or older

3. What is your current student standing?

- Freshman
- Sophomore
- Junior
- Senior

4. What is your current student status?

- Full-time
- Part-time

5. How many courses have you taken that use Blackboard (including this one)?

- One
- 2-5
- 6-10
- 10 or more

6. How many hours per week do you use your computer for fun/play?

- Under 5
- 5-10
- 10-20
- 20 or more

7. How many hours per week do you use your computer for work (including study related work)?

- Under 5
- 5-10
- 10-20
- 20 or more

Section II - Competency

This section is designed to collect information about your computer competency. Please rate your competency using the following scale:
1=Poor (I have never heard of the software and don't know how to use it)
2=Below Average (I have heard of the software, but have little or no knowledge how to use it)
3=Average (I use the software sometimes, but only for basic operations)
4=Above Average (I use the software all the time and know most of its features)
5=Excellent (I know the software very well and could teach my peers)

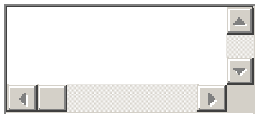
	1=Poor	2=Below Average	3=Average	4=Above Average	5=Excellent
8. Searching/browsing WWW	1	2	3	4	5
9. E-mail	1	2	3	4	5
10. Electronic discussions (chat rooms, instant messaging)	1	2	3	4	5
11. Writing (Word Processing)	1	2	3	4	5
12. Web-page development	1	2	3	4	5

Section III - Usability

The following section is designed to collect data about your experience with the Blackboard system. After reading each statement please indicate how strongly you agree or disagree with the statement using the following scale: 1=Strongly Disagree, 2=Somewhat Disagree, 3=Neutral, 4=Somewhat Agree, 5=Strongly Agree. If a statement does not apply to you, select N/A.

	1=Strongly Disagree	2=Somewhat Disagree	3=Neutral	4=Somewhat Agree	5=Strongly Agree	N/A
13. It was simple to use Blackboard	1	2	3	4	5	
14. I can efficiently complete my work using Blackboard	1	2	3	4	5	
15. I feel comfortable using Blackboard	1	2	3	4	5	
16. It was easy to learn to use Blackboard	1	2	3	4	5	
17. Blackboard gives error messages that clearly tell me how to fix problems	1	2	3	4	5	
18. Whenever I make a mistake using Blackboard, I recover easily and quickly	1	2	3	4	5	
19. The support information provided with Blackboard (such as online help, on-screen messages, and other documentation) is clear	1	2	3	4	5	
20. The Blackboard interface is pleasant	1	2	3	4	5	
21. Blackboard has all the functions and capabilities I expect it to have	1	2	3	4	5	
22. Overall, I am satisfied with Blackboard	1	2	3	4	5	

23. From a learner's perspective list the features of Blackboard you like **best** in the box below:



24. From a learner's perspective list the features of Blackboard you like **least** in the box below:

Section IV - Student Learning Experience

The following section is designed to collect data about how you rate your learning experience in this environment. After reading each statement please indicate how strongly you agree or disagree with the statement using the following scale: 1=Strongly Disagree, 2=Somewhat Disagree, 3=Neutral, 4=Somewhat Agree, 5=Strongly Agree. If a statement does not apply to you, select N/A.

	1=Strongly Disagree	2=Somewhat Disagree	3=Neutral	4=Somewhat Agree	5=Strongly Agree	N/A
25. I am allowed to work at my own pace to achieve learning objectives	1	2	3	4	5	
26. The flexibility allows me to meet my learning goals	1	2	3	4	5	
27. I can explore my own areas of interest	1	2	3	4	5	
28. Other students respond promptly to my queries	1	2	3	4	5	
29. I am supported by a positive attitude from my peers	1	2	3	4	5	
30. The instructor responds promptly to my queries	1	2	3	4	5	
31. I feel a sense of satisfaction and achievement about this learning environment	1	2	3	4	5	
32. I enjoy learning in this environment	1	2	3	4	5	
33. I am challenged enough in this environment	1	2	3	4	5	
34. The learning objectives are clearly stated in each lesson	1	2	3	4	5	
35. The organization of each lesson is easy to follow	1	2	3	4	5	
36. The subject content is appropriate for delivery on the Web	1	2	3	4	5	
37. Overall, I am satisfied with my Learning Experience	1	2	3	4	5	

Please select how often you attended lecture and laboratory meetings using the following scale: 1=Never Attended, 2=Attended less than Half of the Time, 3=Attended Half of the Time, 4=Attended more than Half of the Time, 5=Attended almost All/All.

	1=Never	2=Less than Half	3=Half	4=More than Half	5=Almost All/All
38. Lecture Attendance	1	2	3	4	5
39. Lab Attendance	1	2	3	4	5

40. Comments:

Submit Reset

APPENDIX D - Research Question 2: Detailed Results of One-Way ANOVA Series among Levels of Competency and both Usability and Learning Outcomes

Differences between Computer Competency and Usability

Searching/Browsing WWW Competency and Usability.

Results of one-way ANOVA for searching/browsing WWW and overall usability are shown in Table D1. Analysis showed significant differences among the levels of competency for searching/browsing WWW with overall usability ($F(3,177) = 4.816$, $p < 0.05$).

Table D1

ANOVA Searching/Browsing WWW – Usability

	Sum of squares	df	Mean square	F	p
Between groups	7.592	3	2.531	4.816	.003
Within groups	93.011	177	.525		
Total	100.603	180			

	N	Mean	Std. Deviation
Below average	1	3.22	.
Average	14	3.90	.50
Above average	60	4.21	.79
Excellent	106	4.50	.71
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Email Competency and Usability.

Results for email and overall usability are shown in Table D2. Results of one-way ANOVA displayed significant differences among the levels of competency for email with overall usability ($F(3,177) = 5.912$, $p < 0.05$)

Table D2

ANOVA Email - Usability

	Sum of squares	df	Mean square	F	Sig.
Between groups	9.163	3	3.054	5.912	.001
Within groups	91.440	177	.517		
Total	100.603	180			

	N	Mean	Std. Deviation
Below average	1	4.10	.
Average	10	3.80	.33
Above average	47	4.09	.79
Excellent	123	4.50	.71
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Word Processing Competency and Usability.

Results for word processing and overall usability are shown in Table D3. Results of one-way ANOVA displayed significant differences among the levels of competency for word processing with overall usability ($F(3,177) = 4.656$, $p < 0.05$)

Table D3

ANOVA Word Processing - Usability

	Sum of squares	df	Mean square	F	p
Between groups	7.358	3	2.453	4.656	.004
Within groups	93.245	177	.527		
Total	100.603	180			

	N	Mean	Std. Deviation
Below average	1	4.40	.
Average	14	3.92	.51
Above average	56	4.16	.76
Excellent	110	4.51	.73
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Electronic Discussions Competency and Usability.

Results for electronic discussions and overall usability are shown in Table D4. Results of one-way ANOVA displayed no significant differences among the levels of competency for electronic discussions with overall usability ($F(4,176) = 1.881$, $p = 0.116$)

Table D4

ANOVA Electronic Discussions - Usability

	Sum of squares	df	Mean square	F	p
Between groups	4.124	4	1.031	1.881	.116
Within groups	96.479	176	.548		
Total	100.603	180			

	N	Mean	Std. Deviation
Poor	1	3.86	.
Below average	8	3.87	.47
Average	12	4.30	.66
Above average	56	4.24	.68
Excellent	104	4.46	.79
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Web Page Development Competency and Usability.

Results for web page development and overall usability are shown in Table D5. Results of one-way ANOVA displayed no significant differences among the levels of competency for web page development with overall usability ($F(4,176) = 1.195$, $p = 0.315$)

Table D5

ANOVA Web Page Development - Usability

	Sum of squares	df	Mean square	F	p
Between groups	2.659	4	.665	1.195	.315
Within groups	97.943	176	.556		
Total	100.603	180			

	N	Mean	Std. Deviation
Poor	2	3.85	.78
Below average	28	4.21	.62
Average	72	4.35	.62
Above average	54	4.33	.90
Excellent	25	4.60	.83
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Differences between Computer Competency and Learning Outcomes

Searching/Browsing WWW Competency and Learning Outcomes.

Results for Searching/Browsing WWW and overall learning outcomes are shown in Table D6. Results of one-way ANOVA showed significant differences among the levels of competency for searching/browsing WWW with overall learning outcomes ($F(3,176) = 2.829$, $p < 0.05$)

Table D6

ANOVA Searching/Browsing WWW – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	4.774	3	1.591	2.829	.040
Within groups	98.997	176	.562		
Total	103.772	179			

	N	Mean	Std. Deviation
Below average	1	4.00	.
Average	10	3.75	.61
Above average	46	4.20	.79
Excellent	123	4.48	.73
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

Email Competency and Learning Outcomes.

Results for email and overall learning outcomes are shown in Table D7. Results of one-way ANOVA showed significant differences among the levels of competency for email with overall learning outcomes ($F(3,176) = 4.162$, $p < 0.05$)

Table D7

ANOVA Email – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	6.875	3	2.292	4.162	.007
Within groups	96.897	176	.551		
Total	103.772	179			

	N	Mean	Std. Deviation
Below average	1	4.00	.
Average	10	3.75	.61
Above average	46	4.20	.79
Excellent	123	4.48	.73
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

Word Processing Competency and Learning Outcomes.

Results for word processing and overall learning outcomes are shown in Table D8. Results of one-way ANOVA showed no significant differences among the levels of competency for word processing with overall learning outcomes ($F(3,176) = 1.992$, $p = 0.117$).

Table D8

ANOVA Word Processing – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	3.407	3	1.136	1.992	.117
Within groups	100.364	176	.570		
Total	103.772	179			

	N	Mean	Std. Deviation
Below average	1	4.23	.
Average	14	4.07	.68
Above average	55	4.24	.75
Excellent	110	4.47	.77
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

Electronic Discussions Competency and Learning Outcomes.

Results for electronic discussions and overall learning outcomes are shown in Table D9. Results of one-way ANOVA showed no significant differences among the

levels of competency for electronic discussions with overall learning outcomes (F(4,175) = 0.921, p= 0.453).

Table D9

ANOVA Electronic Discussions – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	2.139	4	.535	.921	.453
Within groups	101.632	175	.581		
Total	103.772	179			

	N	Mean	Std. Deviation
Poor	1	4.18	.
Below average	8	3.98	.49
Average	12	4.29	.68
Above average	55	4.30	.72
Excellent	104	4.44	.81
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

Web Page Development Competency and Learning Outcomes.

Results for web page development and overall learning outcomes are shown in Table D10. Results of one-way ANOVA showed no significant differences among the levels of competency for word processing with overall learning outcomes (F(4,175) = 1.491, p= 0.207).

Table D10

ANOVA Web Page Development – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	3.421	4	.855	1.491	.207
Within groups	100.351	175	.573		
Total	103.772	179			

	N	Mean	Std. Deviation
Poor	2	4.50	.38
Below average	27	4.05	.59
Average	72	4.46	.64
Above average	54	4.37	.90
Excellent	25	4.44	.90
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

APPENDIX E - Research Question 3: Detailed Results of One-Way ANOVA Series among Gender, Age, and Student Standing and both Usability and Learning Outcomes

Differences between Gender, Age, Student Standing and Usability

Gender and Usability.

Results for gender and overall usability are shown in Table E1. Results of one-way ANOVA showed no significant differences among gender with overall usability ($F(1,177) = 0.748$, $p = 0.388$)

Table E1

ANOVA Gender – Usability

	Sum of squares	df	Mean square	F	p
Between groups	0.423	1	.423	.748	.388
Within groups	100.001	177	.565		
Total	100.424	178			

	N	Mean	Std. Deviation
Male	81	4.30	.85
Female	98	4.40	.66
Total	179	4.35	.75

Note. Level of significance was predetermined to be 0.05

Age and Usability.

Table E2 presents results for age and overall usability. Results of one-way ANOVA showed no significant differences among age with overall usability ($F(2,178) = 0.031$, $p = 0.970$)

Table E2

ANOVA Age – Usability

	Sum of squares	df	Mean square	F	p
Between groups	0.035	2	.017	.031	.970
Within groups	100.568	178	.565		
Total	100.603	180			

	N	Mean	Std. Deviation
20 yrs or younger	137	4.35	.80
21-25 years	42	4.38	.59
31 yrs and older	2	4.35	.07
Total	179	4.35	.75

Note. Level of significance was predetermined to be 0.05

Student Standing and Usability.

Table E3 presents results for student standing and overall usability. Results of one-way ANOVA showed no significant differences among student standing with overall usability ($F(3,177) = 0.136$, $p= 0.938$).

Table E3

ANOVA Student Standing – Usability

	Sum of squares	df	Mean square	F	p
Between groups	0.231	3	.017	.136	.938
Within groups	100.371	177	.567		
Total	100.603	180			

	N	Mean	Std. Deviation
Freshmen	4	4.49	.49
Sophomore	91	4.37	.76
Junior	67	4.35	.80
Senior	19	4.27	.57
Total	181	4.35	.75

Note. Level of significance was predetermined to be 0.05

Differences between Gender, Age, Student Standing and Learning Outcomes

Gender and Learning Outcomes.

Results for gender and overall learning outcomes are presented in Table E4. Results of one-way ANOVA showed no significant differences among gender with overall learning outcomes ($F(1,176) = 3.679$, $p = 0.057$)

Table E4

ANOVA Gender – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	2.114	1	2.114	3.679	.057
Within groups	101.142	176	.575		
Total	103.257	177			

	N	Mean	Std. Deviation
Male	80	4.24	.85
Female	98	4.46	.66
Total	178	4.36	.75

Note. Level of significance was predetermined to be 0.05

Age and Learning Outcomes.

Results for age and overall learning outcomes are presented in Table E5. Results of one-way ANOVA showed no significant differences among age with overall learning outcomes ($F(2,177) = 0.232$, $p = 0.794$).

Table E5

ANOVA Age – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	.271	2	.135	.232	.794
Within groups	103.501	177	.585		
Total	103.772	179			

	N	Mean	Std. Deviation
20 yrs or younger	137	4.36	.80
21-25 years	41	4.37	.63
31 yrs and older	2	4.73	.38
Total	179	4.37	.76

Note. Level of significance was predetermined to be 0.05

Student Standing and Learning Outcomes.

Results for student standing and overall learning outcomes are presented in Table E6. Results of one-way ANOVA showed no significant differences among student standing with overall usability ($F(3,176) = 0.549$, $p = 0.649$).

Table E6

ANOVA Student Standing – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	.963	3	.321	.549	.649
Within groups	102.809	176	.584		
Total	103.772	179			

	N	Mean	Std. Deviation
Freshmen	4	4.84	.26
Sophomore	91	4.37	.76
Junior	67	4.34	.82
Senior	18	4.33	.61
Total	180	4.37	.76

Note. Level of significance was predetermined to be 0.05

APPENDIX F - Research Question 4: Detailed Results of One-Way ANOVA Series among Levels of Lecture and Laboratory Attendance and both Usability and Learning Outcomes

Differences between Lecture and Laboratory Attendance and Usability

Lecture Attendance and Usability.

Table F1 presents results for lecture attendance and overall usability. Results of one-way ANOVA showed a significant difference among the level of lecture attendance with overall usability ($F(4,175) = 2.482$, $p<0.05$).

Table F1

ANOVA Lecture Attendance - Usability

	Sum of squares	df	Mean square	F	p
Between groups	5.399	4	1.350	2.482	.046
Within groups	95.182	175	.544		
Total	100.581	179			

	N	Mean	Std. Deviation
Never attended	8	4.27	.69
Less than half	60	3.99	.60
Half	31	4.39	1.13
More than half	35	4.42	.77
Always attended	46	4.35	.52
Total	180	4.37	.75

Note. Level of significance was predetermined to be 0.05

Laboratory Attendance and Usability.

Table F2 presents results lab attendance and overall usability. Results of one-way ANOVA showed no significant difference among levels of lab attendance with overall usability ($F(4,174) = 1.097$, $p=0.360$).

Table F2

ANOVA Lab Attendance - Usability

	Sum of squares	df	Mean square	F	p
Between groups	2.464	4	.616	1.097	.360
Within groups	97.694	174	.561		
Total	100.159	178			

	N	Mean	Std. Deviation
Never attended	9	4.10	.76
Less than half	25	4.41	.52
Half	30	4.14	.97
More than half	30	4.44	.82
Always attended	85	4.40	.69
Total	179	4.35	.75

Note. Level of significance was predetermined to be 0.05

Differences between Lecture and Laboratory Attendance and Learning Outcomes

Lecture Attendance and Learning Outcomes.

Results for lecture attendance and overall learning outcomes are presented in Table F3. Results of one-way ANOVA showed no significant differences among levels of lecture attendance with overall learning outcomes ($F(4,174) = 2.143$, $p = 0.077$).

Table F3

ANOVA Lecture Attendance – Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	4.849	4	1.212	2.143	.077
Within groups	98.432	174	.566		
Total	103.281	178			

	N	Mean	Std. Deviation
Never attended	8	4.42	.65
Less than half	59	4.45	.59
Half	31	4.05	1.18
More than half	35	4.30	.81
Always attended	46	4.52	.48
Total	179	4.37	.76

Note. Level of significance was predetermined to be 0.05

Laboratory Attendance and Learning Outcomes.

Results for lab attendance and overall learning outcomes are presented in Table F4. Results of one-way ANOVA showed no significant differences among levels of lab attendance with overall usability ($F(4,173) = 0.532$, $p = 0.712$).

Table F4

ANOVA Lab Attendance - Learning Outcomes

	Sum of squares	df	Mean square	F	p
Between groups	1.253	4	.313	.532	.712
Within groups	101.812	173	.589		
Total	103.064	177			

	N	Mean	Std. Deviation
Never attended	9	4.53	.71
Less than half	24	3.89	.56
Half	30	4.20	1.01
More than half	30	4.42	.86
Always attended	85	4.38	.69
Total	178	4.37	.76

Note. Level of significance was predetermined to be 0.05

APPENDIX G - Student Open Ended Comments

Question 23 - From a Learner's Perspective list the Features of Blackboard you liked best

Its ease in use.

The discussion board

Being able to post projects anytime I want before Friday and being able to check my grade.

very easy to use

Check grade

Announcements such as class cancellations, reminders, etc

submitting assignments online from the comfort of my own computer

I can work from home. I only attend class to take exams.

How can you can post assignments online.

posting assignments, checking grades, having notes

I like that you can get your class notes on line, and a copy of the class schedule and assignments that are due.

Being able to check my grades

check my grade

easy way to get assignment information

checking grades

ability to submit answers through discussion board

Easy to use

Ability to Check Grade, Easy to keep track of class assignments and deadlines

Check your grade when professors actually post it.

Student Tools

External Links

easy, fast, clear

easy navigation and user friendly

Grades

Assignment posting

Class schedule

check student grades

how my teacher could post things on there

Easy to navigate

Discussion boards to be able to post assignments

I like to be able to check my course grade whenever I want and see how I scored on individual assignments. As well, I like how everything is in one place (i.e. all the notes for classes are in one place, all my grades are in one place).

The ability to check grades and send easy email to professors and other students.

I could download all the notes and print them out

the ability to check your grade

checking grade, accessing class materials

being able to quickly post and see that its posted

simple, easy, sufficient

It allows you to view your grades during the semester. It also allows you to always have a copy of the syllabus because it is posted on blackboard. You can get in touch with people in your class if you need help with anything in that class

that u can email anyone

ability to check grade, ability to view roster, ability to use message board

Easy Access

Instant postings

Being able to turn in assignments online

able to check grades

I like that we can get announcements and assignments before coming to class.

check grade option

The ability to see others' examples of work completed for the course.

Easy to use, able to add sites that I use currently i.e. Google, yahoo, etc.

Easy to access class documents/syllabus.

always available and freedom to do the work at anytime

I liked the ability to work from home at any time.

That you can check assignments and grads easily as long as the professor posts them.

organization of classes

Ability to post assignments directly from my home computer without having to go to a lab computer to do my work.

I like that I am able to find my grades out online.

announcements and how i can check my grade.

Being able to check your grades in one place and check due dates.

I can check my class schedule and my grades easily with out looking all over the place

Discussion Board.. Ability to post assignments online

all of them

Its very easy to submit your work and find daily announcements. its very user friendly

being able to see your calculated grades

enrolling in the class

checking my grade online, list of instructors and students' email addresses, discussion board

being able to see grade

all information from the course was online, so if you ever missed something in class or didn't quite get it you could always go to Blackboard for clarification

discussion boards, virtual classroom, easy grade check

the online submission of work

Check Grade

Retrieve notes

email

posting your work online

the online note posting and schedule the teacher posts.

student tools

checking grades

could check messages from professors very easily and I could check my e-mail while logged onto blackboard

ability to check our grade

announcements made by the professor (makes it easier to interact with them)

posting of assignments and requirements

discussion board

grades online

I feel that it is easy to do your assignments and then send it to you instructor

online grading, updates to the class, online syllabus

seeing my grades

simple to learn

having the instructor post assignments/comments, see grades, assignments to be completed, having the syllabus accessible, everything neat and organized, easy to use

Ability for everyone to view messages at once.

grades and announcements

It gives you access to documents and grades.

i like how i can access power points and papers from the blackboard site

Checking your grade

Being able to communicate with all other students in the class.

it's online, efficient, effective, high accessibility.

easy to use

clear instructions on how to get

started

easy to post messages

being able to submit work

Being able to keep it touch with teachers

list of all classmates

E-mail, student tools, course documents, discussion board

I like the fact that all of my assignments are posted no matter what.

I like the student tools section, as well as discussion board.

sections are divided logically and the site is easy to navigate

i like that fact that i can see my grade whenever i want also i like having all of the students email addresses

You can see other peoples labs

I love the fact that I can work from home and submit all of my work via discussion boards

able to view grades

I can check my grade and course schedule.

Course Schedule

check grade

how our grades our posted for the students to see

I think it is a great way to communicate.

I like how you can check the grades online and hand in work electronically

I am able to find my syllabus online when I can't find it in with my papers

You can interact with your professor and class.

not having to go to class

The features I liked best about blackboard were the current announcements, the posting of grades, and the discussion boards.

online exams

Link where we can check grade

makes the course more online and less interactive with the teacher

that you can see everyone else's work in case you need help

Easy accessibility:

Good Graphics and Organized Links

easier to access the instructor

you can see other creations from students

It's easy, and it's convenient

i like all the feature

check grade

The ability to see all the course documents and have other links to important things for the class.

Being able to go online and look up notes for tests and such is very convenient

being updated on my work electronically

checking grades

I like how I can have more class than one at a time.

accessibility

check your grades, take quizzes at home

User friendly

the layout of blackboard is straight and to the point. it gets a lot easier as you use it more

The Announcements are clear, and checking your grade is made easy.

check grade

printable lecture notes

ease of use and communication

I like the way the quizzes are presented and how easy it is to use

Sending Email, Checking Grade, Assignment Guide

email

discussion board

grades

being able to access everything

You can check your grade

easy to keep track of grades and assignments

More online class discussion.

check grade

Easy to turn in assignments.

submitting coursework

It makes it easier to keep track of my classes and work.

i like the having info on my class schedule at hand

grade listing, announcement posting

discussion boards and student tools

Question 24 – From a Learner's Perspective list the Features of Blackboard you like least

Saving files

sometimes if a lot of users were using blackboard it seemed a bit slow.

Digital Drop Box

the format and often lack of announcements for each class

It's always slow to load

How different teachers had you submit assignments different ways.

links not working properly

Lack of updated announcements

signs you out of e-mail

There is nothing I did not like.

it doesn't refresh websites

everything worked well for me

the multiple screens there are and not knowing where everything is.

Nothing really. Its ok

timed sessions

course searching can be confusing/difficult

the categories such as student tools and communication could be better describe to what

they actually allow users to do

outlook, presentation

It isn't always easy to submit something to the discussion board.

all the clicking

I have no idea

Sometimes the system goes down, limited access to the site.

I least like the sign in process, sometimes you would have to go to three different sites before you could even enter your name and password. I also disliked the homepage. I feel that opening up to the my classes is most effective. I don't like how email cannot be viewed through blackboard without reentering passwords. I find the preview useless because it does not show any attachments, and if you do click on preview you must reenter the address of the attachment.

did not delete past classes from previous semesters

The frames are really annoying. A better navigation system should be established that doesn't employ the use of frames.

I feel like blackboard makes the class less connected to the teacher.

Having to rely solely on blackboard for learning material

You have to hunt for things with in the sections.

I sometimes had a problem changing the format on my assignments so they could post, especially with my homepage.

Not everyone has regular access to a computer or the internet. I do not think it should be required to use blackboard.

none, I was satisfied with everything

the fact that you cannot print out certain documents the way you want to

having to click on numerous links to actually log-in to blackboard. (from learnonline.towson.edu)

nothing

not easily accessible for all classes

none

the frames can reduce the viewing window for seeing information

nothing

communication

virtual classroom

it seemed to be slow a lot and there were times when I couldn't get on at all

how it looks

submitting assignments

error messages

once logged into web mail, I didn’t like having to retype password again. If there were failures, Typing and re-typing became an inconvenience.

Not really sure.

don't know

Student Tools were hard to find, but once I got to them I was fine, just hard to locate

I don't know much about the Resources or how to fix the problems with blackboard, nor how to operate virtual class room

If the system is slow it can effect your assignments.

From my past experience, Blackboard does not have the most efficient email.

discussion board

overall I am very satisfied with blackboard and there isn’t anything that I don’t like

e-mail

well last semester, I had problem using the email associated with learn online. I attempted to submit my midterm project via learnonline email and it didn't show up in my teachers mailbox until a month later...fortunately it was still dated the day I had originally sent it. I think there may be a few bugs to be worked out.

access

No problems as of yet

You don't actually have an instructor giving you the assignment

There was onetime i needed to access blackboard and I couldn't because I could not get to the website.

the informality of it all

deadline cut offs

takes too long to get on the login page

when the network is down.

Too many link's to get in to it.

you must log in about 3 times

well blackboard is not always stable

I wish it gave more help options.

sometimes the server goes down

takes many pages to finally log in from Towson link

if you're first using the system with no prior knowledge of the system, then it can be very frustrating

Discussion board

could look more modern. Looks kind of boxy

I think blackboard is a great thing

its annoying login process

discussion board

Sometimes internet won't work and hard to turn in assignments

I wish every class used it.

Question 40 – General Comments

I really enjoyed the class

I loved this class. I think it is the best class Towson University has to offer. My instructor was so kind and understanding. The class was educational and we learned how to do some really fun things like make an animated greeting card. I enjoyed the class. great class!

Happy with the class

This was a great course. It was instructed very well. The labs were run very efficiently. There was always clear instruction and ALWAYS help available if I needed. I was very satisfied with how this class was run.

Overall I feel this was a very good learning environment sine the class is based on learning using the internet and different graphic tools. I encourage this method for similar classes in the future.

Again, I like that I can do all of my work from home when it is convenient for me. I only attend class for exams and I have an 'A' in the class.

Overall I enjoyed the class but i am disappointed in myself because i should have taken advantage of the open lab times because i missed about 4 labs which i know i couldn't have had an A in this class.

Enjoyable class

After learning the programs (Macromedia Flash and Microsoft FrontPage) in the lab, I got the programs for my home computer and worked from there. It is easier for me to work at my own pace then squeeze it in at a 45min lab.

I enjoyed taking this class. I learned a lot.

Flexible class that I really learned a lot from

Great way to do this class. Leaves a chance for your own pace.

I enjoyed this class as well as the professor. The professor seemed very knowledgeable in this topic and was very helpful. Great professor over all!

The only thing that was really hard for me was to attend lab because I have a class in a building very far from the York Road building immediately following lab.

Didn't really like the class

The online notes on blackboard made all assignments easy to follow. I thought the class was a lot of fun and interesting.

It was an informative class

Enjoyed learning new creative ways on different software and programs. Thanks for a great semester!!!

Great class.

I didn't really go to lab a lot because I could do things easily on blackboard. The instructions were easily explained and the software was available for trial downloads. I did like that lab was available if I had problems or questions with how to do any of the assignments. I am very happy with this course and wish there were more like it.

Good class

Learned a lot

Overall this class was very interesting. I enjoyed making my own website and creating flash. I feel that the first part of lab (cropping pictures, pasting pictures) was a pointless lab. I don't know how many people really need help with that but i felt that those labs could have been better spent. I do find it annoying that front page is only available at the York rd. building. Finding time in my busy schedule was very difficult to drive all the way to school. I think a 30 day trial option (like flash) would be the best however I don't know if that is possible. Overall, I find this class fun during the labs and a bit boring in the lecture. The information we covered didn't always match up or it seemed just thrown into lecture. I think a better merging of lab and lecture would provide more interest in lecture.

I enjoyed the class overall. I didn't understand the attendance policy though because attendance was "mandatory" but it was not calculated into your grade.
if u know computers, you should not be required to attend...this allows for those who are more skilled the ability to work at their own pace, which i like

I did not attend lecture because I found that I could teach myself from the book and the notes that were posted on blackboard.

This a great class and I liked the way it was set up. It would be nice if the lecture was not so early on Friday.

I really enjoyed this class. I learned a lot about the creative side of the computer that I did not know about before.

Great course!

I feel that we should just have another test for the final and not to make it cumulative.

I am very satisfied with the way the course is presented. Those who wanted to learn something - they did it; as for the rest, it was very easy.

This was a great experience

This course taught me a lot, I enjoyed it.

I enjoyed using my creative ability on every assignment

I enjoyed this class very much. I loved creating my own web page and i thought everything was clearly explained.

I went almost all of the time because I learned more from the labs when I have someone there to help me when I didn't understand and the lectures were pointless but at the end of the lectures the professor explained the upcoming lab

Great course!

A very interesting and fun class. The instructor was at every lecture and present in the labs if we ever needed help on the assignments

I thoroughly enjoyed the class...learned a lot which I will be able to use later down the road, fun class, enjoyed the assignments. Fun class, great teacher and student helper

I enjoyed the class. This is a great idea, but some professors might "abuse" this and use it to create more work for the student. By that, I mean the student having to check emails many times a day to make sure he/she doesn't get a surprise requirement that is due on short notices.

none

I really enjoyed this class and learned a lot.

I liked the class overall, I learned a lot.

Blackboard is very useful and efficient medium to communicate and learn the subject's materials.

This was a very fun class to take and I enjoyed learning about new features or programs on the computer. I personally received a great wealth of information, but I wished that I could learn more, being that I am not so great with computers. But that's ok because the teacher was great.

I think because most of the assignments don't require you to attend class it is a lot easier not to go.

I thoroughly enjoyed the class and think that I have learned a good deal of information that I can use for other classes and subjects.

This was a very enjoyable class thank you

I loved being able to do all my work at home. I just couldn't function all day if I had to go to that 8 am class, and it started effecting my other classes.

Overall a well taught class

I think the class could be taught completely online.

This class was alright

I really enjoyed taking this class. The instructor really knew how to help me whenever I needed it. She was very clear about what she expected from every assignment and on every quiz.

never missed a class great teacher

Wish it wasn't a requirement to come to lecture or lab

Sometimes you didn't have to go to lab or lecture b/c you could figure out how to do the labs on your own. great class!

I enjoyed the format... it allowed me to still do my work without having to attend class. I am more of a self learner then sitting and being lectured to. You should keep this format in the future!!! FUN CLASS

The class was fun

I would say replace our lab helper--- for the simple fact is that she really didn't help me so I came back after hours and talked to the tech people in the COSC help center

I liked this class a lot.

I enjoyed this class

I found the course very interesting and felt I left learning a great deal about flash and web designing.

This class was very informative.

I really enjoyed using blackboard in my COSC class. It made the class easier to fit my schedule and more of a hands-on learning process. It was a great learning experience!

this was a great class to have on line since it has to deal with computers and creativity. this was a great class to have.

I enjoyed the class and learned a lot

More flash labs!!

I felt it easier to complete the assignments on my own time. I still gained all of the knowledge from the class

Computer labs should be open for the specified times on the charts. I've gotten kicked out while completing a project & my grade was reflected

Excellent class... keep it the way it is

For me I was able to get good grades in this class doing most of my work from home. I enjoyed using blackboard because it let me work at times that were convenient to me.

REFERENCES

American Distance Education Consortium (2004). Guiding principles for distance teaching and learning, Retrieved March 25, 2004 from http://www.adec.edu/admin/papers/distance-teaching_principles.html.

Association for Computing Machinery (2001). Reviews – Notes From E-Learning Special Interest Group Discussion at Computer Human Interaction Conference 2001 in Seattle, Washington. Retrieved October 28, 2004 from http://elearnmag.org/subpage/sub_page.cfm?section=6&list_item=1&page=1.

Chang, V. (1999). Evaluating the effectiveness of online learning using a new web based learning instrument. *Proceedings Western Australian Institute for Educational Research Forum*. Retrieved February 15, 2004, from http://education.curtin.edu.au/waier/forums/1999/chang.html.

Chin, J., Diehl, A. & Norman, K. (1988). Development of an instrument measuring user satisfaction of the human-computer interface. *Proceedings of ACM CHI'88 Conference on Human Factors in Computing Systems*, 1988, p.213-218.

Dutton, J. (2002). How do online students differ from lecture students? *Journal of Asynchronous Learning Networks JALN*, 6(1*)*.

Feldstein, M. (2002). Ignore usability at your peril. *eLearn Magazine*, April 8, 2002, Retrieved December 11, 2003 from http://elearnmag.org/subpage/sub_page.cfm?article_pk=5142&page_number_nb=1&title=COLUMN.

Fredericksen, E., Picket, A., Pelz, W. Swan, K. & Shea, P. State (1999). State University of New York student satisfaction and perceived learning with on-line courses – principles and examples from the SUNY learning network, Retrieved March 17, 2004, from http://SLN.suny.edu/SLN.

Goldberg, M. (1997). WebCT and first year: Student reaction to and use of a web-based resource in first year Computer Science. *Proceedings of ITiCSE Conference on Integrating Technology into Computer Science Education.*

Grice, R. and Hart-Davidson, B. (2002). Mapping the expanding landscape of usability: the case of distributed education. *ACM Journal of Computer Documentation*, 2002, 26, 159-167.

Human Factors Research Group (2003). Questionnaires in usability engineering, Retrieved December 16, 2003, from http://www.ucc.ie/hfrg/resources/qfaq1.html

Johnson, S., Aragon, N., Shaik, N. & Palma-Rivas, N. (2000). Comparative analysis of learner satisfaction and learning outcomes in online and face-to-face learning environments. *Journal of Interactive Learning Research*, 11(1), 29-49.

Kantner, L., Hinderer, D. & Rosenbaum, S. (2003). Alternative methods for field usability research. *Proceedings of SIGDOC '03*, October, 2003, San Francisco, CA.

Kerr, M., Rynearson, K. & Kerr, M. (2003). Predicting student success in online courses: A new measure. *Proceedings of 10th Annual Distance Education Conference*, January, 2003, Austin, TX.

Koohang, A. (2004). A study of users' perceptions toward e-learning courseware usability. *International Journal on E-Learning 3*(2), 10-17. [Online]. Available: http://dl.aace.org/15321.

Lazar, J. (2001). *User-centered web development*. Sudbury, MA: Jones and Bartlett Publishers.

Lewis, R. (1995). IBM computer usability satisfaction questionnaires: Psychometric evaluation and instructions for use. *International Journal of Human-Computer Interaction* 7(1), p.57-78.

Moore, M. & Kearsley, G. (2005). *Distance education*. Belmont, CA: Thomson Wadsworth.

Nelson, B. & Wayne A. (1999). If you build it, they will come. But how will they use it? *Journal of Research on Computing in Education*, 32(2), 270-287.

Nielsen, J. (2003). Usability 101. Retrieved January 25, 2004 from http://www.useit.com/alertbox/20030825.html.

Novitzki, J. (2000). Asynchronous learning tools: What is really needed, wanted and used? In A. Aggarwal, *Web-based learning and teaching technologies: opportunities and challenge* (pp. 60-79). Hershey, PA: Idea Group Publishing.

Oliver, R. & Herrington, J. (2003). Factors influencing quality online learning experiences. In (G. Davies & E. Stacey Eds.) *Quality education @ a distance*. London: Kluwer Academic Publishers.

O'Malley, J. (1999). Students perceptions of distance leraning, online learning and the traditional classroom. *Online Journal of Distance Learning Administration*, Winter 1999, 2(4).

Perlman, G. (2003). Web-based user interface evaluation with questionnaires. Retrieved December 11, 2003, from http://www.acm.org/~perlman/question.html.

Picciano, A. (2002). Beyond student perceptions: issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks JALN, 6(1)*, 21-40.

Picciano, A. (2001). *Distance learning. Making connections across virtual space and Time.* Upper Saddle River, NJ: Prentice-Hall, Inc.

Reeves, T., Benson, L., Elliott, D., Grant, M., Holshuh, D., im, B., Kim, H., Lauber, E. and Loh, S. (2002). Usability and instructional design heuristics for e-learning evaluation. *Proceedings of ED-MEDIA 2002 world conference oneEducation multimedia, hypermedia & telecommunications.* Denver, CO, June 24-29, 2002.

Rovai, A. (2002). A preliminary look at the structural differences of higher education classroom communities in traditional and ALN courses. *Journal of Asynchronous Learning Networks JALN, 6(1)*, 41-56.

Quigley, A. (2002). Usability-tested e-learning? Not until the market requires it. *eLearn Magazine*, April 8, 2002, Retrieved December 11, 2003 from http://elearnmag.org/subpage/sub_page.cfm?article_pk=3301&page_number_nb=1&title=FEATURE%20STORY.

Savery, J. & Duffy, T. (1995). Problem-based learning: An instructional model and its constructivist framework. *Educational Technology*, 35(5), 31-38.

Shih, C. & Gamon, J. (2001). Web-based learning: Relationships among student motivation, attitude, learning styles, and achievement. *Journal of Agricultural Education*, 42(4), 12-20.

Shneiderman, B. (2002). *Leonardo's laptop*. Cambridge, MA: The MIT Press.

Shneiderman, B. (1998). *Designing the user interface*, 3rd ed. Reading, MA: Addison Wesley Longman, Inc.

Sloan Consortium (2003). Sizing the opportunity: The quality and extent of online education in the United States, 2002 and 2003. Retrieved March 19, 2004 from http://www.aln.org/resources/overview.asp

Tognazzini, B. (2002). First principles of interaction design. Retrieved July 20, 2004 from http://www.asktog.com/basics/firstPrinciples.html.

University of Wisconsin (n.d.). Project ADEPT: Assessment of distance education pedagogy and technology. Retrieved March 19, 2004 from http://employees.csbsju.edu/tcreed/adept.

U.S. Department of Health and Human Services (2004). Usability. Retrieved March 19, 2004 from http://www.usability.gov.

Valenta, A., Therriault, D., Dieter, M. & Mrtek R. (2001). Identifying student attitudes and learning styles in distance education. *Journal of Asynchronous Learning Networks JALN, 5(2)*, 111-127.

Comment [BS10]: font

Zazalenchuk, T. & Boling, E. (2003). Considering user satisfaction in designing web-based portals. *Educause Quarterly*, 1, 35-40.

Zemsky, R. & Massy, W. (2005). Why the e-learning boom went bust. *The Chronicle of Higher Education.* Retrieved October 5, 2004 from http://chronicle.com/temp/email.php?id=4p1giqdzwsppdpcisey9djhf3qbzmznl.

CURRICULUM VITA

Gabriele H. Meiselwitz

716 Teal Court
Havre de Grace, MD 21078

Education

Ed. D., Instructional Technology, Towson University
Towson University**,** M. S., Computer Science, December 1997
Technical College of Hamburg, Germany, B. S., May 1982

Certifications

Microsoft Certified Systems Engineer (MCSE)
Microsoft Certified Professional + Internet

Employment History

1999 - Present **Towson University** **Baltimore, MD**
Visiting Assistant Professor, Department of Computer and Information Sciences

1999 – Present **CAIT, Towson University** **Baltimore, MD**
Training / Consulting for Center for Applied Information Technology

1998 - 1999 **United Parcel Service** **Baltimore, MD**
Network Engineer

1990 – 1998 **Towson University** **Baltimore, MD**
Network Administrator / Technical Support Analyst

1986 – 1990 **NCR Corp.** **Augsburg, Germany**
International Technical Support Analyst – Level III

1982 – 1986 **EDV Electronic** **Munich, Germany**
PC Support Analyst

Publications

Meiselwitz, G. & Lu, C., "Development of a Questionnaire for Integration of Usability Factors into Evaluation of Learning Outcomes in Online or Hybrid Learning Environments". *Submitted to 4th European Conference on e-learning*, 2005

Meiselwitz, G. & Lazar, J., "Investigating the Impact of Usability in Hybrid Virtual and Physical Learning Environments". *11th International Conference on Human - Computer Interaction (HCII), Las Vegas), NV*, 2005

Meiselwitz, G. & Sadera, W. "Usability Considerations in Online Course Design and Development". Presented at *Maryland Distance Learning Association Spring Conference, Adelphi, MD*, 2005

Meiselwitz, G. & Lazar, J., "Development of Usability Heuristics for Content Creation in Course Management Systems." *International Journal of Knowledge, Culture and Change Management in Organizations,* 2004.

Lazar, J., Meiselwitz, G., & Norcio, A., "A Taxonomy of Novice User Perception of Error on the Web." *Journal of Universal Access in the Information Society*, 2003, online at http://www.springerlink.de

Meiselwitz, G. & Lu, C., "On-Line Education for Students with Disabilities." *Association for Educational Communications and Technology Annual Conference, Anaheim (AECT), CA*, 2003

Meiselwitz, G. & Lu, C., "Accessibility of On-Line Degrees & Their Related Security Issues." *Proceedings of International Conference on Computer Science and its Applications (ICCSA), San Diego, CA*, 2003, p. 109-113.

Sarhangi, R., Meiselwitz, G., & Trajkovski, G., "Diversifying the Curriculum: The Tessellations Case." *6th Annual BRIDGES Conference – Mathematical Connections in Art, Music and Science, Granada, Spain*, 2003

Meiselwitz, G., Lazar, J., Clements, J. & Jones, A., "Evaluating the Accessibility of Course Management Systems." *10th International Conference on Human - Computer Interaction (HCII), Crete, Greece*, 2003

Lu, C., Lidtke, D., Dierbach, C., & Meiselwitz, G., "Recent Experience with the Computer Science Accreditation Process in the USA." *Proceedings of 7th World Conference on Computers in Education*, 2002: 523-532

Meiselwitz, G., "Using the Web to Maintain the Benefits of Small Class Instruction in Large Classes." *The Journal of Computing in Small Colleges*, 2001: 135-142

Lidtke, D., Meiselwitz, G., & Schroeder-Thomas, C., "Panel: Information Systems Accreditation." *The Journal of Computing in Small Colleges*, 2001: 34-38

Publications / Other

Meiselwitz, G., PowerPoint Presentation Slides for: Hofstetter, F., *Multimedia Literacy*, 3rd ed. McGraw-Hill, 2001

Associate Editor of the International Journal of Knowledge, Culture and Change Management, Volume 4, 2005