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THE RELATIONSHIP BETWEEN STUDENT CHARACTERISTICS, INCLUDING LEARNING STYLES, AND THEIR PERCEPTIONS AND SATISFACTION IN WEB-BASED COURSES IN HIGHER EDUCATION

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ABSTRACT

Distance education and web-based courses are mainstream in the United States higher education and growing (NCES, 2003) involving over 80% of four year public universities in 2002. The National Academy of Science review of "how people learn" suggests that technology-mediated learning can be used to respond to students' preferences and related characteristics.

This investigation of the relationships between learners' characteristics and their perception of web-based learning and satisfaction with their course used Kolb's (1984) Learning Styles Inventory and Walker's (2003) distance education learning environment instrument plus demographic questions to survey 279 students in five web-based undergraduate courses in a Midwestern university. The study founds that the three dimensions of Moore's Transactional Distance Theory may be linked with Kolb's two dimensional views of individual learning styles. For example, introductory biology courses with high structure are perceived as more satisfactory by students who prefer a more "abstract conceptual" learning style for "knowledge grasping."

The author recommends that courses are designed to accommodate multiple learning styles with variety on all dimensions of transactional distance.

Keywords: **Distance learning, learning styles, transactional distance.**

INTRODUCTION

The growth of distance education courses via the Web prompted educational research focusing on learners' characteristics and learning differences during the past twenty years (Hills, 2003; Khan, 2005). Approaches to learning emphasized the importance of taking learners into consideration when designing instruction. Learners' characteristics have always been an important concern for educators, designers, and researchers (Chute, Thompson, & Hancock, 1999; Dick & Cary, 1990; Khan, 2005; Laurillard, 2001; Mason, 1994; Moore & Kearsly, 2005; Smith & Ragan, 1999; Schwitzer, Ancis, & Brown, 2001). Some of the learners' characteristics the literature points out are gender, age, prior experience, cognitive styles, preferred learning styles, interest, and GPA. Knowledge of learners' characteristics is important when deciding on the type of media by which the content will be delivered and the structure of distance courses by which diverse students will be accommodated (Khan, 2005; Laulliard, 2001).

One important learners' characteristic is learning style preference—defined as an individual's preferred method of learning. According to Simonson, Albright, and Zvacek (2000), learning style could be one indicator of a successful distance learning experience. There have been various instruments developed to identify learning style differences. One is the Learning Style Inventory (LSI) developed by Kolb (1976, revised in 1984 and 1999).

The LSI has appealed extensively to researchers and educators because of its strong theoretical base in experiential learning theory (ELT) (Kolb, 1976), which originated in the works of Piaget, Dewey, and Lewin (Kolb, 1976). According to ELT, learning occurs when students participate in some activity, reflect upon the observations, use their conceptualization skills form their understandings from the experience, and then use their understandings to create new activities or incorporate them into new situations. Knowledge results from the combination of grasping and transforming experience. The theory draws two dialectically related modes of grasping experience—"Concrete Experience (CE)" and "Abstract Conceptualization (AC)"—and two dialectically related modes of transforming experience: "Reflective Observation (RO)" and "Active Experimentation (AE)".

Evaluation is a critical part of developing distance learning courses to assure quality, a very important component to the acceptance of distance learning. Instruments (e.g., standards, rubrics, and survey instruments) are used to evaluate the quality and the effectiveness of distance education (e.g., Carnevale, 2000; Freeth, 2004; Henke, 1997; National Education Association (NEA), 2000; Walker, 2003).

Survey questionnaires have been used extensively for research in distance education (Romiszowski, 2004). One of the reasons may be its convenience to access a larger population (Ary, Jacobs, & Razavieh, 2002). In this study, survey research is conducted to gather and analyze data.

One important element of evaluating distance learning has been students' perceptions and satisfaction (Lee & Driscoll, 2004). According to Khan (2005), institutions must evaluate the educational effectiveness of their distance education programs, including assessments of student learning outcomes, student retention, and student satisfaction, to ensure compatibility with campus-based programs. Several factors may influence students' satisfaction with distance learning.

Mason and Weller (2000) pointed out that students' satisfaction was affected most by instructor support, the amount of time devoted to study, and the extent to which the course content and presentation fit students' expectations and learning styles. Peer-to-peer interactions and social presence also were addressed as important elements in learning and satisfaction (Garrison, 2000).

The purpose of this study was to investigate the relationships between learners' characteristics and learners' perceptions and satisfaction with distance learning in Web-based courses at a Midwestern state university. Learners' characteristics included gender, age, academic major, learning style preferences, enrollment status, number of Web-based courses taken previously, science perception, and hours per week worked. Students' perceptions of distance learning in Web-based courses were measured by the Distance Education Learning Environment Survey (DELES) developed by Walker (2003). Students' learning styles were measured by the Learning Style Inventory (LSI) developed by Kolb (1976, 1984, and 1999).

METHODOLOGY

Research Questions

- **What is the relationship between students' demographic characteristics and their learning style preferences in Web based courses?**
- **What is the relationship between students' demographic and situational characteristics and their perceptions of distance learning and satisfaction with Web based courses?**
- **What is the relationship between students' learning style preferences and their perceptions of distance learning and satisfaction with Web based courses?**

Theoretical Frameworks

Moore's Transactional Distance Theory (Moore, 1993) was the distance education theory selected for this study. Moore (1989) distinguished between three sorts of transaction (or interaction): learner-content, learner-instructor, and learner-learner. Transactional Distance Theory of distance education explains that distance is mostly a pedagogical phenomenon with factors related to structure, dialog and learner autonomy.

A Web-based course is a specific type of distance education in which the instructor and students communicate mainly through web-based media including interactive tools such as simulations, email and discussion groups.

Unlike many other forms of distance education the students may be on campus with the instructor but choose to remain distant from their instructor for a range of reasons. The design of courses and the approach of the instructor vary and may be classified on the three dimensions of Moore's Transactional Distance Theory from high to low:

- **Course Structure: rigid to flexible design of course content and activities**
- **Dialogue among participants and content: factual to reflective**
- **Learner autonomy: independent learning to social approach dependent on peers and/or the instructor**

These three dimensions are also related (Figure 1), such that rigidly structure is most often found associated with low dialog and high individual learner control. Also flexibly structure is associated with high dialog and high social learner control. To gain a better understanding of the influence of student learning styles on Web-based learning, this study adopted the extensively researched Learning Styles Inventory (LSI) developed by Kolb (1976, revised in 1984 and 1999).

The LSI has appealed to researchers and educators because of its strong theoretical base in experiential learning theory (Kolb, 1976), which originated in the works of Piaget, Dewey, and Lewin (Kolb, 1976). According to experiential learning theory, learning occurs when students participate in some activity, reflect upon the observations, use their conceptualization skills to form their understandings from the experience, and then use their understandings to create new activities or incorporate them into new situations.

Knowledge results from the combination of grasping and transforming experience. The theory draws two dialectically related modes of grasping experience: Concrete Experience and Abstract Conceptualization and two dialectically related modes of transforming experience: Reflective Observation and Active Experimentation.

Taking these two theories together, It was predicted that when "knowledge grasping" more students with a preference for AC would perceive a rigidly structured course that permitted high individual leaner control with factual dialog between the student and the content to be satisfactory than students with the contrasting preference for CE.
It was also predicted that when "transforming experience" students who preferred RO would perceive such a course as more satisfactory than students who preferred AE.

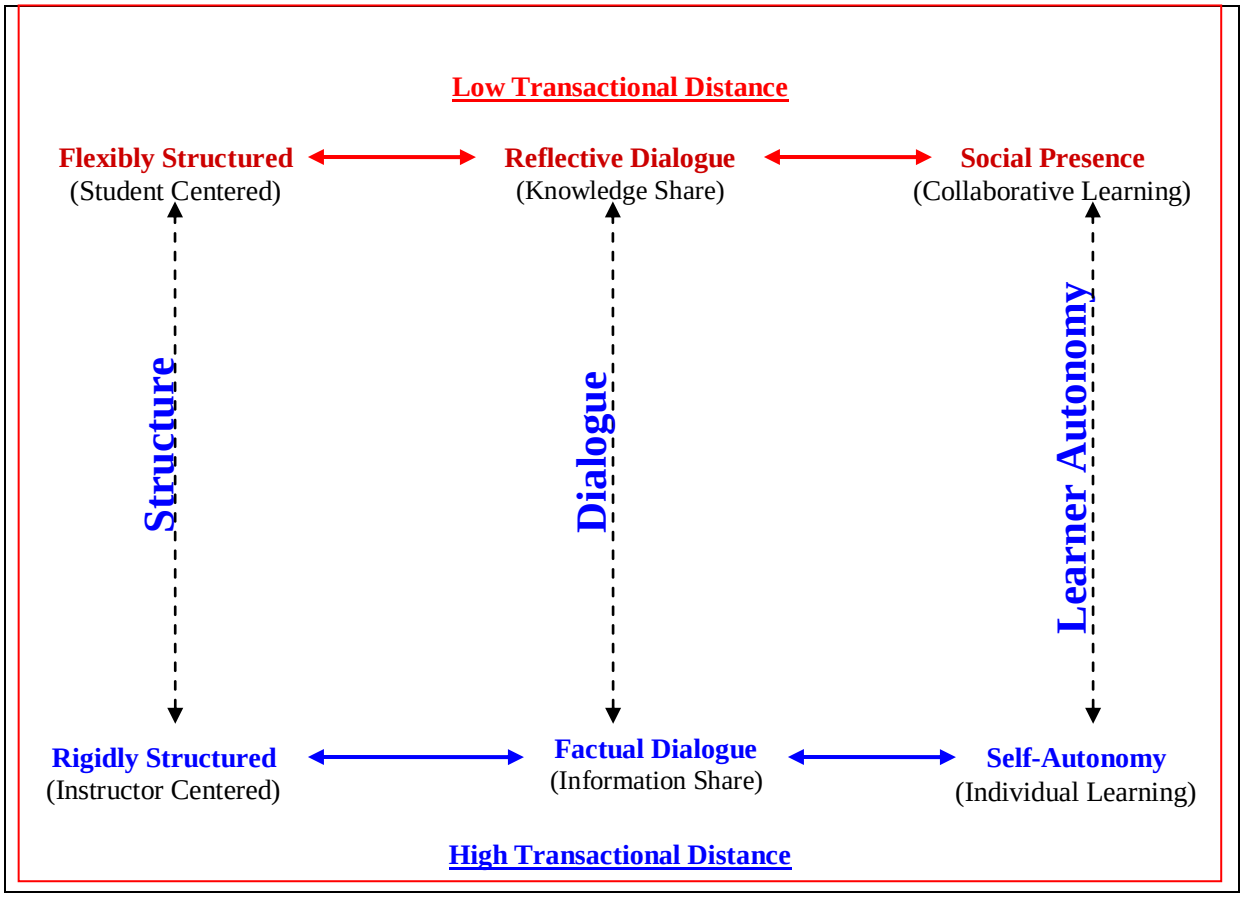

Figure: 1
The author's perspective on Moore's Theory of Transactional Distance

Context

Participant courses are identified by structure, interaction, feedback, relevance, authentic learning, and student autonomy. The summary indicated that the participating courses were similar in many ways of their design. However, Course E and Course D included collaborative activities and reflective activities, while the other courses did not. Course E also included a real life activity. Different than others, Course A and Course B included self assessment tools.

The summary table indicates that all participating courses included individual learning activities. However, none of the courses included experimenting either in lab or by computer simulations. All courses provided a variety of interaction opportunities (e.g., course activities, assignments) and methods for interaction (e.g., email, discussion board, chat).

Participating courses provided students with instructor feedback on course activities and assignments. However, the courses did not use a variety of feedback instruments and methodologies such as peer evaluation, self assessment, and alternative forms such as reflective journals. Course A and Course B provided students with self tests. All courses created relevant course content by using meaningful examples, relevant illustrations and cases, and personal experiences. All participating courses provided their students with authentic learning experiences by using real life cases and examples. However, none of them used computer simulations based on real life situations. Course E was the only course that included a real life activity situated in a real life context. All courses provided their students with a flexible schedule and convenient access to the content so that students controlled their learning.

Table: 1
Summary of respondents' courses design (+ indicates presence; – indicates lack)

Structure	Course A	Course B	Course C	Course D	Course E
Individual activities	+	+	+	+	+
Collaborative activities	–	–	–	+	+
Reflective activities	–	–	–	+	+
Experimenting	–	–	–	–	–
Interaction					
Variety of interaction ways	+	+	+	+	+
Variety of interaction opportunities	+	+	+	+	+
Feedback					
Feedback on activities	+	+	+	+	+
Feed back on assignments	+	+	+	+	+
Self assessment	+	+	–	–	–
Peer-evaluation	–	–	–	–	–
Alternative forms	–	–	–	–	–
Relevance					
Meaningful examples	+	+	+	+	+
Relevant illustrations	+	+	+	+	+
Relevant cases	+	+	+	+	+
Sharing personal experience	+	+	+	+	+
Authentic learning					
Real life cases	+	+	+	+	+
Real life examples	+	+	+	+	+
Simulation exercises	–	–	–	–	-
Real life activities	–	–	–	–	+
Learner Autonomy					
Flexible schedule	+	+	+	+	+
Convenient access	+	+	+	+	+

Research Instruments

The LSI is a 12-item self-assessment instrument intended to evaluate individual's preferences for a specific learning style. Respondents are asked to rank order statements, assessing how well he or she thinks each one fits with how (he/she) would go about learning something in different learning situations.

The Distance Education Learning Environment Survey (DELES) is an online survey instrument developed and validated by Walker (2003). The DELES is used to measure distance education learning environment characteristics, including student interaction, active learning, student autonomy, instructor support, personal relevance, authentic learning, and student satisfaction. The DELES questionnaire contains 32 statements about practices that take place in a Web-based class. These items are presented in seven sections: instructor support, student interaction, authentic learning, active learning, personal relevance, student autonomy, and student satisfaction. Respondents are asked their opinion on each item using a 5-point Likert-type set of ordered alternatives (never, seldom, sometimes, often, always). Following the 32 statements about practices during Web-based classes, eight statements are included about respondents' overall satisfaction about distance learning. Respondents are asked their opinions on each item by using a 5-point Likert-type set of ordered alternatives (strongly disagree, disagree, neither disagree nor agree, agree, strongly agree).

In addition to the two established survey instruments, a demographic section was included to determine demographic characteristics of the respondents. An additional open-ended question was also included to obtain respondents' thoughts and feelings on distance learning, and the Web-based courses they were taking.

Research Procedures

A cover letter was sent to all instructors who taught Web-based courses at a Midwestern state university during the middle of the spring 2005 semester. The e-mail asked for them to volunteer to participate in a study of their Web-based courses. This letter continued with a brief statement regarding the purpose and procedure of the research, the benefits, and the confidentiality concern. The letter also included an expression of the support of the researcher's major professor and the director of Continuing Education and Communication Services of the university. Three days later, a reminder e-mail was sent to the instructors. Four instructors volunteered six classes for the study. However, one course was excluded from the study, since it had a limited number of students, which resulted in confidentiality concerns.

Toward the end of the semester, instructors for these five courses made a posting on the course discussion board with a brief explanation of the survey and their support. This posting included a link to the survey. They also created a link to the survey on the course homepage. The instructors also allowed the researcher access to their courses to collect data regarding the approach to Web-based learning. Instructors provided students with a week to participate in the study. After two weeks, 279 students responded to the survey. The data were transferred to an Excel spreadsheet and then converted to an SPSS file. Next, all data were kept in an electronic folder on the researcher's personal computer. A backup folder also was also created on the university's server.

Following the survey data collection and statistical analysis, a follow-up e-mail was sent to the respondents who volunteered to provide their additional thoughts about the results of the survey. Eight respondents answered this follow up e-mail, with two additional respondents as a result of a reminder e-mail.

Data Analysis

Since this study included various learner characteristics comprised of various levels, multivariate statistics were used to analyze the data. Multivariate statistics provide analysis when there are many independent variables and/or many dependent variables, all correlated with one another to varying degrees (Tabachnick & Fidell, 1996).

A factor analysis was used to create reliable components from the data obtained by the DELES questionnaire. Factor analysis is "a process by which the number of variables is reduced by determining which variables clusters together (Mertler & Vannata, 2002, p. 249)". Cronbach's alpha technique was used to measure the reliability of the instruments. Cronbach's alpha is a measurement of how well a set of items (or variables) measures a single construct (Ary et al., 2002). A linear regression model was executed to identify the predictive ability of distance learning perception scales on distance learning satisfaction. A simple linear regression creates a linear equation to predict the value of the dependent variable, based on the value of the predictor variable (Mertler & Vannata, 2002). A factorial ANCOVA was used to identify the effects of students' demographic characteristics on distance learning perceptions and satisfaction. ANCOVA involves a statistical adjustment procedure when there are extraneous variables influencing dependent variables beside the independent variable (Tabachnick & Fidell, 1996). Therefore, "the use of analysis of covariance provides researchers with a technique that allows us to more appropriately analyze data collected in social science settings" (Mertler & Vannata, 2002, p. 93). A canonical correlation was calculated to measure the relationship between learning style preferences and students' perceptions of and satisfaction with distance learning. Frequency tables also were used to analyze participant comments to the open-ended question.

FINDINGS and DISCUSSION

The relationship between students' demographic characteristics and their learning style preferences in Web based courses

First, the relationship between students' demographic characteristics and their learning style preferences was investigated. The results indicated that male students preferred AC more than female students and older students (over 21) preferred AC more than younger students (18-21). These results are consistent with the results of Kolb (2005). However, Willcoxson and Prosser (1996) pointed these results need to be interpreted carefully, since educational specialization and career choices often interact with gender differences, making it difficult to sort out how much variance in LSI scores can be attributed to gender alone and how much is a function of one's educational background and career. Furthermore, MeBmer and Schmitz's (2004) findings, concerning the relationship between learning styles and gender, present no definite results.

A three-way factorial ANOVA model was calculated by gender, age, and academic major. These results showed that gender and age were not statistically significant in terms of their learning style preferences, when academic major was controlled. Therefore, this study further analyzed the relationship between students' college of academic major and their learning style preferences. As a result of post hoc comparisons, students from Agriculture, Business, Engineering, Liberal Arts and Sciences, and Veterinary Medicine preferred AC more than CE, while students from Education preferred CE over AC. These results are consistent with the results from Kolb (2005) for Business and Engineering. However, it is contradictory for the other colleges.

For knowledge transfer, students from Agriculture, Business, Design, Education, Engineering, Family and Consumer Sciences, and Veterinary Medicine preferred AE more than RO. The contradiction might be result of differences among institutions in terms of the structure of colleges. Therefore, a further analysis using academic disciplines rather than colleges may be useful to appropriately address these results with the results of Kolb.

A further analysis was used to understand the predictive ability of demographic variables to decide on how the results of previous analysis were significant. Therefore, a regression model was calculated to determine which demographic characteristics (gender, age, and academic major) were best predictors of learning style. The results indicated that academic major was a significant predictor of learning style. A student from Liberal Arts and Sciences reduced the probability of being a converger and accommodator versus being an assimilator, while a student from Family and Consumer Sciences increased the probability of being a diverger versus being an assimilator.

Figure: 2 show those students' distributions in assimilator learning style much more than in converger and accommodator for Liberal Arts and Sciences. On the other hand, again Figure: 2 shows that students' distribution in the assimilator learning style is much less than in diverger and accommodator for Family and Consumer Sciences.

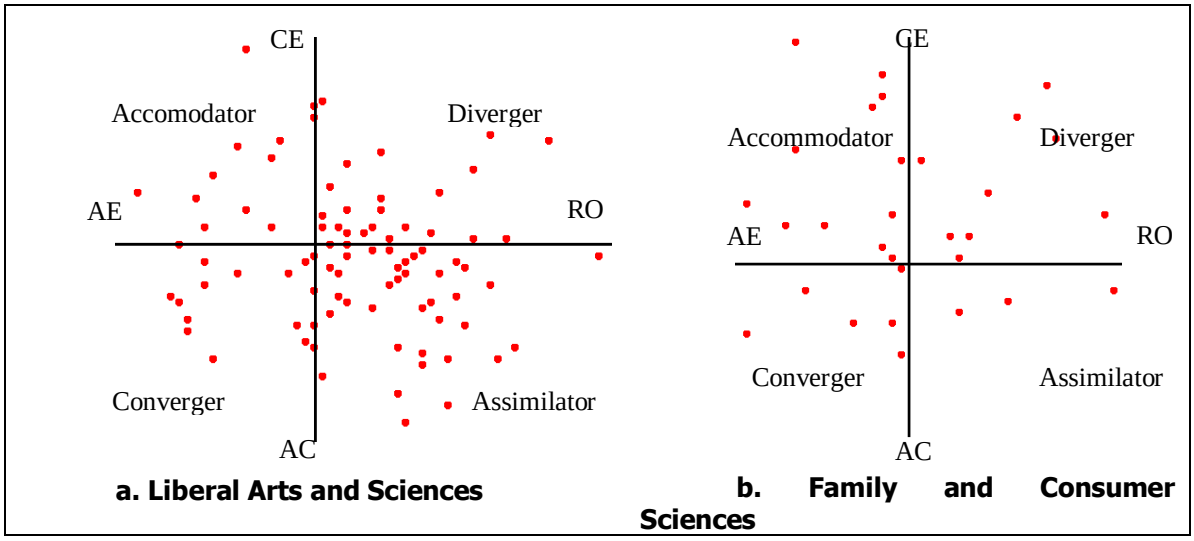

Figure: 2
Learning style distributions of students from
a. Liberal Arts and Sciences (N=90)
b. Family and Consumer science (N=30)

Consequently, the results indicate that although there were mean differences among genders and ages, these differences were not significant when academic major was taken into account. Students of Liberal Arts and Sciences tend to be assimilating, where AC and RO were preferred.

This result is consistent with Kolb (2005), who asserts that assimilators are likely to have education in science and information. The relationship between students' demographic and situational characteristics and their perceptions of distance learning and satisfaction with Web based courses

Gender

This section presents a discussion on gender differences, based on distance learning perceptions and satisfaction. Perception includes instructor interaction, instructor feedback, student interaction and collaboration, personal relevance, authentic learning active learning, and student autonomy.

Female students were significantly less positive about instructor feedback than males. However, there was a contradictory finding in relation to gender. Where female students were most frequent instructor feedback was expected to be perceived least. However, Courses D and E had the most frequent female participation, although instructor feedback in these courses perceived best. This contradiction indicates two possible explanations. One is that differences between courses based on instructor feedback were so large that differences between genders were lost. The second explanation is that female only groups are more satisfactory for female students. Savicki et al. *(*1996) investigated group gender composition and the relationship between gender roles and group process functions on online environments and found that women in female only groups were more satisfied with the group process and had more advanced levels of group development than did either male only or evenly mixed groups. Sussman and Tyson (2003) investigated communication patterns of females and males in a discussion group and found that females communicate more frequently than males. Anderson (1997) also found that female students have more preference for face-to-face communication. This discussion suggests that further research findings are needed to understand gender differences.

The difference with gender is likely to be specific to the United States population. Gender differences may differ among cultures. For example, in Turkey, according to numbers from UNICEF, gender differences in literacy (80.6% for women as opposed to 93.9% for men according to the 2000 census) and current school enrollment rates (91.8% for girls and 100% for boys at the primary level) show inequality in access to education. This should have implications in distance learning also. "Girls especially are under meticulous surveillance by teachers who frequently add further limitations on loudness of speech, manners, etc. Consequently, girls tend to refrain from asking questions or contributing to discussions and decisions in order to minimize the risk of attracting attention" (UNICEF, 2003).

Based on the description of the Transactional Distance Theory and instructional design principles of Web-based courses by Williams (2003), course instructors can use a variety of feedback methodologies and opportunities for their students such as self tests, peer evaluations, and, if possible, blended approaches for face-to-face interactions and feedback to support their students. All these actions will be supportive for female students as well as male students.

Age

This section presents a discussion on age differences, based on distance learning perceptions and satisfaction. Perceptions include instructor interactions, instructor feedback, student interactions and collaborations, personal relevance, authentic learning active learning, and student autonomy.

This study found that older students (over 21) were significantly more positive with instructor feedback and personal relevance than were younger students (18-21). This result agrees with Frederickson, Pelz, and Swan (2000), who found age significant in Web-based learning. Their results indicated that the youngest students (16-26)

perceived the least learning and satisfaction, while the oldest students (36-45) perceived the most learning and satisfaction.

Consequently, course instructors may want to consider age characteristics of their students and accommodate learning preferences. Weiten (1989) asserts that during adolescence (12-20) thought becomes more abstract and reflective, and deductive reasoning improves. During young adulthood (20-40) greater emphasis goes on an application, rather than acquisition of knowledge and a trend toward dialectical thought. Therefore, application exercises that allow more abstraction and reflection can be helpful for older students, while exercises that allow more practice and interaction can be helpful for younger learners.

College of Academic Major

This section presents a discussion on academic discipline differences, based on distance learning perceptions and satisfaction. Perceptions include instructor interactions, instructor feedback, student interactions and collaborations, personal relevance, authentic learning active learning, and student autonomy.

Family and Consumer Sciences' students were significantly more positive with student interactions and collaborations, and instructor feedback than were Liberal Arts and Sciences' students. However, students majoring in Family and Consumer Sciences were only participating in Course E, which had a very small student population. Therefore, the differences between majors were overshadowed by the differences between the courses. Also, the small class size of Course E allowed students and instructors to communicate more frequently.

Situational Characteristics

This section presents a discussion on situational characteristics, based on distance learning perceptions and satisfaction. Situational characteristics varied in the literature. In this study, situational characteristics consist of study hours per week, and students' perceptions of the difficulty of studying science. Distance learning perceptions include instructor interactions, instructor feedback, student interactions and collaborations, personal relevance, authentic learning active learning, and student autonomy.

This study found that study hours per week and students' science perceptions were significant situational characteristics in Web-based learning. As students' study hours per week and science perceptions increase, their perceptions of instructor interactions, student interactions and collaborations, personal relevance, authentic learning, active learning, and student autonomy increase. Previous research studies found that previous Web-based learning experiences and prior knowledge were significant in Web-based learning (Alomyan & Au, 2004; Koogan & Durante, 2003; Oh & Lim, 2005; Hart, 1995). Mason and Weller (2000) also pointed out factors which most affect students' satisfaction—instructor support, the amount of time devoted to study, the extent to which the course content and presentation fit students' expectations, and learning styles.

This research suggests that instructors will improve students' time spent for their courses by including collaborative real life activities. For example, Course E included a collaborative real life activity during the course term and students of this course reported significantly more study hours than other courses.

Lynch (2002) reported that an online education graduate program at Florida University requires that most homework assignments be applied in the real world. "In the doctoral research class, instead of working statistical problems with case studies or common book examples, students are required to actually administer a survey in their work environment, gather and analyze the data, and write reports as their culminating assignment" (p. 126). If a real life application is not possible, courses may include collaborative simulation experiments.

Because students' perceptions of the content area, namely science, was significantly related to their perception of distance learning in the Web-based course, instructors may wish to create extra course resources and instructional tools for students who perceive the subject is more difficult. Interactive graphs and models, spreadsheets, and simulations can be used to help students interact with the content in a more motivating way.

The Relationship between Students' Learning Style Preferences and Their Perceptions and Satisfaction of Distance Learning

This section presents a discussion on Kolb's learning style preferences in relation to distance learning perception and satisfaction. Distance learning perceptions include instructor interactions, instructor feedback, student interactions and collaborations, personal relevance, authentic learning active learning, and student autonomy.

This study found that students' preference of AC positively correlated with the perceptions of authentic learning and active learning. CE preference negatively correlated with active learning. Why did AC learners perceive the Web-based courses more authentic than the other learners? According to Experiential Learning Theory (Kolb, 1976), AC learners tend to be oriented more towards things and symbols, and less towards other people. They learn best in impersonal learning situations and use abstract analysis (Kolb, 1976). Since the participating courses included individual learning activities more than collaborative activities, this design might appear more authentic for AC learners. On the other hand, according to Kolb (1976), CE learners tend to be empathetic and people-oriented.

They generally find theoretical approaches to be unhelpful and prefer to treat each situation as a unique case. They learn best from specific examples in which they can become involved. Only Course E included real world activities for students to become involved. Therefore, the other courses may experience a lack of authenticity for CE learners. Also, individuals who prefer CE tend to be oriented more towards peers and less towards authority in their approach to learning. These individuals benefit most from feedback and discussion with peers. Therefore, these learners might benefit from more collaborative activities and feedback from the instructor and peers in order to perceive Web-based courses as authentic.

This study contradicts the study by Sabry and Baldwin (2003). They found no relationship between learning styles and students' perceptions in Web-based courses. Federico (2000) investigated learner characteristics and found that assimilating and accommodating learning styles were more positive toward Web-based learning. His findings are also puzzling and his research does not unravel why the finding that both assimilating and accommodating (on opposite sides of the learning cycle) were both positive.

As a result of this study, Web-based courses appear more appropriate for AC learners in terms of the perception of authentic and active learning. However, if Web-based courses include more collaborative and real life activities, they can better accommodate

learners with the preference of CE and AE. Collaborative computer simulations can be supportive for these types of students.

RECOMMENDATIONS FOR DESIGNERS

For the relationships between demographic characteristics and learning styles, it is concluded that although there are differences among genders and ages, these differences are not significant when academic major is taken into account. Academic major is a significant student characteristic that influences learning style preference. However, what academic major relates to what learning styles is not definite, since the findings of this study are partially consistent with the findings of Kolb (2005). Therefore further research studies are needed to understand the effect of academic major on the preference of learning style. Random sampling in a broader context would be suitable for this purpose, since it allows the results to be free from unwanted confounding variables.

For the relationship between learning style preferences and perceptions of distance learning and satisfaction, Web-based courses seem more appropriate to AC learners in terms of the perception of authentic learning and active learning, and less appropriate for CE learners. Therefore, distance courses can include more collaborative and real world activities for CE learners. Interactive learning materials such as simulations would also be useful for CE learners in distance education (Kolb, 1999). However, if Web-based courses include more collaborative and real world activities, they might better accommodate those who prefer CE. Computer simulations can also be supportive for students who prefer CE and AE.

For students' comments and follow-up emails, a balance between instructor direction and student autonomy appears important for satisfactory learning experiences on the Web. An adjustable design of course content and structure would be appropriate to satisfy students from different characteristics. Student interactions and collaborations with classmates are also important for a better performance and satisfaction, as well as interacting with the instructor and receiving feedback. On-campus testing, workload, and unclear exams or assignments might cause students' dissatisfaction. Therefore, Web-based course instructors can increase interaction by including collaborative activities and use alternative assessment methodologies (e.g., peer evaluation, self tests, reflective journals, and portfolio).

Finally, it is recommended that course activities be designed to address a range of learning styles with instructional activities. For example, a course can include a collaborative activity that suits CE preference, but include individual assignments in the activity to accommodate AC learners; or include experiments that suit AE preference, but include reflective assignments in the experiment to accommodate RO learners.

RECOMMENDATION FOR RESEARCHERS

This study used a convenience sampling to collect data that resulted in under representation of sub populations. Therefore, it is recommended that further research replicate this study by random sampling. Alternatively, a more limited study may avoid confounding variables by selecting similar courses such as using only large introductory biology courses.

This study uncovered the relationship between learner characteristics and learner perception of distance learning. However, a deep understanding of the phenomena was

limited to learner comments. It is recommended that further research replicate this study with a single course by using both quantitative and qualitative methods to have a comprehensive understanding of the results.

The results showed that learner characteristics investigated in this study showed a low predictive ability on students' perceptions and satisfaction. Therefore, it is recommended that further research include other student characteristics that might relate students' satisfaction such as prior knowledge and motivation.

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