

**SYNCHRONOUS TEXT-BASED CHAT VIS-À-VIS ASYNCHRONOUS
THREADED DISCUSSION:
AN INSTRUCTIONAL STRATEGY FOR PROVIDING AN OPTION IN TWO
COURSE DELIVERY SCHEMES**

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ABSTRACT

SYNCHRONOUS TEXT-BASED CHAT VIS-À-VIS ASYNCHRONOUS THREADED DISCUSSION: AN INSTRUCTIONAL STRATEGY FOR PROVIDING AN OPTION IN TWO COURSE DELIVERY SCHEMES

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The purpose of this study was to investigate whether an instructional strategy of providing students an option of two types of online text-based discussion (chat vs. threaded discussion forum) had significant effects on student satisfaction, cognitive achievement, and self-efficacy. In an effort to identify any differential effects associated with student characteristics, students' age and learning preferences were used as blocking variables. The study sample was teacher education students. Statistical procedures employed were MANOVA, MANCOVA, regression analysis, chi-square, and correlation were employed. The findings show that such an instructional customization—providing the online discussion forum option—has positive impacts on student satisfaction and self-efficacy. In addition, self-efficacy was found to be related to cognitive achievement and satisfaction.

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Chapter 1: Introduction to the Study

Introduction

State-of-the-art technological innovation has enriched the toolbox for instructional design, making possible transformation of traditional reactive learners into proactive learners. In most cases, modern technologies are used to bridge the gap among a diversity of learner characteristics, the teaching per se, and existing infrastructure provided by colleges and universities. Instructional design can be strictly defined as “the systematic process of translating principles of learning and instruction into plans for instructional materials and activities” (P. Smith & Ragan, 1993, p. 2). Instructional design is a complex process that invites creativity, iteration, and activeness (Gustafson & Branch, 2002). Contemporary instructional design seeks to utilize technology to increase the effectiveness, efficiency, and/or cost of instruction. This study was designed to help inform the field by looking at different implementations of a particular instructional event—online discussion—and the resultant effects on student satisfaction, cognitive achievement, and self-efficacy.

Teacher as Instructional Designer

P. Smith and Ragan (1993) indicated that an instructional designer is like an engineer who follows principles that have been established via ample successful or even unsuccessful cases. The instructional designer should be capable of making design choices resulting in instruction that is appealing to and effective for the target audiences. The same is true in higher education: A professor’s task is to diagnose an existing learning situation and make decisions to cause active learning. “The instructor is the manager or, more appropriately, the facilitator of the instructional system, and the

classroom is a dynamic and complex mix of variables” (Sims & Sims, 1995, p. 13).

Fisher (2000) further acknowledged, “To create the teacher’s role as an instructional technology facilitator, the teacher must first understand the capabilities and possibilities of technology” (p. 98). Donohue and Wong (1997) conducted an empirical study on achievement motivation and college satisfaction among diverse students, including both traditional and nontraditional students. They postulated that, for nontraditional students, a cooperative orientation is more conducive to success in college than a competitive orientation. With such observed phenomena and needs, educational practitioners and researchers have long sought to provide instruction that can be optimally matched and applied to each learner’s needs.

Three terms related to instructional individualism have become common: (a) learning preference, (b) learning style, and (c) cognitive style. Using the metaphor of onions, Curry (1983) oriented learning style between cognitive style and learning preference, describing that the core—cognitive style—is the central personality dimension, passing outwards to the outermost layer—learning preference—which emphasizes introspection and tends to be context dependent rather than fixed. There are varying definitions of learning preference, such as Sandler-Smith’s (2001) operational definition that the construct of learning preference measures teaching and learning methods to which target audiences are exposed during instruction. In addition, Mayer and Massa (2003) used the term *learning preference* in their multimedia study in which college students learned verbal information and mathematics; learning context referred to the varied instructional contexts to which the student oriented themselves, or chose, in order to learn in a manner they preferred. Therefore, Mayer and Massa’s context

orientation can be equated with learning preference.

Models and instruments to determine and describe student differences have been developed over the years, such as the Gregorc Style Delineator (GSD) (Gregorc, 1982), the Kolb Learning Style Inventory (LSI) (Kolb, 1993), Witkin's Group Embedded Figures Test (GEFT) (Witkin, Otman, Raskin, & Kats, 1971), and the Myers-Briggs Type Indicator (MBTI) (Myers, McCaulley, Quenk, & Hammer, 1998). The GSD was "designed to aid an individual to recognize and identify the channels through which he/she receives and expresses information efficiently, economically, and effectively" (Gregorc, p. 1). The Kolb LSI, based on Kolb's Experiential Learning Model, posits two modes of grasping experience—Concrete Experience and Abstract Conceptualization—and two modes of transforming experience—Reflective Observation and Active Experimentation—resulting in four types of learners. The GSD and the Kolb LSI are intended to identify individual learning styles (Miller, in press), whereas Witkin's GEFT (Witkin, Moore, Goodenough, & Cox, 1977) uses a different model that generates a continuum-based learning profile of field-independence and field-dependence (see Appendix A). However, field-independence/dependence is not helpful for understanding experiences or knowledge attainment in distance education (Richardson, 1998). Therefore, because this study intends to measure instructional- and context-related preferences in both face-to-face instruction and in online mode, the MBTI is appropriate. In particular, the introversion–extroversion dimension will be used.

Ford and Chen (2001) conducted an empirical study on matched and mismatched learning and teaching styles and found significant differences in performance on conceptual knowledge among 73 postgraduate students between matched and

mismatched conditions. That finding is congruent with earlier findings indicating that matching instructional presentation strategies to students' learning preferences is associated with improving learning performance. The advent of asynchronous and synchronous Web-based course delivery modes in higher education enables this researcher to explore the possibility of a large-scale investigation of learning in a genuine context. In short, this study explores how an individualized instructional approach affects adult learners with heterogeneous life characteristics and cognitive preferences.

Background

With the advent of the computational technology era, "Technology has the potential to open the doors of the university to a wider audience, provide choices for non-traditional students, and extend services to populations that would otherwise not be able to attend the classes on campus" (Wright, Marsh, & Miller, 2000, p. 107). The diversity of adult learners has been increasing in higher education institutions, particularly in urban universities and colleges. More nontraditional students enroll in both nondegree and degree programs for the sake of career advancement and self-aspiration. Nontraditional students are defined in several ways: (a) They have multiple roles (e.g., parent, employee) in addition to being students (Chartrand, 1990); (b) they have at least 1 year between high school and college (Dill & Henley, 1998); and (c) the age break between nontraditional and traditional students ranges from 22 to 28 dependent on their majors and the urbanicity of their residency. Facing increasing heterogeneity and a growing student body, higher education is being challenged by student retention and academic accountability. Serving such a diverse student population in a wide variety of venues has become critical in higher education (Bates, 1997).

To reach and retain a larger and more diverse student population, the way a course is delivered has become critical. The two major course-delivery schemes are traditional face-to-face, which is exclusively synchronous, and online or Web-based, which could be both synchronous and asynchronous. Comparison studies on how students in distance and face-to-face instruction perform have been well documented (Diaz & Cartnal, 1999; Neuhauser, 2002). However, how students in traditional face-to-face instruction make use of the communication technology that was intended for those in online instruction still needs further study (Wilson & Weiser, 2001). Even without considering the delivery method, exploring the effects of peer and instructor interaction on student learning is worthy of research.

Asynchronous, online instruction has been a trend particularly in baccalaureate and master's degree programs. In asynchronous online environments, online interaction, communication, and immediacy (including instructor, student, and computer immediacy) long have been regarded as the important factors for successful asynchronous learning. Seemingly, the asynchronous online course provides great flexibility, but it is still questionable whether the asynchronous online course is more effective than or at least as effective as synchronous online courses in terms of academic success.

Another aspect of instruction is student satisfaction. Distance education offers flexibility in the face of time, distance, and economic barriers; therefore, adult students tend to choose to attend online courses because of physical obstacles rather than their learning preferences. In their examination of the satisfaction of graduate students in asynchronous and synchronous course instruction, Wright et al. (2000) purported that adult students encounter a variety of problems when attending traditional classes, such as

conflicts with employment and family obligations, unless the classes are offered in the evening or on weekends. In an interactive televised case, Anderson and Kent (2002) also observed that most students choose to take interactive televised courses because of travel and time considerations, not because of their learning preferences. Likewise, for those who choose to take online courses, unless instruction is offered in the evening or on weekends, adult students find it difficult to enroll and attend traditional classes because of conflicts with employment and family obligations (Wright et al.). In other words, even though traditional and equivalent online instruction is available to adult learners, most of them make choices based on convenience. “The adult distance learner may be affected by a variety of internal and external factors that account for the continuance/discontinuance in their studies” (Kemp, 2002, p. 65). Fortunately, computer technology helps higher education institutions reach more students, regardless of whether students are taking classes because of career obligations or voluntary self-improvement, or whether they are working part-time or full-time.

The studies cited above, however, do not lead to the conclusion that learning preferences do not have an important role. Among the recent studies reviewed, Diaz and Cartnal’s (1999) work revealed that individual learning preference influences one’s decision to take technology-based courses and further influences levels of achievement in the course. Therefore, many adult learners do not have a realistic course delivery-mode choice. Further, those learners who have recognized their learning preferences have little or no choice of instructional strategies available within the course option. This, however, is not a new idea; Cross (1981), in her *Characteristics of Adult Learning (CAL)* model, stated that adults should have as much choice as possible in the availability and

organization of learning programs. In addition, Knowles (1988), in his theory of andragogy, posited that adult learning programs are supposed to accommodate the fundamental aspect that adults are self-directed and expect to take responsibility for decisions of planning and evaluating their own learning.

Currently, it is not clear “which aspects or forms of computer and information technology have the greatest effects for what types of students for what outcome areas” (Kuh & Hu, 2001, p. 218). Other than time or distance flexibilities, many empirical studies have indicated that the type of delivery system does not make a significant difference in course effectiveness (see, for example, Clark, 1983; Lorenzetti, 2002; Neuhauser, 2002). What makes the difference is the pedagogy (Lorenzetti), not the media, which is a mere vehicle (Clark). Thus, this study attempts to examine whether providing a choice between two discourse modes—asynchronous threaded and synchronous chat—of text-based discussion forum has a differential effect on three important outcome domains: (a) student satisfaction, (b) cognitive achievement, and (c) student level of self-efficacy. To better illustrate the research intention, the diagram in Figure 1 presents the relationships among the factors that are examined in the study.

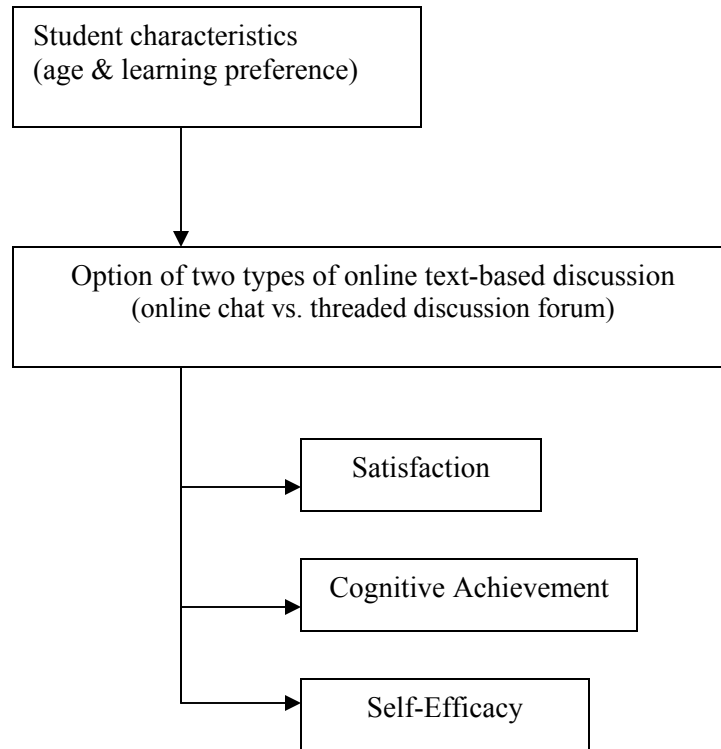


Figure 1. Relationships of the factors examined in this study.

Purpose and Research Questions

The purpose of this study was to investigate whether the instructional strategy of providing students the option of two types of online text-based discussion (chat vs. threaded discussion forum) had significant effects on student satisfaction, cognitive achievement, and self-efficacy. In an effort to identify any differential effects associated with student characteristics, students' age and learning preferences were used as blocking variables. The synchronous text-based chat allows real-time written message exchange among students or between an instructor and students, while the asynchronous threaded discussion develops discourse over time.

To guide the study, five major research questions were examined.

1. Does the chat versus threaded discussion option differentially impact student satisfaction as a function of students' age and learning preference?
2. Does the chat versus threaded discussion option differentially impact cognitive achievement as a function of students' age and learning preference?
3. Does the chat versus threaded discussion option differentially impact self-efficacy as a function of students' age and learning preference?
4. Is there an association between the students' age and learning preference?
5. Are there relationships among the three instructional outcomes: (a) student satisfaction, (b) cognitive achievement, and (c) self-efficacy?

Significance

A goal of contemporary education is to transform learners into self-directed, proactive learners. One way to initiate this transforming process is to grant learners control in their learning process. As Knowles (1988) postulated in his adult learning theory, self-directed learning facilitates the ability to take control of the techniques and the purpose of learning. In urban universities and colleges, adult learners typically choose between traditional face-to-face or equivalent asynchronous online instruction, rather than choose from a combination of the strategies that may be incorporated into both delivery formats. This study focuses on whether flexibility of learning activities during instruction can supply sufficient individualization to promote proactive, self-directed learning.

“Instructional design is instructional design, and when chosen properly, students should learn!” (Overbaugh, Lin, & Rikard, 2003, p. 2). There should not be a difference

in instructional design simply because of the medium (Clark, 1983). In their study of measuring learning effectiveness, Joy and Garcia (2000) concluded that studies comparing delivery media should at least account for the variables of learning preference, ability, and instructional methods in the research. Four primary categories—technology, instructor, course, and student characteristics—have been shown empirically to have strong impacts on student adoption of computer technology. In particular, student factors of learning preference, personal characteristics, and access to required technical resources are important (Wilson & Weiser, 2001).

Learning preference is an important factor that accounts for educational outcomes, particularly in distance education (Rovai & Grooms, 2004). In a correlation analysis utilizing an asynchronous online instruction group, Diaz and Cartnal (1999) found that students whose learning preferences were more independent tended to be less collaborative, whereas students whose learning preferences were more collaborative tended to be more dependent and participatory in their approach to learning. Based on the MBTI, one can intuit that the introvert learner is more likely to learn better independently, whereas the extrovert learner is more likely to learn better via interaction and frequent communication with others. Therefore, a logical extension is that the introverted learner is better suited to learning in an asynchronous environment than the extroverted learner. Ogden (2003) in his study examined two of the Myers-Briggs continuums—Sensing (S)—Intuition (N) and Thinking (T)—Feeling (F). The MBTI indicates that basic psychological attributes do make a difference in one's learning preference. For example, in Ogden's study, intuitive and feeling (NF) learners preferred "possibilities and learn best through discussion" while sensing and thinking (ST) learners "learn[ed] best through guided

study” (p. 24). Without doubt, some adult students prefer to work and learn collaboratively, whereas others prefer to work individually because of their different attitudes. Similarly, some learners are more likely fond of delayed online discussion forums to promote reflective and critical responses, whereas others are more likely to be interested in real-time online discussion forums. More specifically, extroverts are fond of prompt interaction—such as brainstorming—to learn effectively, because they learn during instantaneous message exchange. Introverts, on the other hand, are fond of delayed interaction.

To summarize, learning preferences, need for interaction, access to the Internet, and other learner characteristics should be considered when making instructional design decisions, especially when choosing technology tools (Wilson & Weiser, 2001). The Myers-Briggs dimension of introversion–extroversion was used to differentiate student learning preferences in this study. Regardless of the medium through which instruction is delivered, identifying students’ learning preference can be beneficial if instruction is oriented to those preferences. Research supports this idea (see, for example, Beck, 2001; Ford & Chen, 2001; Robotham, 1999). In terms of student satisfaction, Irons, Keel, and Bielema (2002) postulated that providing students a choice of a variety of communication tools greatly increases student satisfaction.

Relevance to Urban Policy Development

Alarmed about the escalation of college expenses, legislatures and governing boards are under increasing pressure to reduce costs and increase productivity (Wynd & Bozman, 1996). The growing heterogeneity of students—increasingly diverse student populations, shifting demographics, public demand for quality and accountability, and

concerns about the widening gap between ideal academic standards and actual student learning (Schroeder & Hurst, 1996)—is challenging colleges and universities across the country. Donohue and Wong (1997) concluded that older students will continue to comprise a substantial percentage of the higher education student body. Undoubtedly, this is relatively a new phenomenon; hence, it is necessary to develop a greater understanding of students' personal goals and needs in light of an educational system that was originally established to facilitate the growth, training, and education of *young* adults.

In addition, “as the proportion of traditional age students decline, institutions must realize the importance of the increasing number of nontraditional students” (Ryder, Bowman, & Newman, 1994, p. 6). Ryder et al. further noted that to survive, universities should become more efficient in recruiting and retaining students to make budgetary ends meet. To recruit and retain more students and increase tuition profits, urban institutions attract many full-time employees back to college to advance their careers. The keys to success are to make certain that appealing courses have been offered, satisfaction with the courses has been achieved and, most importantly, that academic success has been accomplished. Rickinson and Rutherford (1995) concluded that the university grade-point average (GPA) serves as a significant predictor of academic persistence. It is clear that academic achievement has been a critical incentive for adult students to decide to pursue advancement in higher education and to persist in studies afterwards. Ross, Drysdale, and Schulz (2001) contended that many students withdraw without receiving a degree primarily because of academic failure. Thus, to target both traditional and nontraditional students, “a prerequisite to higher education’s becoming more productive is the identification of how students learn” (Wynd & Bozman, 1996, p. 232) and to do so

proactively. The purpose of this study was to investigate the efficacy of computer-based instructional discourse suitable for needs of contemporary students. With increasing calls for accountability and assessment in higher education and calls for a greater acceptance and appreciation of individual differences, higher education instructors cannot afford not to increase their understanding of learning and individual learning differences (Sims & Sims, 1995).

Overview of the Study

This study examined flexible pedagogy in online, text-based collaborative discussion: (a) synchronous text-based chat and (b) asynchronous threaded discussion. The sample consisted of 13 classes with a total of 252 subjects, including three online classes with 64 students and 10 face-to-face classes with 188 students. The study investigated the impact of two conditions: (a) a treatment condition in which students were offered an option to choose either synchronous chat or asynchronous threaded discussion and (b) a control condition in which students were assigned to one of the two formats. Three outcome variables important to instructional design were included: (a) student satisfaction, (b) cognitive achievement, and (c) self-efficacy. To accommodate student differences, the study took into account age and learning preferences in the comparisons of the two conditions via the three outcome domains.

Chapter 2: Review of the Literature

Introduction

The concept of learning trajectory is not new to the instructional design arena. The essence of the instructional design recognizes successful customization of learning path and pace. During the learning process, students should be provided as many alternatives as possible to assist them in learning. Some researchers have recognized that each student learns differently (Swan, 2001; Wynd & Bozman, 1996). Computer technology serves as the foremost tool to accommodate students' needs in a number of ways. Studies have employed computer technology to provide a wide array of communication avenues (Irons et al., 2002) as a result of providing multiple modalities of instructional delivery. All in all, the intent is to minimize learning barriers that tend to hinder students from learning successfully and effectively. This is the goal, but different learning trajectories are utilized.

As Sims, Dobbs, and Hand (2002) pointed out, based on their examination on quality of online learning, two beliefs should be kept in mind when planning the use of computer technology to assist student learning: (a) examining ways students are able to control their learning process and tie activities to their own learning requirements and (b) looking at ways students are able to structure the learning environment to fulfill their individual learning preferences and needs. The former deals with learner control and learner-centered instruction, whereas the latter is associated with customization vis-à-vis individualization of delivered instruction. In a similar view, Irons et al. (2002) investigated whether an association exists between blended learning and learner satisfaction and postulated that providing a variety of communication tools for students to

utilize greatly increases their satisfaction. Enhancing student satisfaction and student acceptance seems to be a baseline requirement for the successful implementation of a learning modality.

Fundamentally, certain factors influence students' selection of delivery modes of instruction. If a desired course is being offered in both face-to-face and equivalent online delivery modes, it is hoped and assumed that learners are able to make a choice depending on their learning preferences and ways of processing knowledge. However, the reality is that most of the time learners make choices to accommodate their physical and time barriers instead. Such motives often confound empirical studies comparing the delivery modes of instruction—online versus face-to-face. Neuhauser (2002) investigated two sections of the same undergraduate course by examining gender, age, learning preferences, media familiarity, and effectiveness of the course—one taught face-to-face and one taught equivalent online. She found no significant difference in course effectiveness metrics—test scores, assignment, participation, and final course grade. Supporting earlier studies, Neuhauser's study demonstrated that "equivalent learning activities can be equally effective for learning online and FTF [face-to-face] groups" (p. 111). Yet, the important premise of this study was that students are able to choose either online or face-to-face course based on their learning preferences, not based on their physical or time considerations. Still, it is premature to suppose that delivery modes do not significantly affect learning, for the delivery modes are fundamentally different, and each possesses unique merits over the other (L. Smith & Dillon, 1999).

With multiple communication tools, instructors believe that providing enough choices can satisfy students' needs (Overbaugh et al., 2003). When students have

alternatives, Wilson and Weiser (2001) found that student characteristics such as learning preferences and life characteristics tend to influence the decision as to whether and how use of computer technology assists the learning process. Ultimately, the use of technology further impacts academic performance and satisfaction in a class. Such leads to the focus of this study, in which students were provided an option that allowed them to choose between synchronous text-based discussion and asynchronous text-based discussion, based on their learning preferences and age characteristics, rather than on situational characteristics.

Delivery Modes

In the general educational realm, course delivery can be viewed in light of two basic aspects: (a) the time dimension—synchronous versus asynchronous—and (b) the place dimension—Web/online versus face-to-face (Wilson & Weiser, 2001).

Traditionally, the face-to-face mode requires students to meet exclusively synchronously, whereas online/Web-based learning, used interchangeably, takes place mostly, but not exclusively, in an asynchronous environment.

A precise definition of online learning is difficult, for it involves a variety of technologies. As an overview, Jolliffe, Ritter, and Stevens (2001) defined an asynchronous learning environment as “one where communication between learners and the facilitator is done via a computer forum of some description at different times,” whereas a synchronous learning environment “takes place in real time where those involved in the communication process are present all at the same time, but not necessarily in the same place” (p. 9). Furthermore, asynchronous learning refers to a

situation where students are allowed to access course material “on demand, irrespective of time and place” (Wilson & Weiser, 2001, p. 363).

Clearly, online learning does not necessarily refer to asynchronicity; instead, online learning could include real-time video conferencing or chat rooms to make it synchronous. Regardless of this, Jolliffe et al. (2001) pointed out that online learning often takes advantage of some elements of asynchronous learning networks such as computer forums to assist learners with organizing and processing the learning materials.

Characteristics of Online Learning

Indisputably, the online learning environment offers four major strengths over the traditional, face-to-face learning environment.

1. First, the online learning environment provides “instructional work areas that are open for use any time” (Berge, Collins, & Dougherty, 2000, p. 35). Learning can occur outside classrooms. In addition, online learning expands the traditional perspective of learning. Heuristically, Hannafin, Land, and Oliver (1999) stressed that prerequisites of open learning environments are self-directed learning and learning autonomy to tackle relevant, real-world problems. Additionally, communication tools, entailing both synchronous and asynchronous modes, provide means for information manipulation and resource inquiry.

2. The online learning environment recognizes that learners with heterogeneous characteristics in terms of prior experiences, skills, and attitudinal differences proceed with learning at their own pace (Jolliffe et al., 2001).

3. Sanders and Morrison-Shetlar (2001) argued that the online environment has a highly positive effect on student learning with respect to problem solving and critical

thinking skills. Presumably, the asynchronous online learning environment provides sufficient time to deepen ideas and offers an opportunity for divergent conversions, as opposed to synchronous, face-to-face learning environments. Asynchronous text-based online discussions have been suggested as a substitute for classroom interaction in online courses; such potential allows additional reflection and posting of revisions to promote reflective and critical thinking, perhaps further encouraged by the perception that postings have more permanence than spoken words (Jaeger, 1995). In her qualitative investigation of learning-centered educational experiences, Petrides (2002) reported that when a student responds to distributed or distance-learning environments, “it allows for more freedom of thought and discussion” (p. 72). Moreover, in their comparison study of student satisfaction in synchronous and asynchronous course instruction, Wright et al. (2000) reported that the asynchronous group scored higher at both pre- and posttests than the synchronous group, and the asynchronous group appeared to be more active in learning preference than the synchronous group. The potential enhancement of both quality and quantity of student interaction and learning experiences might be another strength of instructional immediacy, especially in determining whether instructor immediacy is satisfactory.

4. The fourth strength is that the online learning environment strongly reflects on learning preference and self-regulation. Neuhauser (2002) concluded in her study comparing online and face-to-face instruction that an effective distance learner has characteristics of being a strong self-starter, self-disciplined, and knowledgeable of technology requirements. Learners in online education are required to be self-directed, intrinsically motivated, and proficient in computer technology (Irizarry, 2002). That is,

independent learners prefer independent study and self-paced instruction and would prefer to work alone rather than with others on course projects; whereas dependent learners look to their teachers and peers as a source of structure and guidance and prefer an authority figure to tell them what to do (Diaz & Cartnal, 1999). Presumably, independent learners tend to be more motivated because they decide when and where to learn as well as how the learning process proceeds. Compared with a traditional, face-to-face learning environment, online instruction requires more learning autonomy. It is plausible that a proactive learner in a rather low-structured learning environment like the online, Web-based setting tends to learn more effectively than a reactive learner. As a whole, because the two different instructional environments are structured and delivered differently, ample factors associated with learning outcomes such as high–low course structure should be taken into account in addition to learning style and life characteristics.

In essence, online, Web-based learning can make use of vast Internet resources. With access to a wide range of global and local resources, Internet-based learning, per se, has embraced a constructive process that allows independent study for students to search for materials relevant to their interests (Tait, 1997). Expert Internet-based learners are more likely to be highly motivated and to be sophisticated in independent learning as they dominate the use of the Internet in their academic interests. On the contrary, for novice Internet-based learners, much effort is needed to overcome accompanying computer anxiety and, in turn, to strengthen self-efficacy. Concomitantly, Tait pointed out that learning via the Internet indeed requires time and effort to get familiar with its use. As Internet access increases rapidly, computer skills sufficient for effective learning becomes less of a hindrance. Howard (2002) reported that the percentage of preservice

teachers using computers during instruction increased tremendously from 11.8% in the spring of 2000 to 53.8% in the spring of 2001.

Conspicuously, the online delivery mechanism tends to move towards a learner-centered and constructivist paradigm. It has been suggested that such online learning increases students' critical thinking and active learning (Hughes & Daykin, 2002), for online learning provides an instructional context in which a cooperative and more constructivist learning preference is encouraged (Tait, 1997). Given that the online environment is perceived as supporting the constructivist paradigm, employing strict instructivist strategies would otherwise undermine its overall effectiveness as experienced by students (Sims et al., 2002).

With two underlying paradigms distinctly embedded in online and traditional instruction, educators ought to take into account the students' learning preferences by considering transitioning the traditional courses into online mode (Diaz & Cartnal, 1999). The major tenet of constructivism is that learners have enough autonomy and flexibility to construct their learning. Unlike instructive behaviorism with strictly step-by-step instruction, constructive online-based instruction tends to meet versatile learners with varying personal preferences and situational parameters. And the major online approach for constructivism is to make use of asynchronous discussion forum and synchronous online chat (Mishra, 2002).

Regardless of the merits of online Web-based learning mentioned above, drawbacks still exist. For most Internet-based learners, the most difficult problem is assumed to be deficiency of computer literacy among learners. Today's learners, whether traditional or nontraditional, have acquired more computer experience and knowledge

through increasing computer exposure at school and work (Sanders & Morrison-Shetlar, 2001). Generally, as the gap between levels of computer experience becomes narrower, positive results in student attitudes toward online Web-based instruction are foreseeable.

Although online learning technologies have been ubiquitous at all levels of education and training programs, it is rather disappointing that most of the online Web-based courses merely transplant classroom lecture-based materials to the Web (Mishra, 2002). In an online environment and its equivalent traditional environment, educators need to pay great attention to varying social dynamics (Diaz & Cartnal, 1999) such as social needs, learning preferences, and life characteristics. Such characteristics of adult learners make their motives for learning much more complicated, and, in turn, their choices, when given instructional alternatives—online versus equivalent traditional delivery, and synchronous versus asynchronous discussion.

Many researchers have concluded that the delivery system does not make a significant difference (Clark, 1983; Lorenzetti, 2002; Neuhauser, 2002). Furthermore, Lorenzetti hypothesized that what makes the difference is the pedagogy not the medium. The medium is a mere vehicle (Clark). On the other hand, it has also been strongly suggested that much of the literature asserts no significant difference in learning effectiveness between technology-based and conventional delivery media because of serious design flaws (Joy & Garcia, 2000; Kozma, 1994). Then again, “learning effectiveness is a function of effective pedagogical practices” (Joy & Garcia, p. 33). Even with nonsignificance among media, more empirical studies are needed to explore whether instructional designs and strategies accommodate the modes of course delivery.

Online Text-Based Discussion

Online text-based discussion has become an important component of most instructional management tools (Jolliffe et al., 2001). Online text-based discussion provides a cyberspace in which learner-learner and learner-facilitator can meet to collaborate and share information. Aside from that, text-based discussion augments interaction of ideas generated from discussions. Students tend to focus more on issues than on speakers when the accompanying face-to-face pressure is avoided (Aoki, 1995).

Online text-based discussion can be held in two formats: asynchronous and synchronous. In the asynchronous format, the delayed communication is based on a text-based discussion board and/or electronic mailing list communications. While in the synchronous format, real-time communication requires students to meet at the same time, but not necessarily in the physical presence of other students. Each of the modes has its unique merits for certain instruction and learning situations. The online text-based discussion format overcomes physical and time barriers to allow students to learn from each other. Kuh and Hu (2001) mentioned that online learning apprenticeship offers an opportunity for experts and learners to share their ideas and post questions of any concern, in a way to clarify and extend their thinking and knowledge. Additionally, the online text-based discussion does not limit its application to the distance-learning environment. It can be employed in traditional, face-to-face learning environments to augment classroom discussion and enhance positive interaction (Irons et al., 2002).

In their pilot study of how technologies typically designed for distance learning can also benefit traditional, face-to-face students, Wilson and Weiser (2001) found a statistically significant difference of needs for interaction between integrated users and

nonintegrated users when the traditional, on-campus students have alternatives. In other words, the reason the nonintegrated users did not choose to integrate technology to assist their learning process was because they needed more synchronous class interaction. The results showed that need for interaction seems an important factor that influences student decisions on technology tools when they are offered alternatives. Computer conferencing devices can be carried both asynchronously, allowing enough time for reflection between postings, and synchronously, allowing real-time, interactive chats or simultaneous open sessions among many online participants online (Murphy & Collins, 1997).

Despite modes of immediacy of interaction, Jolliffe et al. (2001) listed 16 types of online discussion forums to assist learning: (a) free-flow, (b) peer review, (c) moderator-led, (d) presentation, (e) debate, (f) learner-led, (g) individual case study, (h) team case study, (i) individual journal, (j) group project, (k) external, (l) buzz group, (m) brainstorming, (n) role-playing, (o) seminar, and (p) simulation. These distinct ways of utilizing discussion forums incorporate delivery tools. From an instructional aspect, what is particularly important is not only to appreciate the delivery tools, per se, but also to recognize how their unique features can promote effective learning and teaching. Put simply, social interaction for learning is no longer limited to a face-to-face mode (Zafeiriou, Nunes, & Ford, 2001).

Asynchronous online text-based discussion. Asynchronous computer-mediated communication such as bulletin board systems offers a feature of time independence. That is, asynchronous online text-based discussion allows people to spend time reading, reflecting on a message, and responding. Even more, asynchronous online text-based discussion allows international collaboration in which people need to communicate

across different time zones (Aoki, 1995). In addition, in his case study investigating student participation in a discussion-oriented online course, Poole (2000) found that students tended to respond to the threads and accompanying postings on Saturdays and during the hours of 4–8 p.m. or 8 p.m. until midnight. Moreover, they tended to access the discussion board from their home computers.

The merits of using asynchronous text-based Internet communication technology are not only to better support interpersonal interaction but also to sustain two-way communication. Asynchronous text-based Internet communication is not bound by time or place and is more cost effective (Bates, 1997). As observed from Poole's (2000) case study on how students participate in a discussion-oriented online course, students seem to prefer the asynchronous discussion boards because they have enough time to draft reflected responses to others' postings. Sufficient time for reflection is indeed the major merit of asynchronous online discussion forums. The students are able to self-regulate when it is best for them to participate in the threaded discussion and to avoid distractions.

In a qualitative study soliciting perceptions of students who have had experience with both synchronous and asynchronous computer-mediated communication, the asynchronous mode of communication not only allowed students to participate at a convenient time to reflect at their own pace, but also allowed a choice to respond instantaneously or to set aside a time to reflect and compose a train of thought (Zafeiriou et al., 2001). Contrarily, the synchronous text-based chat does not offer the flexibility for students to make choices on immediacy of responses, based on their preferences and surrounding situations. In the text-based chat session, students ought to participate simultaneously. Other pros and cons of the two modes will be discussed further.

Asynchronous interactions are now prevailing not only in Web-based courses but also in traditional face-to-face courses. Fisher (2000) suggested that the most effective use of Internet in the classroom is to augment the regular lesson by incorporating Internet use as a source of information. Seemingly, online learning and traditional classroom learning are no longer parallel, but online learning seems to compliment traditional classroom learning. It is worth noticing that conventional classroom learners also can benefit from participating in asynchronous online discussion outside the classroom. Irons et al. (2002) described such an instructional arrangement as “blended learning” for it involves two different modalities. At any rate, when integrating asynchronous Internet communication tools into traditional classrooms, most university instructors still “continue to experience a tension between structure, dialogue and autonomy” (Kanuka, Collett, & Caswell, 2002, p. 151).

Synchronous text-based chat room. Synchronous online communication embraces features of closed groupware systems like LotusNotes and FirstClass for computer-supported collaborative works in business and education, in which the norms of business and academic discourse usually prevail (Murphy & Collins, 1997). The synchronous text-based online discussion forum allows learners and an instructor to interact at the same time, different from asynchronous online discussion forum. Related to recreational contexts, synchronous online text-based chat involves real-time conversation through short written messages that seem like a play script on screen (Burnett, 2003). Basically, such an electronic chat involves a series of real-time, short text sentences, usually one to three lines exchanged with peers who are logged in at the same time, and the use of nicknames (Murphy & Collins). In a recent study investigating university instructor

perceptions of the use of synchronous text-based discussion in distance courses, the instructors found it possible to translate many face-to-face instructional strategies to the online classroom and to become acquainted with synchronous text-based Internet communication tools for more effective use (Kanuka et al., 2002).

Interactive dialogue not only allows continuous, structural modifications of course content, pace, and activities to accommodate students' individual needs, but also allows their concerns to be addressed instantaneously to reduce transactional distance significantly (Murphy & Collins, 1997). Moore (1993) defined transactional distance as "psychological and communications space to be crossed, a space of potential misunderstanding between the inputs of the instructor and those of the learner" (p. 22). Transactional distance tends to be at its peak when there is no dialogue from student to student and student to instructor (Moore & Kearsley, 1996).

It is very important to remember that the great advantage of the online text-based chat is to allow a sense of communicative immediacy and presence to occur, and, in turn, to resolve any misconception without delay (Murphy & Collins, 1997). By means of real-time interactions, students tend to feel obligated to participate in the chat session in much the same way they feel obligated to attend a traditional, face-to-face class. Additionally, through discussion and brainstorming sessions, students are immersed in extensive problem-solving and decision-making processes (Murphy & Collins).

Certainly, limitations work against the merits of synchronous text-based discussion. Synchronous text-based discussion is difficult for a large number of participants to participate effectively because of "coordination problems and stability of technology using a low band-width" (Jolliffe et al., 2001, p. 57); however, the problems

can be reduced if a regular basis of meeting is arranged. Additionally, to communicate effectively, a participant must have substantial typing skills; otherwise, the conversation flow may move too fast for participants whose English is a second language, because they do not have time to reflect on what is asked, to frame questions, and to compose responses as the text flows rapidly on the screen (Aoki, 1995). Other problems occur when a large number of participants log onto the system (Murphy & Collins, 1997); the conversation may be affected by different typing speeds. Furthermore, to meet in real time, the participants need to schedule a time convenient for all, thus synchronous online discussion is more or less time bounded. When meeting in cyberspace synchronously, participants may be distracted by family members, as most of them are working adults whose best time to meet is after they get home from work. Also, the conversation often flows too fast for the participants to reflect deeply on the topics. The content thus might be restricted to a lower level of cognitive engagement, particularly for a certain type of learners such as those with introvert learning preferences.

Even though synchronous online text-based chat allows students to interact in real time, it is still distinct from the traditional, face-to-face interaction. Burnett (2003) posited, “More democratic tutor/student interaction” (p. 249) makes online text-based chat different from face-to-face discussion. Further, students who are shy and lack confidence are able to focus and take time in posting responses without feeling uncomfortable from facing the less supportive cues and attitudes they may encounter in traditional classroom discussion. However, lack of paralinguistic cues such as nodding and smiling in the online chat room makes traditional, face-to-face class meeting more conducive to participation for others. To make up for the lack of paralinguistic cues,

students evolve shorthand and make use of color to express their attitudinal languages and in turn create a more supportive cyberspace climate.

Asynchronous versus synchronous interaction. In their analysis of online Web-based instruction, Harmon and Jones (2001) observed, “Students who had low participation in the bulletin boards never missed a chat and were quite vocal in the chat room” (275). They also observed that some students in the synchronous chat session experienced frustration because of frequent technical crashes and the negative feelings of fighting for words. Consequently, the students tended to be more competitive in posting the messages and eventually ignored their peers who were online simultaneously. Undeniably, pros and cons depend on student characteristics and other environmental factors. Nonetheless, with the alternatives of online text-based discussion, students in different learning environments still possess varying needs for interaction and independence. Poole (2000) observed that despite the availability of a synchronous chat option, students prefer the more time-independent communication facilitated through the bulletin board and e-mail rather than live conversations with their peers. They only schedule synchronous chats when it is necessary for them to seek certain understanding.

In brief, “there is a growing interest in using discussion groups for distance learning via threaded asynchronous tools or synchronous chat rooms” (J. Lee, MacKendree, Dineen, & Mayes, 1999, p. 5). Surprisingly, synchronous (e.g., real-time text-based chat) and asynchronous (e.g., newsgroup and discussion boards) delivery tools have been introduced to charter high schools for home-schooled and independent-study students (Lopez, 2003) and for student teachers who need to become familiar with these delivery tools and to understand the tools’ merits and limitations. Overall, both

synchronous and asynchronous conferencing modes promote more frank discussion and equality among students than traditional classroom instruction (Sproull & Kiesler, 1993). Accordingly, exploring needs for interaction warrants the purpose of this study examining students' learning inclination and life characteristics.

Adult Learners

Unlike K–12 education, higher education consists of unique student characteristics. Students are all adults whose age and life characteristics make them different from children. As Cross (1981) suggested in her Characteristics of Adults as Learners (CAL) model, two clusters of variables should be considered: (a) personal characteristics referring to aging, life phases, and developmental stages and (b) situational characteristics referring to part-time versus full-time and voluntary versus compulsory learning. In the personal characteristics, the three components often intertwine and have reciprocal impacts on one another. As Cross further explained, each individual is at variance in age—20, 30, 40—and the life/developmental phases—adolescent/searching, young/striving, mature/stable. In light of learning, their motives and preferences fluctuate dependent on their multiple roles plus their ages and their need to accommodate themselves to a variety of instructional environments, unlike children. Based on these concerns, Cross explained her conclusions in regard to adult education and training. First, Cross recommended that adult learners be offered as many choices as possible in light of the availability and organization of the programs. Second, she suggested that educational or training programs intended for adult learners should conform to their aging limitation, which includes deteriorating physical capabilities such as vision and hearing. However, adult learners also tend to advance greatly on

sophistication of self-regulation, intrinsic motivation, and other metacognition skills. Overall, with respect to academic achievement, in their regression analysis on college educational psychology courses, Gadzella, Stephens, and Baloglu (2002) concluded that the age of college students is the best predictor of course grades.

Age Phase

A clear-cut differentiation between traditional students and nontraditional students is difficult. The divided age for the two types of students varies from study to study and from subject to subject. Some refer to those aged 22 or older as nontraditional students (Hruby, 1985; Morris, Brooks, & May, 2003; Neuhauser, 2002); others set the dividing mark at age 24 (Collins, 1999; Dill & Henley, 1998; Kuh & Hu, 2001; Rosental, Folse, Alleman, Boudreaux, Soper, & Bergen, 2000) or even at age 25 (Donohue & Wong, 1997; Miglietti & Strange, 1998; Ryder et al., 1994; Sizoo, Malhotra, & Bearson, 2003). Very few justify the rationale for such grouping. Defining traditional and nontraditional college students based on subject areas and urbanicity (or regions) warrants further endeavor. For instance, in liberal arts, the mean age for traditional college students was 19.5, whereas that of nontraditional college students was 28 (Morris et al.). Even taking average age into consideration, the cutoff age between traditional and nontraditional college students still warrants further studies. For this study, given the subject area and the urbanicity of the university, the age 25 was determined to be a viable breakpoint between traditional and nontraditional students after observing the age groups used in empirical studies.

When examining the age variable in adult education, empirical studies typically subcategorize subjects into traditional and nontraditional with arbitrary cutoff ages. As discussed, Cross (1981) in her CAL postulated that in their three different age phases—

20, 30, 40—adult learners differ significantly as a result of the deterioration of sensory or motor abilities such as eyesight and reaction time, but that age improves abilities such as decision-making skills and reasoning. In a similar trend, Bower and Kamata (2000) categorized adult learners into four clusters: (a) age of 20 or below, (b) 21–30, (c) 31–40, and (d) 41 or above. Alternatively, Gadzella et al. (2002) attempted to cluster their subjects into three age groups depending on having an even number of subjects in each group: (a) 19–23 years old, (b) 24–33 years old, and (c) 34–57 years old. Additionally, Ryder et al. (1994), in their study on nontraditional students, clustered the age groups as follows: (a) 25–29, (b) 30–34, (c) 35–39, (d) 40–44, (e) 45–49, and (f) 50 or older, but with the cutoff age of 25 between traditional and nontraditional college students.

Life Phases

Apart from the age phase, nontraditional students can also be defined as having multiple roles (e.g., parent, employee) in addition to the student role (Chartrand, 1990) and at least one year between high school and college. On the contrary, traditional students typically do not have those multiple roles and enter college straight from high school (Dill & Henley, 1998). Ryder et al. (1994) claimed that nontraditional students have concerns related to children, household responsibilities, past experiences, and other special needs.

Age accounts for learning satisfaction in adult education (Thurmond, Wambach, Connors, & Frey, 2002). Traditional and nontraditional students show extreme distinctions in varying dimensions. Without possessing multiple roles and imposing on family obligation, traditional college students tend to be able to concentrate more on their studies because they have more time available for their coursework preparation and

reflection. On the contrary, nontraditional students not only need to bear stress from work, but also need to make use of very limited time (e.g., after work or on the weekend) to come to the conventional classroom or enroll in online courses. In their study comparing traditional and nontraditional students, Dill and Henley (1998) concluded that traditional students tend to be more autonomous and independent, whereas nontraditional students tend to have more family responsibilities and obligations. Regardless of the time issues, a cluster of empirical studies as reported by Gadzella et al. (2002) revealed that nontraditional college students perform as well academically as traditional students or even better.

With the rapidly increasing number of nontraditional college students, Morris et al. (2003) pointed out that traditional and nontraditional college students employ different coping styles when encountering a stressful situation and also differ significantly in learning-related goal orientation. In addition to the situational characteristics, nontraditional and traditional college students also vary in the way they learn most effectively and in the way they prefer to learn. Sizoo et al. (2003) found that learning strengths and weaknesses of both full- and part-time nontraditional college students are distinct from those of traditional college students. Along the same line, a survey study administered to undergraduates of a business school showed that nontraditional and traditional college students differ in their learning preference based on their identifiable demographic traits (Wynd & Bozman, 1996). Wynd and Bozman also found that the distribution of learning preferences differed significantly depending on age and cumulative GPA. Yet, other demographic variables such as major, gender, number of

dependants, and work status were not significant to show the differentiation of learning preferences.

Conventionally, by the time they enter colleges and universities, adult learners tend to have fairly sophisticated capabilities to adjust themselves to diverse learning environments. As Huang (2002) summarized, adult learners tend to possess strong self-direction in learning so as to be recognized as “actively participating learners” (p. 31). Ryder et al. (1994) studied nontraditional students’ perceptions of impediments encountered in college education and found that nontraditional students are more self-assured in their likelihood of degree completion. However, when it comes to online Web-based learning, adjustment to the environment is a different issue. Due to the inherent autonomy in Web-based settings and although learning proceeds beyond the scope of instructors and peers, ineffective learning is still common. A successful online course completer is more likely to possess a strong ability to “master oneself and one’s environment, persistence at working through difficulties, and the confidence to make the most of bad situations” (Kemp, 2002, p. 74). However, Kemp’s study was limited to students in their first undergraduate distance course, so generalization of the results is not very feasible. Nonetheless, the result provides an insightful baseline for further studies.

Learning Preference: Extroversion Versus Introversion

Learning preference may be interpreted as a biologically and developmentally imposed set of personal characteristics that invite the matched teaching or learning strategy to be effective for some or ineffective for others. Regardless of the way instruction should be delivered, from an instructor’s standpoint, realizing students’ learning preference can be beneficial in several ways. “The instructor can orient his

lecture toward those students with the modal learning preference keeping in mind that some students may be at a disadvantage. By varying the explanations, the instructor can reach a larger proportion of the students” (James, 1998, p. 527). James continued to clarify that knowing students’ learning preference can also be helpful when working with them individually. In light of instructional delivery, however, asynchronous courses apparently tend to be more flexible in terms of time, distance, and most importantly, learner preferences. In reiteration, the extent to which an instructor has flexibility in a traditional classroom is debatable. Facing a whole classroom of students with various learning preferences, an instructor may be overwhelmed by attempting to utilize pedagogy that fits all needs, particularly when the class includes a blend of nontraditional and traditional students, which is often the case in higher education. Hypothetically, online instructional environments seem more compatible with a versatility of individual characteristics. In short, Allen, Bourhis, Burrell, and Mabry (2002) recapitulated that, as a stem of individual difference, learning preference is the predominate impact on the issue of distance education. “Students learn in different ways, whether in traditional or distance learning settings” (Parkinson, Greene, Kim, & Marioni, 2003, p. 23).

It has been suggested that instructors introduce the learning preference inventory first, along with an explicit explanation of its purpose, when beginning a college course or any other adult training education (Hickcox, 1995). In so doing, adult learners might have a better sense of orientation on how they can learn in a more effective way and make better decisions. With the use of learning preference questionnaires, Harrison, Andrews, and Saklofske (2003) concurred that researchers characterize students’ learning preferences according to how internalization and information retention might be

processed in three tiers: (a) various learning environments (e.g., classroom layout), (b) sociological factors (e.g., individual vs. group work), and (c) physical factors (e.g., visual or auditory). Educators and researchers have come to recognize how influential learning preferences have an impact on student learning.

Definition of Learning Preference

The terms *learning style* and *learning preference* are used interchangeably. A learning style refers to “a predisposition on the part of some students to adopt a particular learning strategy regardless of the specific demands of the learning task” (Davison, Bryan, & Griffiths, 1999, p. 10). Along the same line, “learning preferences may be defined as an individual's disposition towards one particular mode of learning” (Sandler-Smith, Allison, & Hayes, 2000, p. 244). Learning preference theories can be viewed as a pedagogical response to the recognition of student differences, for it is unlikely that all students will succeed academically if taught with a so-called “one-size-fits-all” approach. In considering how to improve student learning, we need to understand how they acquire knowledge. As indicated by Robotham (1999), students develop a style of learning and then refine that style in response to unconscious and conscious personal interventions and interventions by external agents.

Myers-Briggs Type Indicator (MBTI)

The MBTI is one of the most popular instruments for personality assessment (Boyle, 1995, p. 73). The MBTI includes theoretical constructs devised by the Swiss psychoanalyst, Carl Jung, and is a self-report questionnaire designed to assess personal preferences in dimensions of perception, decision making, social interaction, and environment interaction (Duck & Ogden, 1990).

MBTI differentiates 16 psychological types based on the preferred orientation on each of four axes or dimensions. Four dichotomous dimensions classify individuals as (a) introvert (I) or extrovert (E), (b) sensing (S) or intuitive (N), (c) thinking (T) or feeling (F), or (d) judging (J) or perceiving (P). Combinations of the four preferences determine personality types. Each type is represented with four letters, one from each pair (e.g., ESTP, ENFP). Each letter represents a preference on one of the four dimensions. The first dimension is concerned with an individual's attitude to others, the second with how an individual absorbs information, the third with how an individual makes decisions, and the fourth with the relative importance of the second and third dimensions (Davison et al., 1999). This study focused on the first dimension of what attitude an individual possesses to seek energy. The rationale is discussed in the following sections.

Attitudes of Energy: Introversiion–Extroversiion

The introversiion–extroversiion dimension does not pertain to shyness versus gregariousness, but emphasizes whether one's attitude towards the world is actively oriented outward to other persons and objects—extroversiion—or whether it is internally oriented—introversiion (Sipps & Alexander, 1987). Extroverts think most effectively when interacting with others but only become aware they are thinking when they are uttering. On the contrary, one with an introverted attitude of energy focuses on reflection of ideas without interacting with others (Quenk, 1999). Along the same lines, Keirsey and Bates (1984) defined an extrovert learner as one who needs people as a source to regenerate his/her energy, whereas an introvert learner prefers solitude to recover energy. Keirsey and Bates continued that introverts tend to be “slow to volunteer in the classroom, hesitating in sharing their ideas with others, and need privacy,” whereas extroverts are

more ready to “enter into group activities and to accept the ideas of others” (p. 101). Moreover, the introvert attends more to internal reality (the inner world) and concentrates more on concepts and ideas. On the contrary, the extrovert tends to focus on external reality (the outer world) and directs attention toward people and objects (O’Brien, Bernold, & Akroyd, 1998). The introversion–extroversion dimension is also postulated as “preference for being in the world” (Fox-Hines & Bowersock, 1995, p. 4).

With respect to educational applications, introverted students prefer to develop frameworks that integrate or connect subject matter. For an introvert, disconnected chunks are not knowledge but merely information. Introverts prefer knowledge being presented in a more holistic way. Conversely, extroverted learners prefer to learn by explaining to others. They also enjoy working in groups (Quenk, 1999). They tend not to understand a subject until they attempt to spell it out to others. As opposed to extroverted learners, who need interaction and like to be heard, seen, and acknowledged overtly, introverted learners need time to formulate ideas before presenting them (Fox-Hines & Bowersock, 1995). This study assumed that extroverts would be fond of cultivating their interpersonal skills because of their preference and ability of interacting with others; the introverts, because of their cognitive ability of focusing on their sense of self, would focus on self-enhancement and a strength of ability to solve internal problems.

Note that introverts intend to reflect quietly and alone, whereas extroverts intend to seek energy from socialization. When it comes to online text-based discussion, extroverts are fond of prompt interaction such as brainstorming to learn effectively, for they process the learning during instantaneous message exchange. On the contrary, introverts are fond of delayed interaction. That way, they are allowed to have adequate

time alone to process quietly and deeply and to reflect on messages. As discussed, synchronous chat sessions necessitate immediate responses. Theoretically, extroverts in chat sessions would have matched instructional strategies to their energy attitude. Because asynchronous discussion boards are time independent, the energy attitude of introverts would be satisfied in such asynchronous discussion modes.

Research and theory suggest that introversion–extroversion is substantially related to learning outcomes. Based upon an operational definition of introversion and extroversion, it is plausible to infer that introverts might have higher self-regulation that leads to the likelihood of success in asynchronous, online courses. Neuhauser (2002) maintained that introverts might perform better in online courses than in face-to-face courses and might find online courses more effective for their learning. In other words, introverts would be more successful in online courses than extroverts. Diaz and Carnal (1999) concluded that learning preferences influence students' choice of technology-based courses as well as their achievement in those courses, particularly when they have a choice between an online and a traditional classroom course. Due to certain constraints of life characteristics, adult students are inclined to make a choice based on their schedules and family obligations, rather than on their learning preferences. This study examined instructional strategies for providing a choice of online discussion modes to compensate for adult students' learning preferences.

Nonetheless, to avoid learning fatigue and low motivation, Quenk (1999) concluded that an extroverted learner should not spend too much time without external activities, and an introverted learner should not spend too little time alone and too much time interacting with others. Understanding learners' source of retrieving energy is the

priority when designing instruction. Keeping learners highly motivated is always the best pathway to effective learning. Thus, educators must balance the pros and cons, depending on learners' attitudes of energy. The remaining three Jungian dimensions are discussed next, but were not included in the study.

Functions of Perception: Sensing–Intuition

An individual revealing sensing perception uses the five senses and trusts the evidence of the senses, focuses on concrete reality, and gathers facts and niceties, whereas an individual revealing intuitive perception centers on concepts, ideas, and theories, inferring connections among the discrete clusters of the information (Quenk, 1999). Quenk contended that individuals with intuitive perceptions are more likely to experience difficulty in memorization and using facts without embedding them into an interesting context.

Functions of Judgment: Thinking–Feeling

When making a judgment or a decision, an individual with thinking inclination tends to take an objective and dispassionate approach without being influenced by other persons, whereas an individual with feeling inclination tends to “maximize harmony and well-being for people and situations” (Quenk, 1999, p. 7). Those with thinking preference have advantages over those with feeling preference, for most academic courses are teacher centered, highly structured, and have clear instructional goals. These components fit the thinking learners perfectly (Van, 1992).

Attitudes Toward the Outside World: Judging–Perception

Judging attitude refers to a desire to reach a conclusion (e.g., use judgment) and in turn make a decision as quickly as possible when interacting with the outer world;

perceiving attitude refers to a desire to collect as much information as possible before coming to a conclusion (Quenk, 1999). Quenk further explained that an individual showing a judging preference tends to be quite organized and effective with schedules to meet deadlines comfortably, whereas an individual showing a perceiving preference tends to be more spontaneous and flexible and can work effectively with an imminent deadline under great pressure but finds it difficult to begin a task very far in advance of a deadline. That is, with a deadline set, those with perceiving attitudes tend to procrastinate, unlike those with judging attitudes.

Summary

Pertaining to the purpose of this study, only the introversion–extroversion dimension will be included in the data collection. Some might argue that the four Jungian dimensions should be examined intact with 16 personality types. However, for educational purposes, Duck and Ogden (1990) assumed that it might be adequate to investigate each dimension separately in a way that shows an individual's preference regarding a functional dichotomy. In her exploratory study, Ullmain-Petrash (2000) investigated whether Jung's thinking–feeling dimension of decision-making preference is correlated with ways of knowing on the basis of gender. Pertaining to the purpose of her study, Ullmain-Petrash only verified the thinking–feeling dimension. However, in his experimental study on feedback lecture, Ogden (2003) justified his use of four learning preferences—a juxtaposition of the sensing–intuition and thinking–feeling dimensions. Boyle (1995) explained that Jungian theory asserts that the dichotomous preference scores of an individual symbolize fundamental differences between types such as

extroversion and introversion. Hence, examining the four Jungian dimensions separately or individually is not only practically feasible, but also valid for instructional purposes.

Researchers and trainers can utilize ample learning preference inventories. However, it is extremely important to choose an appropriate inventory for the target audience. Hickcox (1995) suggested three major criteria to consider when making a selection on learning style inventories: (a) the extent and results of the reliability and validity testing, (b) revision on its origination in light of relevance of language and issues changing over time, and (c) appropriateness for the adult population.

The literature suggests other learning preferences that are somewhat gender related (Campbell, 1999). In both face-to-face and online learning environments, “female students place emphasis on relationships, are empathetic in nature, and prefer to learn in an environment where cooperation is stressed rather than competition” (Blum, 1999, p. 51). I. Lee (2002) posited three popular gender issues in existing literature: (a) the dynamic of social interaction and its purposes and style; (b) motivation factors; and (c) expression frequency and style, discussion, and feedback. In his project on how variables of gender and learning style affect decision making and perception, Salter (2003) found that men and women differ significantly only in the dimension of feeling–thinking. Thus, as this study focuses exclusively on the dimension of introversion versus extroversion, the gender variable is not included in the study.

Student Satisfaction

Nowadays, in colleges and universities, the growing heterogeneity of student populations has been prevalent, particularly ranging in age and life obligations. Factors contributing to student satisfaction become even more complex, extending from

conventionally physical classrooms to contemporarily virtual classrooms. Student satisfaction is dependent on a wide range of internal and external issues. It has been long argued whether higher student satisfaction results in better academic success (Bean & Bradley, 1986; Pascarella, Whitt, Edison, Hagedorn, & Terezini, 1996) or better academic success results in higher student satisfaction. However, a reciprocal dynamic seems to occur between the two. Such dynamics are also dependent on different individuals with distinct personal and situational characteristics and different environments in which instruction takes place. Donohue and Wong (1997) generally summarized that the relationship between student satisfaction and student achievement is different for nontraditional and traditional students. They recapitulated that a cooperative orientation might be fitting to nontraditional students for enhancement of academic success rather than a competitive orientation, whereas a competition-orientated learning condition fits traditional students in terms of their academic success. As far as the latter is concerned, in an extensive meta-analysis on comparing student satisfaction between traditional and online courses, the findings surprisingly suggested that online learning does not undermine student satisfaction (Allen et al., 2002). In response, in a study as to whether student satisfaction results in course effectiveness, the researchers cautiously argued that controlling student characteristics minimizes bias and lessens the fallacies of incorrectly attributing outcomes to the instructional environment (Thurmond et al., 2002).

Whether student satisfaction results from environmental attributes or from personal preferences toward the learning process still leaves room for argument. Bear in mind that in two major trends of learning condition—physical and online—student satisfaction might differ distinctly due to entirely different attributes of the two. In

determining the impact of an online, Web-based environment, Thurmond et al. (2002) concluded that student satisfaction was influenced by the online environment rather than by student characteristics. They explained that controlling for student characteristics minimizes experimental bias and reduces the chance of incorrectly attributing outcomes to the online environment.

Aside from the above, assessing student satisfaction is another domain in which outcomes might be distorted or masked. Most studies employ self-constructed questionnaires that are quantitative (Rosental et al., 2000; Thurmond et al., 2002), qualitative, or a combination of both (Sherry, Fulford, & Zhang, 1998) to present student perceptions of courses. A quantitative questionnaire might present results in a superficial manner if researchers did not control carefully for student characteristics, failing to elevate the genuine purpose of such an assessment: to determine whether greater student satisfaction results in higher academic success. In other words, does greater student satisfaction or more satisfactory perception toward course participation lead to enhancement of academic success or cognitive achievement? Among all intertwining variables associated with the satisfaction level, self-efficacy, and student selection of learning activities tend to dominate in the field, and these are discussed in detail.

Cognitive Achievement and Assessment

Assessing what students know has been a serious concern for both in-service and pre-service educators. Shifting from the behaviorist perspective that posits stimulus–response associations with accumulations of reinforcement, the generic assessment of this study relied on the cognitive perspective. The cognitive perspective emphasizes the learning process more than the end products, which can be achieved mostly by drill and

practice. Instead, the cognitive perspective focuses on students and the generation of knowledge via a series of cognitive engagements such as deductive reasoning and inductive reasoning, which should result in deeper levels of understanding. Students are immersed in an instructional environment in which the way they process their knowledge and build their knowledge on prior experience is valued, but an assessment of the depth of knowledge is crucial for empirical investigation. Thus, this study intended to measure the knowing based on levels of cognitive engagement instead of using course grades. The use of course grades is less adequate when the purpose of the study is to generalize learning effectiveness in terms of depth of knowledge on specific topics. Rovai and Grooms (2004) postulated that extraneous variables like the timeline of work and class participation other than learning may contribute to grades. Particularly in this study, the use of final course grade was the least desirable option, for the final grade is an accumulation of many assessments besides the treatment. Similarly, other researchers have shown that course variables affect the levels of student cognitive engagement (Thomas, Bol, Warkentin, Wilson, Strage, & Rohwer, 1993).

As increasing attention has been paid to the process of knowing and teaching, taxonomic models like Bloom's Taxonomy of Educational Objectives (Bloom, Enghart, Furst, Hill, & Krathwohl, 1956) and Merrill's Performance Content Matrix (1994) have been used extensively in the education arena. Bloom's taxonomy involves six stages of cognition: (a) knowledge, (b) comprehension, (c) application, (d) analysis, (e) synthesis, and (f) evaluation. Merrill proposed a descriptive theory of knowledge consisting of a two-dimension classification based on a performance dimension and a content dimension. The performance dimension consists of four stages: (a) Remember Instance, (b)

Remember Generality, (c) Use Generality, and (d) Find Generality. The content dimension also consists of four types in parallel: (a) Fact, (b) Concept, (c) Procedure, and (d) Principle. To call for curriculum reference, Merrill's Modified Performance Content Matrix (Overbaugh & Lin, 2003) was applied to the gist of the study, as shown in Figure 2.

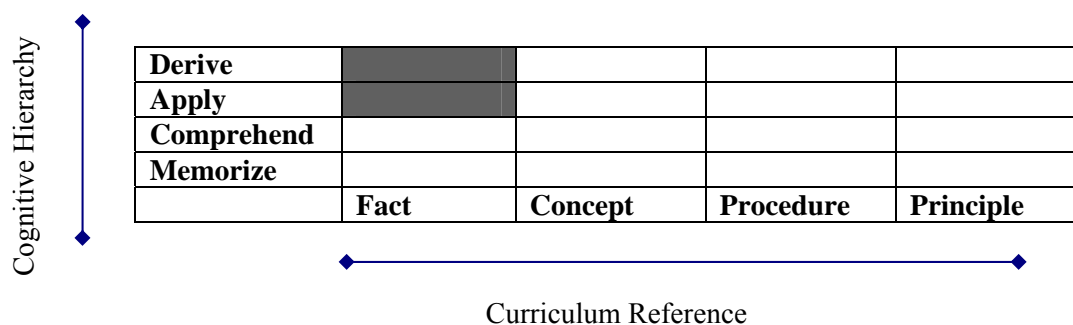


Figure 2. Merrill's modified Performance Content Matrix (Overbaugh & Lin, 2003).

Merrill (1994) posited that instruction would be more effective if all three primary performance stages are present. Basically, as shown in the modification, the highest stage in the performance dimension is substituted with the term *derive* rather than the term *find*. In their practical utilization of the matrix to assessments of undergraduates and fourth graders, Overbaugh and Lin (2003) found the term *derive* to be more instructive to their subjects. Likewise, *apply* has been substituted for *Use Generality*, *comprehend* for *Remember Generality*, and *memorize* for *Remember Instance*. Based on the implicational merits, this study adopted Merrill's modified Performance Content Matrix as a map for cognitive assessment.

By definition, fact simply relates to a piece of information such as a particular name, date, or object. Concept relates to common characteristics shared by a group of events or objects. Procedure refers to any knowledge that involves sequential steps in order to solve a problem. Principle refers to those causal effects or correlations that are used to interpret events or processes. In the performance dimension, on the other hand, cognitive objectives of Remember Instance (memorize) are simply recall of discrete information without involving cognitive activities. Remember Generality (comprehend) requires minimum cognitive activities to demonstrate sufficient understanding of previously known information. Use Generality (apply) is to apply previously known information to a specific case or scenario that has not been in instruction. That is, Use Generality requires advanced cognitive activities to reach a solution in an unfamiliar context, which is to demonstrate the transfer of previously learned information. Finally, cognitive objectives of Find Generality (derive) are to derive an original abstraction or evaluation proposal. Find Generality has a great need of sophisticated cognition in a combination of utilizing deductive reasoning and inductive reasoning. As to its assessment application, Find Generality always allows multiple good answers embedded with prospective facts, concepts, procedures, and principles as frameworks to produce a new proposal or an original evaluation plan.

In their study with undergraduates at an urban university, Overbaugh et al. (2003) revealed that online students achieved differently in differential cognitive levels. The researchers noted a need for future efforts to promote higher cognitive-level knowledge in academic learning. Therefore, this study has continued that effort to inquire into what

students can comprehend authentically and how capably they can apply knowledge in varied contexts and in turn to a higher cognitive level.

Self-Efficacy

Considering the significance of student differences, two major topics in recent research have shown significant impacts on academic success: (a) learning preference (e.g., Diaz & Cartnal, 1999; Ross et al., 2001) and (b) self-regulation (e.g., Eom & Reiser, 2000; Zimmerman & Martinez-Pons, 1990). Relatively speaking, learning preferences are more fixed, context independent, and unlikely to transform quickly over time; however, self-regulated learning strategies are responsive to time constraints and context. Additionally, learning preferences and self-regulated learning strategies can be considered as intrinsic and extrinsic attributes, respectively. Learning-preference theories seem to embrace more intrinsic attributes of student differences as opposed to self-regulation. Unlike learning preferences, self-regulated learning strategies seem to be more extrinsic and more learnable (Orange, 1999). Zimmerman and Martinez-Pons suggested, “Self-regulation theories seek to explain student differences in motivation and achievement on the basis of a common set of processes” (p. 51). Acknowledging one’s learning preference as a contributor to the likelihood of academic success is highly associated with self-regulation. James (1998) elucidated, “Students should know their learning styles in order to make better use of their study time” (p. 527). Sutliff and Baldwin (2001) suggested that to fit the learning preference of students, a course can begin with assessment of students’ learning preferences and follow with appropriate learning experiences to structure a possible “balanced” course.

Particularly in two distinct learning environments with distinct pedagogies and instruction immediacy, introversion–extroversion learning characteristics and self-regulation play important roles in improving learning outcomes. Typically, in online education, degree completion is heavily influenced by “perception of individual ability, student motivation, self-beliefs, and teaching practices” (Irizarry, 2002, p. 55). Due to the great autonomy of online education, the role of learners is gradually undergoing a transition to adjust from face-to-face instruction to online instructional settings. People perceive a great call to become highly motivated independent learners. Aside from that, learners in online education need to be aware of their capabilities in terms of skills in computer technologies and metacognition. These seemingly necessary attributes tend to be obstacles to online education. Pajares (2002) explained that the way people behave can be predicted more accurately by the beliefs they hold about what they can do than by what they are actually capable of doing. It is plausible that being intrinsically motivated and capable in metacognition and self regulation often drives people to overcome obstacles rather than being held back by their perceived incapability. Thus, understanding the role of self-efficacy belief is of importance in online education.

Bandura (1994) explicated that people’s beliefs about their efficacy can be accounted by four major sources of influence.

1. The first and the most effective avenue comes from cultivating a strong sense of efficacy through mastery experiences.

2. The second avenue is through vicarious experiences provided by social models. People tend to perceive a higher probability of success when they see individuals similar to themselves succeeding in a particular task. Likewise, the belief in self-efficacy tends to

be undermined significantly when they see individuals similar to themselves fail at a related task. That is, the perceived self-efficacy accounts for the impact of modeling by similarity to the models.

3. Social persuasion is another way to fortify one's perceived abilities or capabilities to be successful.

4. Reducing people's reaction to stress, negative emotional predispositions, and misinterpretations of physical states is the fourth avenue to tune the belief of self-efficacy.

More specifically, Fernandez-Ballesteros, Diez-Nicholas, Caprara, Barbaranelli, and Bandura (2002) proposed a structural model regarding how socioeconomic status impacts perceived individual efficacy and how it links to perceived collective efficacy (Figure 3). They defined *personal efficacy* as perceived self-efficacy to manage one's life circumstances, *individual social efficacy* as beliefs that one would help bring about social changes by one's individual actions, and *collective social efficacy* as one's belief that society can accomplish desired social changes through exerting its collective voice.

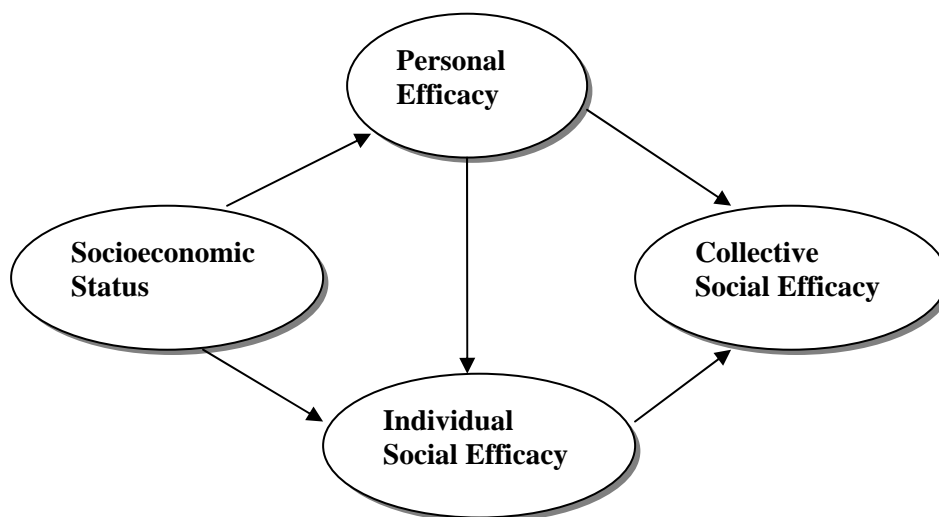


Figure 3. A causal structural model regarding how socioeconomic status impacts perceived individual efficacy and how it links to perceived collective efficacy (Fernandez-Ballesteros, Diez-Nicholas, Caprara, Barbaranelli, & Bandura, 2002, p. 111).

In examining perceived self-efficacy and problem solving among young and older adults, Daniele, Daniel, and Lina (2003) reported that levels of self-efficacy belief vary substantially as a function of age and problem type, which refers to traditional, common, young-adult, and older adult problems. With an equally divided number based on gender within a group, young adults between the ages of 20 and 29 tend to have higher levels of self-efficacy on traditional and young-adult-oriented problems. Older adults, between the ages of 65 and 75, tend to possess a higher sense of self-efficacy than the young on older adult problems. These findings support the hypothesis of an interaction effect between age group and task characteristics with regard to perceived self-efficacy and problem-solving performance. Concurrently, a study has provided substantial empirical support for the finding that the forms of perceived efficacy vary as a function of age and gender (Fernandez-Ballesteros et al., 2002). In light of age difference, young adults typically in the transition of establishing stable partnerships are more insecure financially and are

more likely to express a lower sense of self-efficacy in varying aspects of their lives than are their older counterparts. On the other hand, younger adults are more likely to judge themselves as more efficacious in bringing about social changes than are their older counterparts. That is, in the researchers' sociodemographic analysis, younger adults judged themselves less efficacious at managing their work lives, intimate partnerships, and financial conditions, but perceived themselves more efficacious in promoting social changes than did their older counterparts. As to gender difference in forms of self efficacy, Fernandez-Ballesteros et al. also revealed that male and female adults did not differ in their perceived personal efficacy, but men expressed stronger individual social efficacy.

Pajares (2002) maintained that sense of efficacy can promote human accomplishment in many ways. Self-efficacy beliefs help determine how much effort people are likely to spend on a task and how long they will endure when encountering impediments. Additionally, Pajares claimed that self-efficacy beliefs account for "thought patterns and emotional reaction" (p. 7). He further explained that people with high self-efficacy are inclined to building a sense of serenity to approach more difficult tasks, whereas people with low self-efficacy, because of the accompanying stress, anxiety, and a narrow vision, tend to undermine confidence and morale when they perceive themselves incapable of performing a difficult task. Concomitantly, "students' self-efficacy beliefs can affect their manipulation and choice of learning environment" (Zimmerman, 1989, p. 331).

Students who believe they are capable of performing academic tasks use more cognitive and metacognitive strategies and persist longer than those who do not (Pintrich

& Garcia, 1991). Age-related differences in perceived efficacy reflect not only developmental changes over time, but also the impact of sociopolitical eras (Fernandez-Ballesteros et al., 2002). Therefore, the endeavor of this study was to explore whether the option of chat versus threaded discussion enhances levels of self-efficacy and, consequently, to improve effectiveness of learning in light of cognitive engagement.

Chapter 3: Methodology

Introduction

Given the potential influence of student selection of instructional strategy on their learning and related outcomes, this study examined two types of online text-based discussion on student satisfaction, achievement, and self-efficacy. Furthermore, the impact of the instructional strategy on these outcome variables could depend on students' ages and learning preferences.

Research Plan and Questions

The purpose of the study was to examine the impact of an instructional strategy on three major outcomes. The intervention was to offer an option of two types of online text-based discussion— asynchronous threaded discussion vis-à-vis synchronous chat sessions. Thus, the treatment was the instructional strategy associated with the two online text-based discussion options. The hypothesis was that the treatment group, which had the option of the two types of online discussion format, would differ from the control group assigned to one of the two types of online discussion formats on student satisfaction, efficacious beliefs toward the use of online discussion, and most importantly, cognitive achievement.

In contrast to the treatment condition in which students were offered the option of the two types of online discussion format but were not allowed to switch from one to another once they made the choice, students in the control condition were not offered the option of either synchronous or asynchronous online text-based discussion session. Control-group students participated in an assigned online discussion format. Students were randomly assigned into groups of four in both groups.

The study investigated the impact of the treatment in the context of the four project-based discussion sessions. Each of the discussion sessions was thread oriented and included four threads. The first session discussed learning theories covering behaviorism, cognition, and constructivism. The goal was to interpret the three learning theories and incorporate them into instruction. The second session was on problem-based learning (PBL) and cooperative learning. The objectives covered differences between a PBL classroom and a traditional classroom, the importance of driving questions as an integral part of PBL, and technology integration as an important component of the constructivist approach to learning. The third session looked at social and ethical issues that cover the digital divide, ethical conduct, plagiarism, and ownership. The fourth session discussed information literacy regarding the use of filtering software and strategies for Web-site evaluation.

To reiterate, the purpose was to investigate whether the instructional strategy of providing undergraduate and graduate students an option of two types of online text-based discussion had significant impacts on student satisfaction, cognitive achievement, and self-efficacy, dependent on student age and learning preferences. To guide the study, five major research questions were examined.

1. Does the chat versus threaded discussion option differentially impact student satisfaction as a function of students' age and learning preference?
2. Does the chat versus threaded discussion option differentially impact cognitive achievement as a function of students' age and learning preference?
3. Does the chat versus threaded discussion option differentially impact self-efficacy as a function of students' age and learning preference?

4. Is there a relationship between the students' age and learning preference?
5. Are there relationships among the three instructional outcomes: (a) student satisfaction, (b) cognitive achievement, and (c) self-efficacy?

Research Design

Overall, this study was a factorial 2 x 2 x 2 between-subject design (see Appendix B). The three outcome variables were (a) student satisfaction, (b) cognitive achievement, and (c) self-efficacy. First, the pretest and posttest measures were administered to assess self-efficacy toward the use of online discussion. Posttest-only measures assessed student satisfaction toward the use of online discussion and cognitive achievement.

The sample was students enrolled in undergraduate and graduate sections of a core education course in face-to-face and equivalent online course delivery formats. Different sampling procedures applied to the study. For the face-to-face courses, the subjects registered for the class based on the time and date offered, whereas in the online courses, the subjects were randomly assigned to each of the classes with a "round robin" selection. For all courses in the two delivery schemes, the unit of analysis was the students, not the courses. The potential limitation of different sampling procedures is minimized when the units of analysis are the subjects.

Sample

Participants were 252 teacher education students in an Educational Curriculum and Instruction (ECI) program at a large, mid-Atlantic state university. The subjects consisted of pre-service and in-service teachers from two courses, a graduate level course entitled Instructional Technology and the Classroom and an undergraduate course entitled Educational Applications of Computers. These courses are essentially identical because

the instructors use a similar syllabus, and the assignments are the same. The graduate-level course is part of a 5-year master's degree. Some in-service teachers take the course for re-certification. Offered face-to-face and online, both courses focus on classroom technology, learning theories, cognitive psychology, and Internet resources to enhance classroom management techniques and K–12 curriculum materials related to Standards of Learning (SOL). For the graduate-level course, one online and two face-to-face sessions are offered, and for the undergraduate-level course, two online and six face-to-face sessions are offered. Different faculty members teach the courses, but the course content is consistent across all sections. To reiterate, the text and course objectives for online or face-to-face session and for graduate- or undergraduate-level course are identical.

Independent Variables

The three independent variables are (a) online discussion forum option (“w/option” vs. “w/o option”), (b) student age (≤ 25 vs. > 25), and (c) learning preference (introvert vs. extrovert). The three independent variables are all dichotomous and in nominal scale.

Dependent Variables

The three dependent variables are in ratio or interval scale. The first is self-efficacy toward use of online text-based discussion. The efficacious belief is measured with respect to six skill domains: (a) Web activities, (b) information literacy, (c) learning theories, (d) problem-based learning, (e) cooperative learning, and (f) online communications in general. The second dependent variable is student satisfaction. Students rated their level of satisfaction in two major domains—course appraisal and online text-based discussion appraisal. Achievement is the third dependent variable. For

this study, student achievement was assessed using the 4 x 4 matrix of cognitive engagement, based on Merrill's modified Performance Content Matrix (Overbaugh & Lin, 2003). Four cognitive levels were covered in the assessment. The measures are more fully described below.

Measures

Four measures were administered to the subjects during the spring of 2004: (a) Self-Efficacy on Use of Online Discussion Questionnaire (see Appendix F), (b) Student Satisfaction Survey on Use of Online Text-Based Discussion (see Appendix G), (c) Introversion–Extroversion Index (see Appendix H), and (d) Cognitive Assessment. The measures, except for Cognitive Assessment, were piloted prior to the data collection to establish reliability and validity. Most surveys ensure anonymity, particularly student satisfaction surveys. Because anonymity restricts the possibility of tracking data and follow-ups, the researcher asked for the subject's identity, but ensured confidentiality. Identities were filtered out by the researcher and kept from the instructors, except for the Introversion–Extroversion Index.

Self-Efficacy on Use of Online Discussion Questionnaire

The Self-Efficacy Questionnaire, developed by the researcher for the purpose of this study, is based on Bandura's self-efficacy theory (Bandura, 1997; Fernandez-Ballesteros et al., 2002; Pajares, 2002). The Self-Efficacy Questionnaire was intended to investigate whether using different online text-based discussion modes results in varied levels of efficacy, which may be related to learning. Based on the course objectives, the questionnaire consists of 33 items (see Appendix F) with respect to six skill domains: (a) Web activities (five items), (b) information literacy (five items), (c) learning theories

(five items), (d) PBL (five items), (e) cooperative learning (seven items), and (f) online communications in general (six items). Foci of personal efficacy and individual social efficacy were identified based on Fernandez-Ballesteros et al.. In each skill domain, the subjects were asked to rate their level of confidence on a 5-point Likert scale (Pajares, 2002), ranging from *strongly not confident* (1) to *strongly confident* (5). A blueprint of the instrument was developed (see Appendix C) based on literature and aligned with the research questions to help establish content validity. Established in the pilot test with 109 subjects, the internal consistency was .76 for Web activities, .91 for information literacy, .88 for learning theories, .83 for PBL, .87 for cooperative learning, .91 for online communications in general, and .93 overall.

Student Satisfaction Survey on Use of Online Text-Based Discussion

The Student Satisfaction Survey is a 27-item Likert-type questionnaire with which students rate their level of satisfaction in two subscales—course appraisal and online discussion appraisal (see Appendix G). Subjects rated their degree of satisfaction on a 5-point scale: *strongly disagree* (1), *somewhat disagree* (2), *neutral* (3), *somewhat agree* (4), and *strongly agree* (5). The negatively worded items were reverse coded. The course appraisal includes items such as “The course syllabus and handouts are helpful.” The online discussion appraisal includes, “When engaged in online discussions, I put a lot of thought into my comments.” To help establish validity, a blueprint of the instrument based on literature and aligned with the research questions is provided in Appendix D. Pilot test data ($N = 109$) used to gauge the reliability of scales showed the internal consistency to be .90 for the course appraisal, .81 for the online discussion appraisal, and .89 overall.

Introversion–Extroversion Index

The Introversion–Extroversion Index (see Appendix H) was developed by the researcher for the purpose of this study. The Introversion–Extroversion Index is a nine-item, dichotomous, forced-choice questionnaire designed to examine the attitude preference of how respondents direct and retrieve their energy inward to self or outward to people. Because the questionnaire contains dichotomous responses, having an odd number of items avoids an evenly divided score, which would result in a “draw” between introversion and extroversion. The Introversion–Extroversion Index was constructed based on a blueprint (see Appendix E). Based on the literature, the blueprint provides the major characteristics of introverted and extroverted individuals. Established in the pilot test with 109 subjects, the internal consistency was .75, which is satisfactory.

Cognitive Achievement Assessment

Consistent with Merrill’s Performance Content Matrix, this modified version is also a 4 x 4 matrix (see Figure 4). Throughout the semester, there were four main project-related discussion sessions: (a) Learning Theories—Educational Psychology, (b) PBL and Cooperative Learning, (c) Social and Ethical Issues, and (d) Information Literacy. Each discussion session covered four threads. The cognitive levels represented by the assessment questions are Memorize-Fact, Comprehend-Concept, Apply-Concept, and Apply-Principle. In the dimension of cognitive performance, the threaded questions range from memorization to application. At the dimension of curriculum reference, the questions entail three domains: Fact, Concept, and Principle. The assessment has 32 items in both open-ended and closed-ended format. With the four different cognitive levels, the weight of each multiple-choice question is 1 point (*Memorize-Fact*), 2 points

(*Comprehend-Concept*), 3 points (*Apply-Concept*), and 4 points (*Apply-Principle*). The possible points of the open-ended questions vary based on the number of criteria covered in the rubric. The assessment questions were developed to reflect the four levels of cognitive engagement and were reviewed by the expert instructors who teach the courses as the subject-matter experts for content validity. The discussion topics of the project-based discussion sessions served as a blueprint to construct the assessment questions.

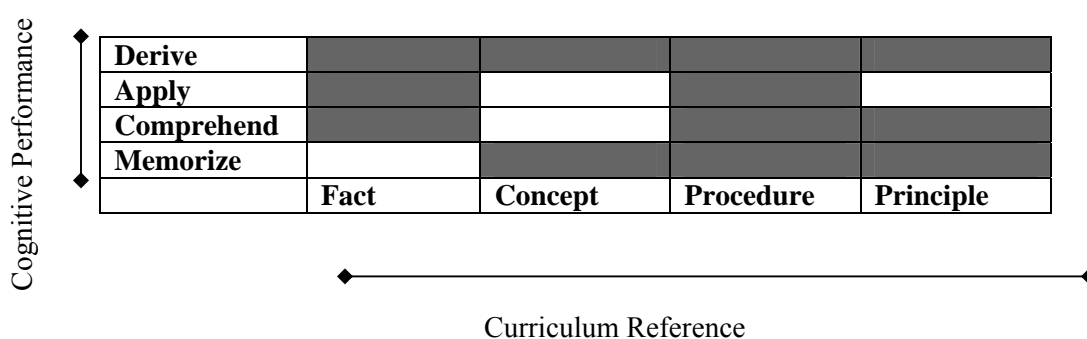


Figure 4. The mapped assessment questions on modified Merrill's Performance Content Matrix (Overbaugh & Lin, 2003).

Procedure

The treatment—a series of four online text-based discussion topics over a period of eight weeks—was administered to the treatment group throughout the semester. The subjects in the treatment group were given an option to choose their online discussion mode—synchronous versus asynchronous in the second week of the Spring 2004 academic semester. Subjects in the control group were randomly assigned to either synchronous or asynchronous online text-based discussion. The mode of online discussion persisted throughout four major project-based discussion sessions. Both synchronous and asynchronous groups, no matter what mode was assigned or chosen,

participated in discussion sessions with identical structures and topics and completed the open-book Cognitive Assessment immediately after the discussion session concluded.

The synchronous group attended a period of four chat sessions that last a minimum of 45 minutes each. These 45-minute chat sessions were implemented with the Virtual Classroom feature of Blackboard™. The group members decided the date and time. They met synchronously within a one-week timeframe and then took turns hosting and moderating chats. After the chat sessions, the students completed a chat student-assessment rubric for the instructor. The results of the rubric were not included as a variable in this study but were used to assist interpretation of the results.

For the asynchronous group, the students attended delayed threaded discussion sessions implemented with the Discussion Board feature of Blackboard. For each discussion session, the group members contributed required readings and their thoughts asynchronously within a one-week timeframe.

The Introversion–Extroversion Index was administered online within the first 2 weeks in the Spring 2004 academic semester, and the Student Satisfaction Survey was administered one week prior to the final exam week.

To identify the subjects' self-efficacy regarding learning via online text-based discussion, a pretest of the Self-Efficacy Questionnaire was administered in the first week of the spring semester, 2004. The pretest intended to take into account prior experiences toward the use of online text-based discussion. The posttest, with the identical questionnaire, was administered online 2 weeks prior to the final exam week.

Chapter 4: Results

Introduction

This study investigated whether use of an instructional strategy that provides the chat versus threaded discussion forum option impacts student satisfaction, cognitive achievement, and self-efficacy with respect to age and learning preference. To do so, a factorial 2 x 2 x 2 between-subject experimental design was employed with three statistical procedures: (a) chi-square, (b) multivariate analysis of variance (MANOVA) and multivariate analysis of covariance (MANCOVA), and (c) correlation. This chapter consists of four major sections—(a) Characteristics of Participants, (b) Reliability of the Instruments, (c) Data Analysis, and (d) Results—followed by a summary. Within the Results section, each of the research questions is analyzed. First, the research question is restated, followed by the type of statistical analysis and procedures. Second, the independent and dependent variables are described and the data sources are provided. Third, the results of the inferential statistics are presented, and fourth, the accompanying descriptive statistics, are used to help interpret the inferential statistical results.

Characteristics of Participants

A total of 13 classes participated in the study, with 74.6% ($n = 188$) of the students enrolled in 10 face-to-face classes and 25.4% ($n = 64$) enrolled in three online classes. Of the 252 students, 76.6% ($n = 193$) were undergraduate students, and 23.4% ($n = 59$) were graduate students. Further, 83.7% ($n = 190$) were female and 16.3% ($n = 37$) were male. All students were between 18 and 58 years of age, with a mean age of 28 ($M = 28.76$, $SD = 9.43$). Specifically, 54.3% ($n = 126$) were older than age 25, and 45.7% ($n = 106$) were equal to or younger than 25. Of the participants, 71.8% ($n = 158$) identified

themselves as full-time students, and 28.2% ($n = 62$) as part-time students. In light of learning preference, altogether 62.6% ($n = 137$) of the students were introverted and 37.4% ($n = 82$) were extroverted (see Table 1). Each class was randomly assigned to either a “w/ option” condition in which the students had the option to choose between asynchronous threaded and synchronous chat discussion forum or a “w/o option” condition in which the students did not have the option. The w/ option condition included 48% of the students ($n = 121$), who had the option to choose between asynchronous threaded and synchronous chat discussion forum. The remaining 52% ($n = 131$) were in the w/o option condition in which they did not have the option and were randomly assigned to either forum as a unit of class.

Table 1

Descriptive Statistics on Characteristics of Participants

	Frequency	Percent (%)
Course format		
Face-to-face	188	74.6%
Online	64	25.4%
Course level		
Undergraduate	193	76.6%
Graduate	59	23.4%
Gender		
Female	190	83.7%
Male	37	16.3%
Option		
w/ option	121	48.0%
w/o option	131	52.0%
Discussion format		
Chat	87	34.8%
Threaded	163	65.2%
Age		
≤25	106	45.7%
>25	126	54.3%
Student status		
Part-time	62	28.2%
Full-time	158	71.8%
Learning preference		
Introvert	137	62.6%
Extrovert	82	37.4%

Reliability of the Instruments

Table 2 provides the reliability coefficients for each of the instruments used in the study. Cronbach's alpha was computed using the data collected from the 252 study participants. Introversion–Extroversion Index revealed a reliability of .70. In general, a coefficient of .70 or higher is considered acceptable for attitude scales (Forbes & Ross, 2003). The reliability of Student Satisfaction Survey measure was .92 overall with .88 for the course appraisal and .86 for the online discussion appraisal.

On the administration of the self-efficacy measure, the reliabilities were high, ranging from .86 for Web activities to .95 overall. The overall reliability coefficients for this measure were .96 and .95 for the pretest and posttest, respectively. Specifically for each subscale of the pretest, reliability coefficients were (a) .96 overall, (b) .86 for the Web activities subscale, (c) .91 for the information literacy subscale, (d) .95 for learning theories, (e) .91 for PBL, (f) .91 for cooperative learning, and (g) .90 for the online communications in general subscale. Consistently high reliability coefficients were also obtained for the posttest administration of this instrument. The posttest reliability coefficients were (a) .95 overall, (b) .78 for Web activities, (c) .92 for information literacy, (d) .92 for learning theories, (e) .89 for PBL, (f) .93 for cooperative learning, and (g) .89 for online communications in general.

Table 2

Internal Consistencies of Self-Efficacy Questionnaire Including Pre- and Posttest, Student Satisfaction Questionnaire, and Introversion–Extroversion Index

<i>Introversion–Extroversion Index</i>		
		.70
<i>Student Satisfaction Questionnaire</i>		
Course appraisal		.88
Online communication in general appraisal		.86
Overall		.92
<i>Self-Efficacy Questionnaire</i>		
	Pretest	Posttest
Web activities	.86	.78
Information literacy	.91	.92
Learning theories	.95	.92
Problem-based learning	.91	.89
Cooperative learning	.91	.93
Online communications in general	.90	.89
Overall	.96	.95

Data Analysis

Statistical procedures in this study included MANOVA, MANCOVA, analysis of covariance (ANCOVA), a two-way contingency table analysis (chi-square), and regression analysis. The MANCOVA and ANCOVA were used to test for main effects and interactions of the independent variables on the dependent variables of student satisfaction, cognitive achievement, and self-efficacy. The analysis was to test for a relationship between the two dichotomous variables, learning preference and age.

1. Does the chat versus threaded discussion option differentially impact student satisfaction as a function of students' age and learning preference? To answer the first research question, a MANOVA was conducted with presence or absence of option, introversion or extroversion, and subject age of less than 25 or older as the independent

variables and with student satisfaction with two appraisals as the dependent variables. Given that the factors have multiple levels in MANOVA, ANOVAs were used for follow-up.

2. Does the chat versus threaded discussion option differentially impact cognitive achievement as a function of students' age and learning preference? To answer the second research question, a MANOVA was conducted with presence or absence of option, introversion or extroversion, and subject age of less than 25 or older as the independent variables and with cognitive achievement with the four levels as the dependent variables. Given that the factors have multiple levels in MANOVA, ANOVAs were used for follow-up.

3. Does the chat versus threaded discussion option differentially impact self-efficacy as a function of students' age and learning preference? To answer the third research question, a MANCOVA was conducted with presence or absence of option, introversion or extroversion, and subject age of less than 25 or older as the independent variables and with self-efficacy with the six domains as the dependent variables. Follow-up ANCOVAs were used, for the omnibus MANCOVA was significant.

4. Is there an association between the students' age and learning preference? To answer the fourth research question, the chi-square test for a two-way contingency table analysis examined whether the age category (≤ 25 vs. > 25) and learning preference (introverted vs. extroverted) were linked. The chi-square statistic is to determine how well observed frequencies fit expected frequencies.

5. Are there relationships among the three instructional outcomes: (a) student satisfaction, (b) cognitive achievement, and (c) self-efficacy? To answer the last research

question, a regression analysis was performed to see whether the three measured variables correlated and predicted one another, or whether student satisfaction and self-efficacy predicted cognitive achievement.

Results

The treatment option the students chose—synchronous or asynchronous discussion—was of importance to this study. Exploring how the students in the treatment condition distributed in terms of their choice and learning preference was crucial to the results. The data revealed significant differences between the distribution of choice and the discussion format (see Table 3), $\chi^2(1, N = 250) = 61.14, p < .001$ with *Phi* of .50, indicating a strong association between the option (w/ option vs. w/o option) and discussion format (chat vs. threaded). This finding indicated that when offered the option to choose type of discussion forum, students overwhelmingly chose the threaded discussion forum as opposed to chat. Their rationale is discussed later in the chapter.

Table 3

Chi-Square Analysis on Option by Online Discussion Format

		Discussion format		Total
		Threaded	Chat	
w/ option	Count	105.0	11.0	116.0
	Percentage	90.5%	9.5%	100.0%
w/o option	Count	58.0	76.0	134.0
	Percentage	43.3%	56.7%	100.0%
Total	Count	163.0	87.0	250.0
	Percentage	65.2%	34.8%	100.0%

As to whether students with the option to choose made their choice congruently with their learning preference (introvert vs. extrovert), the chi-square result (see Table 4) indicated that, overall, both introverts and extroverts largely chose threaded discussion. A larger percentage of the introvert students chose threaded discussion than the extrovert students (95.2% vs. 87.3%), $\chi^2 (1, N = 105) = 3.86, p < .05$. Additionally, *Phi* of .19 indicated a moderate association between the percentage of introvert and extrovert students choosing different online discussion forums in the treatment condition. The results are consistent with a study by Diaz and Carnal (1999), which supports the notion that learning preferences influence students' choice of technology-based courses.

Table 4

Chi-Square Analysis on Option Versus Online Discussion Format by Learning Preference

Learning preference		Discussion format		
		Threaded	Chat	Total
w/ option				
Introvert	Count	59.0	3.0	62.0
	Percentage	95.2%	4.8%	100.0%
Extrovert	Count	36.0	7.0	43.0
	Percentage	83.7%	16.3%	100.0%
Total	Count	95.0	10.0	105.0
	Percentage	90.5%	9.5%	100.0%
w/o option				
Introvert	Count	31.0	44.0	75.0
	Percentage	41.3%	58.7%	100.0%
Extrovert	Count	16.0	23.0	39.0
	Percentage	41.0%	59.0%	100.0%
Total	Count	47.0	67.0	114.0
	Percentage	41.2%	58.8%	100.0%

Research Question 1

The first research question addressed whether the chat versus threaded discussion option has a differential impact on student satisfaction with respect to the students' age and learning preference. To answer this question, a MANOVA was performed to determine whether there were significant differences in student satisfaction between the treatment condition and the control condition, and furthermore to explore whether there were significant differences in student satisfaction with respect to age and learning preferences. The independent variables in this model were (a) option (w/ option vs. w/o option), (b) age (≤ 25 vs. > 25), and (c) learning preference (introvert vs. extrovert). The dependent variables were two subscale scores on the Student Satisfaction Survey on Use of Online Text-Based Discussion: Course Appraisal and the online communication appraisal.

Satisfaction by treatment group. The multivariate test revealed a significant difference between the w/ option group and the w/o option group, $F(1, 179) = 3.13, p < .05$. Because the independent variable, option, has two levels, Hotelling's Trace was reported. Specifically for the course appraisal, the w/ option group revealed significantly more satisfaction than the w/o option group, $F(1, 179) = 6.23, p < .05$ (see Table 5). Based on Cohen's (1988) definition of effect size, d for the course appraisal was .34, considered medium effect size. The concept of effect size also can be interpreted as descriptions of measures of nonoverlap between a treatment group and a comparison or control group. In this case, the Cohen's d of .34 indicated a nonoverlap of 23.74% in the w/ option group and the w/o option group distributions. On the online communication appraisal, no significant difference was found between the two groups, $F(1, 179) = 3.56,$

$p > .05$. Cohen's d for the online communication appraisal was .28, which is considered small.

Table 5

Summary of MANOVA on the Two Subscales of Student Satisfaction by Option, Age, and Learning Preference

Dependent variables	Student satisfaction			
	df	F	p	Cohen's d
Option ($n = 179$)				
Course appraisal	1	6.23	.01*	.34
Online communication appraisal	1	3.56	.06	.28
Age ($n = 173$)				
Course appraisal	1	.13	.72	.06
Online communication appraisal	1	1.68	.18	.20
Learning preference ($n = 167$)				
Course appraisal	1	.70	.41	.13
Online communication appraisal	1	.03	.86	.03

* $p < .05$

Table 6 displays descriptive statistics on the two subscales of student satisfaction by option. The treatment group ($M = 53.20$, $SD = 6.71$) in which the chat versus threaded option was offered (w/ option group) scored higher in course appraisal than the control group (w/o option group; $M = 50.63$, $SD = 8.19$). In the online communication appraisal, the w/ option group ($M = 60.49$, $SD = 9.86$) also scored higher than the w/o option group ($M = 57.73$, $SD = 9.71$) (see Figure 5). No interaction was found. Thus, it was clear that the w/ option group was more satisfied than the w/o option group. In addition, it is worth noting that both groups had higher satisfaction in online communication than in course appraisal, as the total points of the two subscales were assigned in balance.

Table 6

Student Satisfaction Scores—Course Appraisal and Online Communication Appraisal with Respect to the Three Independent Variables

	Student satisfaction			
	Course appraisal		Online communication appraisal	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Option (<i>n</i> = 179)				
Treatment group (w/ option)	53.20	6.71	60.49	9.86
Control group (w/o option)	50.63	8.19	57.73	9.71
Age (<i>n</i> = 173)				
<= 25	52.25	6.88	59.99	8.97
> 25	51.82	8.53	58.01	11.06
Learning preference (<i>n</i> = 167)				
Introvert	52.46	7.46	59.31	9.86
Extrovert	51.44	7.83	59.03	10.02

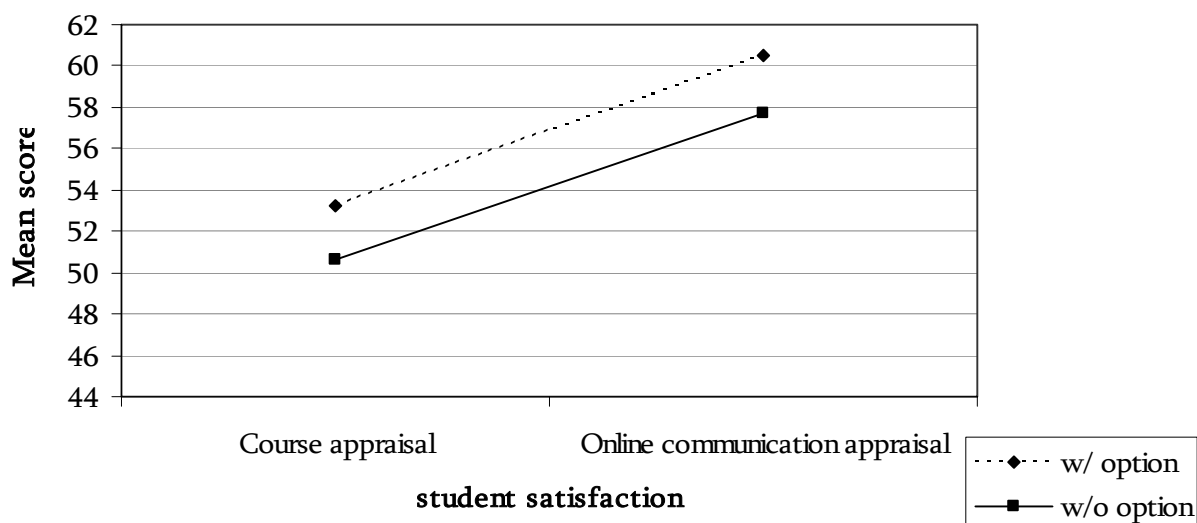


Figure 5. Main effect of student satisfaction by option (*n* = 179).

To illuminate the significant finding of students in the w/ option condition having higher levels of satisfaction in the course appraisal measure, it should be noted that this scale covered the following areas: (a) course Web site, (b) course material and instruction, (c) online activity and assignment, and (d) technical difficulties. On the other hand, the treatment (w/ option) group did not show a significant difference in the online communication appraisal measure, which entailed (a) level of participation, (b) reflective thinking, collaboration and interaction, (c) communication effectiveness, and (d) communication satisfaction.

Satisfaction by age group. The multivariate test revealed no significant difference between the age group of ≤ 25 and the age group of > 25 , $F(1, 173) = 1.12, p > .05$. Because the age independent variable was categorized in dichotomous form, Hotelling's Trace was used for the report. Specifically, for the course appraisal, the age group of ≤ 25 revealed no substantially higher satisfaction than the age group of > 25 , $F(1, 173) = .13, p > .05$ (see Table 5). The same was true for the online communication appraisal. No significant difference was found between the two age groups, $F(1, 173) = 1.68, p > .05$. The finding suggested that age is not a substantial factor relating to any subscale of student satisfaction. The fact that significant differences were not detected may be due to the selection of age 25 as the cutoff, which failed to reveal potential associations of age with student satisfaction.

Descriptive statistics on the two subscales of student satisfaction by age groups are reported in Table 6. On the course appraisal scale, students aged 25 or younger showed slightly higher satisfaction than the students older than 25 ($M = 52.25, SD = 6.88$ vs. $M = 51.82, SD = 8.53$, respectively). On the online communication appraisal scale,

students 25 or younger also showed more satisfaction than students older than 25 ($M = 59.99$, $SD = 8.97$ vs. $M = 58.01$, $SD = 11.06$, respectively) but in greater magnitude. As Figure 6 shows, the two lines appear to deviate from parallel. However, these differences were not statistically significant.

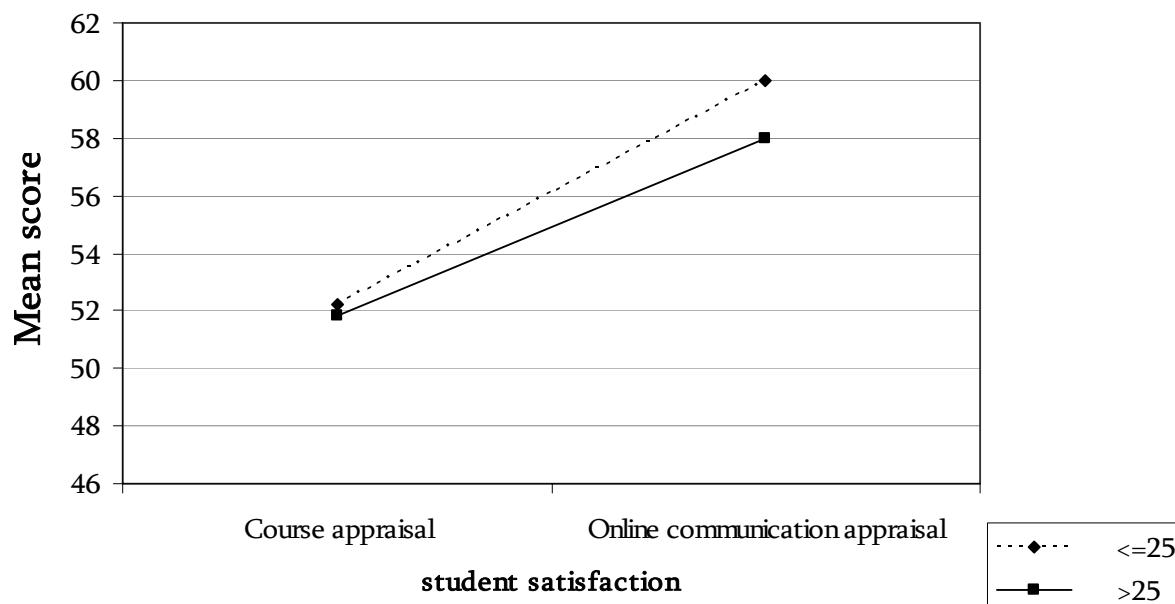


Figure 6. Mean differences of student satisfaction by age ($n = 173$).

Satisfaction by learning preference group. The multivariate test revealed no significant difference between the introverts and the extroverts, $F(1, 167) = .51$, $p > .05$. In particular, for the course appraisal, the introverted students revealed no substantially higher satisfaction than the extroverted students, $F(1, 167) = .70$, $p > .05$ (see Table 5). The same was true for the online communication appraisal. No significant difference was found between the two groups, $F(1, 167) = .03$, $p > .05$. The findings suggested the

students' learning preference was not associated significantly with student satisfaction in either of its two scales.

From the descriptive statistics of student satisfaction by learning preference group (see Table 6), the introvert group was slightly more satisfied on the course appraisal than were the extroverted students ($M = 52.46$, $SD = 7.46$ vs. $M = 51.44$, $SD = 7.83$, respectively). For the online communication appraisal, the introverted students were also more satisfied than the extroverted students ($M = 59.31$, $SD = 9.86$ vs. $M = 59.03$, $SD = 10.02$) but in less magnitude of difference as in the course appraisal. Figure 7 illustrates how similarly these two groups of students scored on the two satisfaction measures.

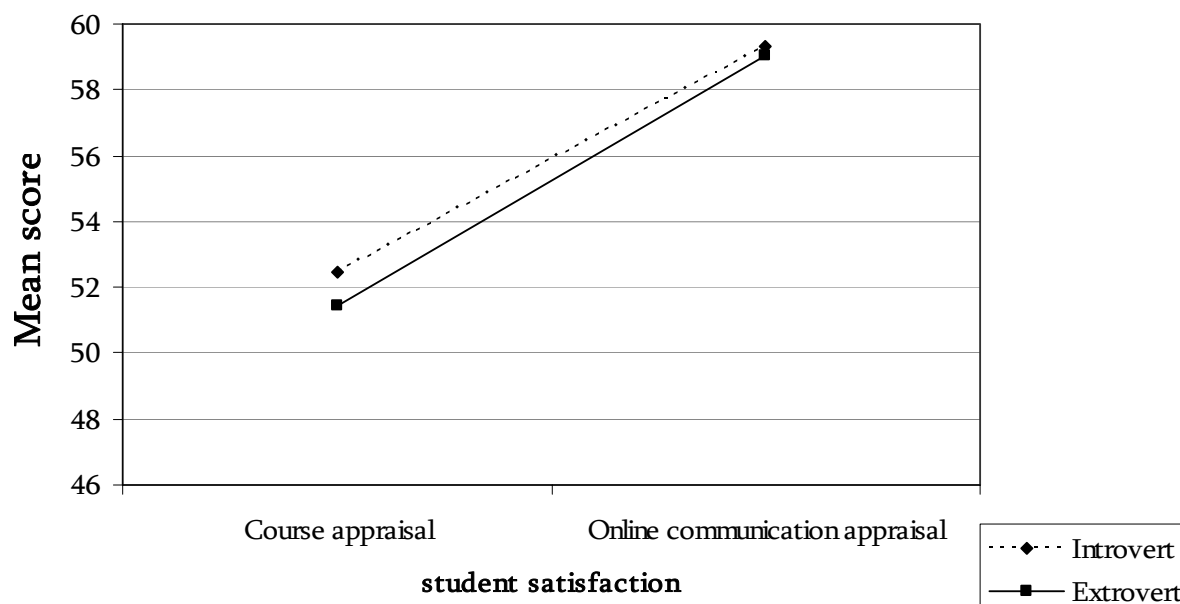


Figure 7. Mean differences of student satisfaction by learning preference ($n = 167$).

Finally in the multivariate test, the results reported by Wilk's Lambda revealed a significant three-way interaction among the factors of option, age, and learning

preference, $F(1, 159) = 4.26, p < .05$, with Eta squared value (η^2) of .05, indicating the three-way interaction accounted for 5% of variance in student satisfaction. In addition, the test noted another significant three-way interaction, option by age by learning preference, specifically in the online communication appraisal, $F(1, 159) = 6.08, p < .05$, with Eta squared value (η^2) of .04, indicating the three-way interaction accounted for 4% of variance in the online communication appraisal. Because the effective size is small, the follow up can be ignored.

Research Question 2

The second research question addressed whether the chat or threaded discussion option had a differential impact on students' cognitive achievement with respect to their age and learning preference. To this end, a MANOVA was performed to determine whether there were significant differences in students' cognitive achievement between the w/ option group and the w/o option group, and furthermore to explore whether there were significant differences with respect to their age and learning preference. The independent variables in this model were option (w/ option vs. w/o option), age (≤ 25 vs. > 25), and learning preference (introvert vs. extrovert). The dependent variable was cognitive achievement categorized into four levels— (a) Memorize-Fact, (b) Comprehend-Concept, (c) Apply-Concept, and (d) Apply-Principle—measured by the *Cognitive Achievement Assessment*.

Achievement by treatment group. The multivariate test disclosed a significant difference in the cognitive achievement between the w/ option group and the w/o option group, $F(1, 250) = 2.48, p < .05$.

1. For the Memorize-Fact level, the w/o option group did not score significantly higher than the w/ option group, $F(1, 250) = 2.14, p > .05$ (see Table 7).
2. For the Comprehend-Concept level, there was no significant difference between the two groups, $F(1, 250) = 1.90, p > .05$.
3. In the Apply-Concept level, the study found a significant difference between the w/o option group and the w/ option group, $F(1, 250) = 9.81, p < .001$. Cohen's d for the Apply-Concept level is .39, indicating 26.74% of nonoverlap. The effective size is moderate. Last in the Apply-Principle level, no difference between the two groups was found, $F(1, 250) = 1.16, p > .05$. In short, the only significant difference between the w/ option group and the w/o option group was found in the Apply-Concept level.

Table 7

Summary of MANOVA Results on Cognitive Achievement Levels by Option, Age, and Learning Preference

Dependent variable	Cognitive achievement			
	<i>df</i>	<i>F</i>	<i>p</i>	Cohen's <i>d</i>
Option (<i>n</i> = 250)				
Memorize-Fact	1	2.14	.15	.19
Comprehend-Concept	1	1.90	.17	.15
Apply-Concept	1	9.81	.00***	.39
Apply-Principle	1	1.16	.28	.13
Age (<i>n</i> = 225)				
Memorize-Fact	1	2.9	.09	.24
Comprehend-Concept	1	.02	.88	.00
Apply-Concept	1	3.66	.06	.26
Apply-Principle	1		.17	.17
1.87				
Learning preference (<i>n</i> = 219)				
Memorize-Fact	1	6.43	.01**	.34
Comprehend-Concept	1	.27	.61	.10
Apply-Concept	1	1.78	.38	.14
Apply-Principle	1	1.09	.30	.13

* $p < .05$. ** $p < .01$. *** $p < .001$.

Means and standard deviations on all four levels of cognitive achievement versus option (w/option vs. w/o option) were reported. On the all four levels of cognitive achievement, the w/o option group did better than the w/ option group. Specifically, the w/o option group answered 70% of the Memorize-Fact questions correctly, as opposed to the w/ option group's 65% ($M = .70$, $SD = .27$ vs. $M = .65$, $SD = .27$, respectively) (see Table 8). Similarly on the Comprehend-Concept level, the w/o option group also scored higher than the w/ option group ($M = .61$, $SD = .21$ vs. $M = .58$, $SD = .20$, respectively). For the higher cognitive levels, the w/o option group performed better than the w/ option

group for Apply-Concept ($M = .64, SD = .27$ vs. $M = .53, SD = .29$) and for Apply-Principle ($M = .68, SD = .32$ vs. $M = .64, SD = .29$). Overall, the mean difference was not consistent across the cognitive levels (see Figure 8). The w/o option group performed surprisingly better than the w/ option group in all four cognitive levels. The w/ option group tended to perform best in the Memorize-Fact level, which was the lowest tier in the cognitive hierarchy, and to perform worst in the Apply-Concept level, while the w/o option group did their worst in the Comprehend-Concept level but did best in the Memorize-Fact level. Both groups performed their highest in the lowest tier in the cognitive hierarchy. Although these differences may be noteworthy, it is important to reiterate no significant difference except on Apply-Concept.

Table 8

Summary of Mean Percentage on the Four Levels of Cognitive Achievement With Respect to the Three Independent Variables

	Cognitive achievement							
	Memorize-Fact		Comprehend-Concept		Apply-Concept		Apply-Principle	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
	Option ($n = 250$)							
w/ option	.65	.27	.58	.20	.53	.29	.64	.29
w/o option	.70	.27	.61	.21	.64	.27	.68	.32
	Age ($n = 225$)							
<= 25	.66	.26	.60	.21	.57	.28	.64	.31
> 25	.72	.25	.60	.20	.64	.26	.69	.28
	Learning preference ($n = 219$)							
Introvert	.72	.23	.60	.19	.61	.27	.68	.29
Extrovert	.63	.29	.58	.21	.57	.29	.64	.33

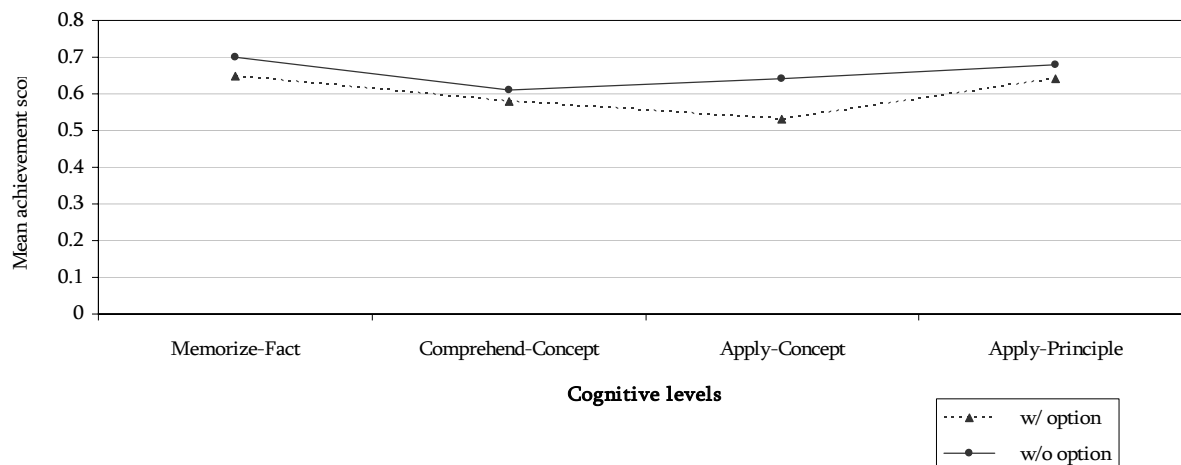


Figure 8. Mean differences of mean cognitive achievement by option scores in percentage ($n = 250$).

Achievement by age group. The multivariate test showed no significant difference in the cognitive achievement between students who were older than 25 and those 25 or younger, $F(1, 225) = 1.42, p > .05$. Specifically for the Memorize-Fact level, students who were older than 25 and those 25 or younger did not score significantly differently, $F(1, 225) = 2.9, p > .05$ (see Table 7). The same was true for the Comprehend-Concept level, $F(1, 225) = .02, p > .05$. The mean of students who were older than 25 was at the 50th percentile of those 25 or younger, and vice versa. Likewise, neither were the two age groups substantially different in the Apply-Concept level, $F(1, 225) = 3.66, p > .05$. Last, for the higher cognitive level, Apply-Principle, no significant difference between the two groups was found, $F(1, 225) = 1.87, p > .05$. Overall, the results suggested that age was not related to performance on any of the cognitive levels.

Means and standard deviations on the four levels of cognitive achievement by option (w/option vs. w/o option) were reported. For the Memorize-Fact level, students who were older than 25 performed better than those 25 or younger ($M = .72, SD = .25$ vs.

$M = .66$, $SD = .26$, respectively; see Table 8). In the Comprehend-Concept level, students who were older than 25 and those 25 or younger performed equally well ($M = .60$, $SD = .25$ vs. $M = .60$, $SD = .21$, respectively). Similarly with the Memorize-Fact level, students who were older than 25 performed better than those 25 or younger ($M = .64$, $SD = .26$ vs. $M = .57$, $SD = .28$, respectively) as well in the Apply-Concept level. Last, in the Apply-Principle level, students who were older than 25 also performed better than those 25 or younger ($M = .69$, $SD = .28$ vs. $M = .64$, $SD = .31$, respectively). Overall, students older than 25 did better in the upper three cognitive levels than those 25 or younger.

Figure 9 provides a visual of the mean difference in the two groups' performance on each level. Again, these differences were not statistically significant but do point to some trends in the data by age group.

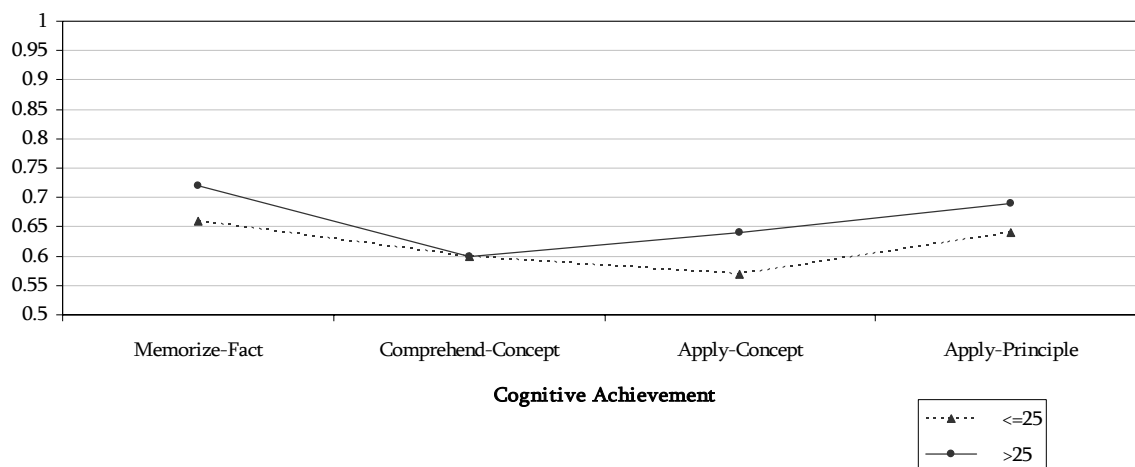


Figure 9. Mean differences of cognitive achievement scores in percentage versus age ($n = 225$).

Achievement by learning preference group. The multivariate test revealed no significant difference in the overall cognitive achievement between the introverts and the

extroverts, $F(1, 219) = 1.71, p > .05$. However in the Memorize-Fact level specifically, a substantial difference between the introverts and the extroverts was found (see Table 7), $F(1, 219) = 6.43, p < .01$. Cohen's d for this level was .34, indicating that the two distributions deviated 23.46% from each other. This also indicated that the mean score of the introverted students was at 63.6 percentile of the extroverted students. For the next cognitive level, results indicated no significant difference between introverts versus extroverts on the Comprehend-Concept scores, $F(1, 219) = .27, p > .05$. Results indicated no significant difference between introverts versus extroverts on the Apply-Concept scores, $F(1, 219) = .78, p > .05$. In the Apply-Principle level, extroverts did not score substantially worse than introverts, $F(1, 219) = 1.09, p > .05$. The finding indicated that the introverted students substantially outperformed the extrovert only in the Memorize-Fact cognitive level.

The descriptive statistics (see Table 8) on cognitive achievement vis-à-vis learning preference (introvert vs. extrovert) indicated that the introverted students outperformed the extroverted students at all four cognitive levels: (a) Memorize-Fact: $M = .72, SD = .23$ vs. $M = .63, SD = .29$; (b) Comprehend-Concept: $M = .60, SD = .19$ vs. $M = .58, SD = .21$; (c) Apply-Concept: $M = .61, SD = .27$ vs. $M = .57, SD = .29$; and (d) Apply-Principle: $M = .68, SD = .29$ vs. $M = .64, SD = .33$. Figure 10 illustrates the mean differences between the two learning preference types.

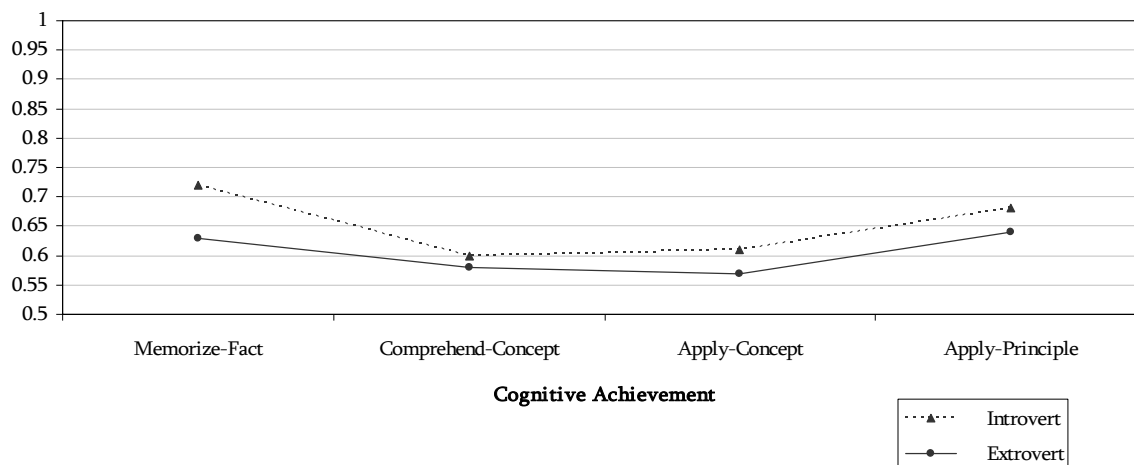


Figure 10. Mean differences of cognitive achievement in percentage scores by learning preference ($n = 219$).

Finally, the MANOVA reported by Wilk's Lambda revealed a significant three-way interaction, option by age by learning preference, $F(1, 212) = 5.53, p < .05$, in the Memorize-Fact level, with Eta squared value (η^2) of .03, indicating the three-way interaction accounted for 3% of variance in the Memorize-Fact level of cognitive achievement. Because the effect size is small, the follow up can be ignored.

Research Question 3

The third research question sought to determine whether the chat or threaded discussion option had a differential impact on students' self efficacy with respect to their age and learning preference. To this end, a MANCOVA was performed to determine whether there were significant differences in students' self-efficacy between the treatment group and the control group and, furthermore, to explore whether there were significant differences with respect to their age and learning preferences. The

independent variables in this analysis were option (w/ option vs. w/o option), age (≤ 25 vs. > 25), and learning preference (introvert vs. extrovert). The dependent variables were six domains of self-efficacy—(a) Web activities, (b) information literacy, (c) learning theories, (d) PBL, (e) cooperative learning, and (f) online communications in general—as measured by *Self-Efficacy on Use of Online Discussion Questionnaire*.

Self-efficacy by treatment group. The multivariate test revealed that no significant difference existed between the two groups (w/ option vs. w/o option) in self-efficacy, $F(1, 167) = .53, p > .05$. Specifically, the w/ option group and the w/o option group did not show significant difference in the domain of Web activities, $F(1, 167) = .73, p > .05$ (see Table 9). For the next domain, information literacy, the w/ option group also did not differ from the w/o option group significantly, $F(1, 167) = .22, p > .05$. Likewise for the learning theories domain, the w/ option group and the w/o option group were considered statistically alike, $F(1, 167) = .01, p > .05$. As for the PBL domain, the two groups also did not differ substantially, $F(1, 167) = .46, p > .05$. The same was true for the cooperative learning domain, $F(1, 167) = .00, p > .05$, and the online communication domain, $F(1, 167) = .24, p > .05$. The results indicated that the treatment, providing the option to choose the two formats of discussion format, was not a substantial factor impacting on any of the domains of self-efficacy.

Table 9

MANOVA Results for the Self-Efficacy Domains by Option, Age, and Learning Preference

Dependent variables	Self-efficacy			
	df	F	p	d
Option (<i>n</i> = 167)				
Web activities	1	.73	.39	.08
Information literacy	1	.22	.64	.02
Learning theories	1	.01	.91	.06
Problem-based learning (PBL)	1	.46	.50	.02
Cooperative learning	1	.00	.99	.08
Online communications in general	1	.24	.63	.12
Age (<i>n</i> = 161)				
Web activities	1	2.19	.14	.20
Information literacy	1	2.87	.09	.20
Learning theories	1	6.31	.01**	.23
Problem-based learning (PBL)	1	3.41	.07	.24
Cooperative learning	1	.00	.97	.03
Online communications in general	1	1.07	.30	.15
Learning preference (<i>n</i> = 161)				
Web activities	1	.36	.55	.06
Information literacy	1	.88	.35	.17
Learning theories	1	.38	.54	.08
Problem-based learning (PBL)	1	1.03	.31	.23
Cooperative learning	1	4.53	.04*	.45
Online communications in general	1	.17	.68	.17

* $p < .05$. ** $p < .01$.

Descriptive statistics on the six domains of self-efficacy by option (w/option vs. w/o option) were reported (see Table 10). Surprisingly, the w/o option group felt more efficacious than the w/option group for the Web activities domain ($M = 21.37$, $SD = 3.30$ vs. $M = 21.11$, $SD = 3.01$, respectively) and for the PBL domain ($M = 20.91$, $SD = 3.46$ vs. $M = 20.83$, $SD = 3.40$, respectively). These means are essentially identical. Conversely, the w/o option group possessed lower self-efficacy than the w/option group for the remaining four domains: (a) information literacy: $M = 22.36$, $SD = 3.01$ vs. $M =$

22.42, $SD = 2.68$; (b) learning theories: $M = 20.00$, $SD = 2.29$ vs. $M = 20.22$, $SD = 3.42$; (c) cooperative learning: $M = 25.81$, $SD = 3.71$ vs. $M = 26.12$, $SD = 4.45$; and (d) online communication in general, $M = 25.63$, $SD = 4.63$ vs. $M = 26.19$, $SD = 4.53$. In short, although the w/ option group tended to have greater self-efficacy in the domains of information literacy, learning theories, cooperative learning, and online communication in general, the reverse was true in the domains of Web activities and PBL. As the mean differences showed (see Figure 11), both groups obtained much higher self-efficacy in cooperative learning as opposed to learning theories. The w/ option group had the highest level of self-efficacy in online communication and also showed higher levels of self-efficacy in this area than the w/o option group. The w/o option group possessed the highest self-efficacy in cooperative learning.

Table 10

Descriptive Statistics on the Domains of Self-Efficacy With Respect to the Three Independent Variables

Self-efficacy	Option		Age		Learning preference	
	w/ option	w/o option	<= 25	> 25	Introvert	Extrovert
Web activities	(n = 167)		(n = 161)		(n = 161)	
<i>M</i>	21.11	21.37	20.96	21.57	21.31	21.12
<i>SD</i>	3.01	3.30	3.35	2.82	2.62	3.86
Information literacy						
<i>M</i>	22.42	22.36	22.14	22.70	22.23	22.71
<i>SD</i>	2.68	3.01	2.84	2.85	2.84	2.88
Learning theories						
<i>M</i>	20.22	20.00	19.66	20.73	19.93	20.21
<i>SD</i>	3.42	2.29	3.16	3.57	3.45	3.17
Problem-based learning (PBL)						
<i>M</i>	20.83	20.91	20.56	21.37	20.57	21.33
<i>SD</i>	3.40	3.46	3.58	3.22	3.70	2.87
Cooperative learning						
<i>M</i>	26.12	25.81	25.98	25.87	25.36	27.10
<i>SD</i>	4.45	3.71	4.12	4.26	4.52	2.97
Online communications in general						
<i>M</i>	26.19	25.63	25.70	26.37	25.71	26.45
<i>SD</i>	4.53	4.44	4.62	4.04	4.89	3.47

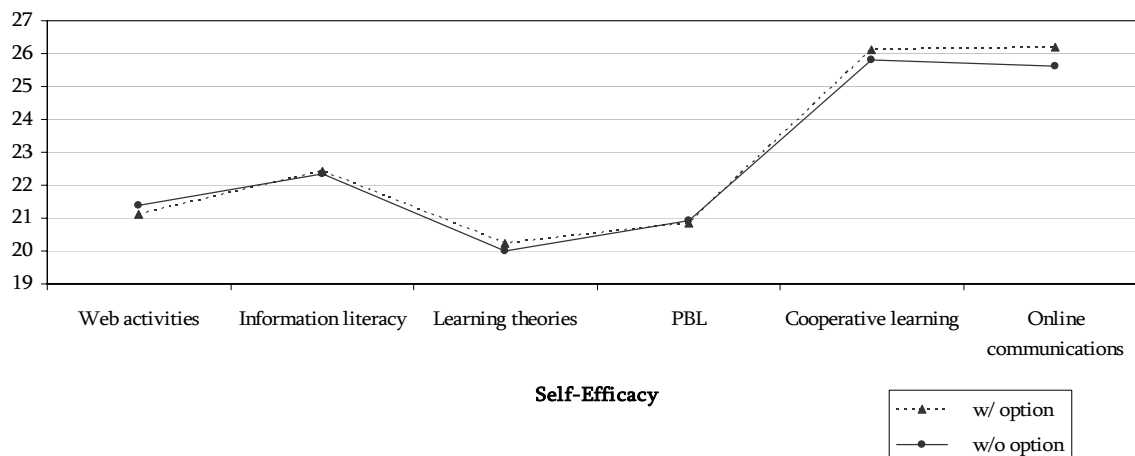


Figure 11. Mean differences of self-efficacy scores by option ($n = 167$).

Self-efficacy by age group. The multivariate test revealed no significant difference between the two age groups (≤ 25 vs. > 25) in overall self-efficacy, $F(1, 161) = 1.85, p > .05$. For Web activities, students older than 25 and those 25 or younger did not present significantly different magnitudes of self-efficacy, $F(1, 161) = 2.19, p > .05$ (see Table 9). Next for the information literacy domain, the two age groups were not substantially different from each other, $F(1, 161) = 2.87, p > .05$. Interestingly, the two age groups differed significantly in the domain of learning theories, $F(1, 161) = 6.31, p < .05$, with an effect size of .23, implying that the two distributions deviated from each other about 15.92%. This can also be interpreted that the mean score of students who were older than 25 was at the 58.88 percentile of that of those 25 or younger. As for the PBL domain, the two age groups did not differ substantially, $F(1, 161) = 3.41, p > .05$. Similarly for the cooperative learning domain, the two age groups did not differ substantially, $F(1, 161) = .00, p > .05$. Likewise, the two age groups did not differ substantially in the online communication domain, $F(1, 161) = 1.07, p > .05$. Overall, students who were older than

25 and those 25 or younger possessed significantly different self-efficacy in learning theories only.



Figure 12. Mean differences of self-efficacy scores versus age ($n = 161$).

Descriptive statistics (see Table 10) on self-efficacy vis-à-vis age showed that students who were older than 25 felt more efficacious than those 25 or younger in five domains: (a) Web activities: $M = 21.57$, $SD = 2.82$ vs. $M = 20.96$, $SD = 3.35$, respectively; (b) information literacy: $M = 22.70$, $SD = 2.85$ vs. $M = 22.14$, $SD = 2.84$; (c) learning theories: $M = 20.73$, $SD = 3.57$ vs. $M = 19.66$, $SD = 3.16$; (d) PBL: $M = 21.37$, $SD = 3.22$ vs. $M = 20.56$, $SD = 3.58$; and (e) online communication in general: $M = 26.37$, $SD = 4.04$ vs. $M = 25.70$, $SD = 4.62$. Conversely, in cooperative learning, students who were older than 25 presented slightly lower self-efficacy than those 25 or younger ($M = 25.87$, $SD = 4.26$ vs. $M = 25.98$, $SD = 4.12$ respectively). In an overall view, students who were older than 25 showed greater self-efficacy than those 25 or younger while facing the various subjects required for the course except the domain of cooperative learning (see Figure 12). In addition, students who were older than 25 were the most efficacious on the

domain of online communication in general as opposed to the other five domains, while those 25 or younger felt most self-efficacious in the domain of cooperative learning as opposed to the other domains. The greatest mean difference between those who were older than 25 and those 25 or younger was in the learning theories domain, and the smallest mean difference between the two was in the cooperative learning domain.

Self-efficacy by learning preference group. The multivariate test indicated that the introverted students and the extroverted students did not differ significantly in overall self-efficacy, $F(1, 161) = 1.23, p > .05$. Specifically, for Web activities, the introverts did not feel substantially more efficacious than the extroverts, $F(1, 161) = .36, p > .05$. For information literacy, the introverted students did not feel substantially less efficacious than the extroverted, $F(1, 161) = .88, p > .05$. The introverted students were not substantially less efficacious than the extroverted students for learning theories, $F(1, 161) = .38, p > .05$, or for PBL, $F(1, 161) = 1.03, p > .05$. However, in cooperative learning extroverts felt substantially more efficacious than the introverts, $F(1, 161) = 4.53, p < .05$. The effect size, Cohen's d , was .45, indicating that the mean of the extrovert group was at the 67.13 percentile of the introvert group. Additionally, the effect size of .45 implied that the two distributions were 29.85% not overlapped. Finally, the introverted students and the extroverted students still did not differ significantly in online communication scores, $F(1, 161) = .17, p > .05$. The results indicated that the students' self-efficacy was dependent on their learning preference only in the cooperative learning domain.

Based on the descriptive statistics (see Table 10) on self-efficacy vis-à-vis learning preference (introvert vs. extrovert), the introverted students were less efficacious

than the extroverted students in five domains: (a) information literacy ($M = 22.23$, $SD = 2.84$ vs. $M = 22.71$, $SD = 2.88$, respectively), (b) learning theories ($M = 19.93$, $SD = 3.45$ vs. $M = 20.21$, $SD = 3.17$), (c) PBL ($M = 20.57$, $SD = 3.70$ vs. $M = 21.33$, $SD = 2.87$), (d) cooperative learning ($M = 25.36$, $SD = 4.52$ vs. $M = 27.10$, $SD = 2.97$), and (e) online communication in general, ($M = 26.45$, $SD = 3.47$ vs. $M = 25.71$, $SD = 4.89$). Conversely, the introverts had higher self-efficacy than the extroverts in the domain of Web activities ($M = 21.31$, $SD = 2.62$ vs. $M = 21.12$, $SD = 3.86$). The introverts tended to be slightly more efficacious than the extroverts in the Web activities domain, while the extroverts were more efficacious than the introverts in the rest of the domains (see Figure 13).

Interestingly, the extroverts felt themselves the most capable in terms of cooperative learning among the six scales and also substantially outscored the introverts, which was intuitively meaningful. Both the introverts and the extroverts felt themselves the least capable or efficacious when the goal was to master learning theories.

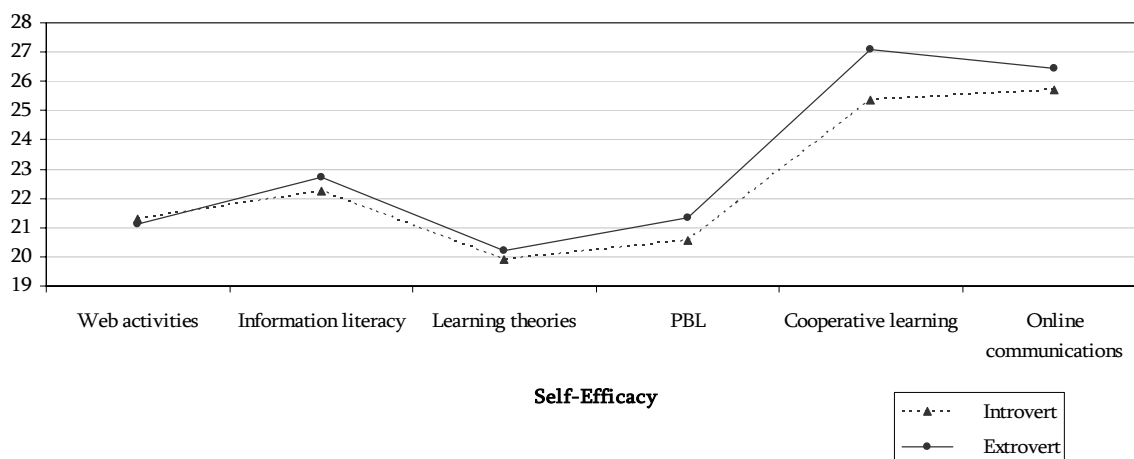


Figure 13. Mean differences of self-efficacy scores by learning preference ($n = 161$).

Research Question 4

The fourth research question attempted to determine whether an association exists between students' age and learning preference. To answer, a chi-square analysis using a two-way contingency table was used to determine whether the two categorical variables, age (≤ 25 vs. > 25) and learning preference (introvert vs. extrovert), were associated. The age variable was entered as column factor, and the learning preference variable as row factor.

Preliminary observation (see Table 11) showed that for the students 25 or younger, 50.4% were introverted and 49.6% were extroverted. For students who were older than 25, 61.3% were introverted and 38.8% were extroverted. In the age group of ≤ 25 , the introverts and the extroverts were about half and half, while in the age group of > 25 , the introverts outnumbered the extroverts. The chi-square analysis also showed that because of the similar observed values and expected values, age and learning preference were independent of each other, $\chi^2 (1, N = 213) = 2.38, p > .05$. That is, measures of association were small and did not approach significance. The low chi-square suggested that learning preference was not dependent on age. Finally, *Phi* of .11 also represented a weak association between age and learning preference.

Table 11

Chi-Square Analysis on Learning Preference by Age

Learning preference		Age	
		<= 25	> 25
Introvert	Count	67.0	66.0
	Percentage	50.4%	61.3%
Extrovert	Count	49.0	31.0
	Percentage	49.6%	38.8%
Total	Count	116.0	97.0
	Percentage	100.0%	100.0%

Research Question 5

The fifth research question investigated whether or not relationships could be found among the three instructional outcomes—student satisfaction, cognitive achievement, and self-efficacy. To answer the question, a regression analysis was used to determine whether the three measured variables correlate with each other and whether self-efficacy can be predicted by student satisfaction and cognitive achievement.

The β value, varying between ± 1.0 in linear relationship, indicates the relative strength of relationships of the entered variables or the predictive power of predictor variables (see Table 12). The results indicated that student satisfaction had a stronger magnitude on students' self-efficacy ($\beta = .35$) as compared to the other predictor variable, cognitive achievement ($\beta = .18$). The direction of relationship for both predictor variables was positive. In other words, the more satisfaction the students felt toward the course, the more likely they would feel more self-efficacious. Likewise, the more students achieved at the higher cognitive levels, the more likely they would obtain higher self-efficacy.

Table 12

Regression Analysis of Self-Efficacy on Predictor Variables—Cognitive Achievement and Student Satisfaction

Predictor variables	<i>B</i>	<i>SE B</i>	β	<i>t</i>
(Constant)	89.09	8.13		10.97**
Cognitive achievement	16.78	6.75	.177	2.48*
Student satisfaction	.32	.07	.353	4.97**

Note. Predictors: cognitive achievement, student satisfaction. Dependent variable: self-efficacy
* $p < .05$. ** $p < .001$.

This finding (see Table 13) suggested a positive relationship between student satisfaction and self-efficacy ($r = .37, p < .01$), implying that 14% (r^2) of the variance of the student satisfaction variable was accounted for by its linear relationship with self-efficacy. In addition, the finding also indicated a small positive relationship between self-efficacy and cognitive achievement ($r = .18, p < .05$), implying that 3% (r^2) of the variance of cognitive achievement variable was accounted for by its positive linear relationship with self-efficacy. Overall, the r^2 value ($r = .41, r^2 = .17, \text{adjusted } r^2 = .16$) indicated that about 17% of self-efficacy could be accounted by its linear relationship with the predictor variables, cognitive achievement and student satisfaction, $F(2, 166) = 16.86, p < .001$. However, the sample r^2 tended to overestimate the population r^2 and needed to be adjusted downward. Moreover, predictor variables resulted in more adjustment penalty of r^2 .

Table 13

Intercorrelations Among the Three Instructional Outcomes

	Self-efficacy	Student satisfaction	Cognitive achievement
Self-efficacy	—	.37**	.18*
Student satisfaction		—	.08
Cognitive achievement			—

* Correlation is significant at the .05 level (2-tailed).

** Correlation is significant at the .01 level (2-tailed).

Summary

The first three research questions addressed whether the w/ option treatment enhanced student satisfaction, cognitive achievement, and self-efficacy, and whether age and introversion–extroversion influenced these relationships. The fourth research question sought to identify whether an association between age and learning preference existed. The last research question investigated whether relationships could be found among the three dependent variables—student satisfaction, cognitive achievement, and self-efficacy. Ultimately, the study attempted to examine the potential impacts of the online communication format option—synchronous chat versus asynchronous threaded discussion—on the students’ three instructional outcomes.

In brief, the results showed that, when given an option, a higher percentage of introverts than extroverts tended to choose the threaded discussion forum. The option indeed had an impact on overall student satisfaction, specifically on the course appraisal subscale but not on the online communication appraisal. In addition, the option also had an influence on cognitive achievement—specifically, on one cognitive levels, Apply-

Concept, but not on three other levels, Comprehend-Concept, Memorize-Fact and Apply-Principle. Second, students' learning preferences had a differential influence on their cognitive achievement in the Memorize-Fact level and overall. Third, learning preference was a factor affecting self-efficacy but only in the cooperative learning domain. Finally, the students' self-efficacy scores were associated with their cognitive achievement and satisfaction. In other words, the more satisfied the students felt toward the course, the higher cognitive engagement the students achieved, and the more likely they would feel self-efficacious.

Chapter 5: Discussion

This final chapter consists of five major sections. First, the findings are addressed based on the five research questions. The interpretation by research question is followed by the Limitations, Recommendations for Future Research, Summary, and Overall Conclusion sections.

Findings

Factors Influencing Student Satisfaction

The findings answered whether the chat versus threaded discussion option differentially impacts student satisfaction, and whether students' ages and learning preferences correlate with their satisfaction with respect to the course and the embedded online communication. The factor option substantially accounts for student satisfaction, and specifically as it pertains to the course appraisal. Although the degree of student satisfaction in the online communication appraisal between the two option groups was different, the difference was not statistically significant.

As the course appraisal covers several criteria—Web site, course materials and instruction, online activity and assignment, and technical difficulties—the findings lend support to earlier studies (Irons et al., 2002; Overbaugh et al., 2003) that suggested providing students with a choice of a variety of communication tools should better meet students' needs and in turn increase their satisfaction. This study found no substantial difference in student satisfaction on the online communication appraisal, in which participation grade was stressed, congruent with Neuhauser's (2002) study. Neuhauser investigated two sections of the same undergraduate course—one taught face-to-face and the other taught equivalently online—by examining gender, age, learning preferences,

media familiarity, and course effectiveness, thereby claiming that there is no significant difference in the course effectiveness with respect to level of participation. That is, student degree of participation in the course is not correlated with course effectiveness. Stein (2004) argued that no matter whether a course is delivered online or face-to-face, course structure, including clearly defined objectives and assignments, online activities, and such attributes, is the most critical element affecting student satisfaction. His explanation is intuitively meaningful because the course appraisal covers the relatively broader, major scaffold of a course, whereas the online communication appraisal subscale can be seen as tools to help carry out the course.

The finding of no relationship between age and student satisfaction concurs a study (Shirvani, 2002) that examined and compared factors influencing student satisfaction between two distance classes, one with video media and the one without. Similarly, Thurmond et al. (2002) concluded that in an online environment, student satisfaction was greatly influenced by environmental factors rather than student characteristics such as age and learning preference. The lack of association between student age and satisfaction is, however, inconsistent with the majority of prior research findings (Bower & Kamata, 2000; Neuhauser, 2002; Wang, Hinn, & Kanfer, 2001). In Bower and Kamata's study on exploring factors influencing student satisfaction with online courses, age, defined into four discrete categories (20 or below, 21–30, 31–40, and 40 or above), had a significantly positive correlation with overall student satisfaction. The age categorization was different from that of this study, which used the age of 25 as the breaking point. The prior empirical studies with the different findings might be due to uncontrollable variables, different age categorizations, and study contexts. Thurmond et

al. postulated that studies of this type should carefully control for student characteristics to minimize experimental bias and to reduce the chance of incorrectly attributing outcomes to the learning environment.

In addition, Neuhauser's (2002) study on face-to-face versus equivalent online instruction brings out another issue that prior experiences with either type of online discussion forum tend to contaminate the research findings. It is worth noting that student satisfaction might be influenced by prior experiences with use of technology tools, group composition with varying peer interaction, and instructor intervention (Rosental et al., 2000). Rosental et al found that students who had a positive interaction with their instructor reported significantly higher satisfaction than those who experienced a negative interaction. Because this study included 13 classes taught by seven faculty members, there was a concern about the potential differential effect the faculty members might have on the treatment effect. Significant effort was made to control for instructor differences by (a) using a similar syllabus, (b) requiring identical assignments and accompanying assessment rubrics, (c) meeting with all instructors and explaining the desired procedures and pedagogy, and (d) providing learning guidance to all the students at the beginning of the semester. These efforts were to help minimize differences that might be due to instructor influences; however, instructor may have effects nonetheless influenced the student satisfaction results.

Factors Influencing Cognitive Achievement

The second research question addressed whether the chat versus threaded discussion option differentially impacts students' cognitive achievement, and whether students' cognitive achievement has relationships to their age and learning preferences.

As the findings indicate, the option has a significant impact on students' cognitive achievement, and specifically at the Apply-Concept cognitive level. The findings are congruent with several earlier studies (Beck, 2001; Ford & Chen, 2001; Robotham, 1999) and further provide more insight into *levels* of cognitive achievement. Contrary to what was expected from an instructional customization viewpoint, the comparison group in which no option was offered scored significantly higher than the w/ option group in the Apply-Concept cognitive level. To further examine the veracity of this connection, two additional analyses were conducted. First, a chi-square test was used to examine whether the phenomenon was due to the disproportionate number of the students in the course level (graduate vs. undergraduate) in the two conditions. The observed values versus expected values showed that the course level and the option factors were dependent of each other, $\chi^2(1, N = 252) = 67.84, p < .001$. *Phi* of .52 suggests a strong relationship between course level and option. In addition, the multivariate analysis revealed that the variance of the course level (graduate vs. undergraduate) accounts for substantial differences in cognitive achievement, $p < .001$, and specifically in the four levels, $p < .001$. Such findings of graduates performing better than undergraduates suggest that the w/o option control group outperforming w/ option treatment group might be due to having the disproportionately large number of graduate students in the w/o option comparison group. Under the identical course structure and material and meticulously controlled instructor intervention, the study implied that graduate students outperform undergraduate in cognitive achievement. Yet, whether graduate students tend to have more sophisticated study strategies, adaptive strategies, or other skills that advance them in terms of cognitive achievement is beyond the scope of this study.

To further inspect factors influencing cognitive achievement, another chi-square test with option as column factor and student status (part-time vs. full-time) as row factor showed a disproportionate number of student status (part-time vs. full-time) in the two condition, $\chi^2(1, N = 221) = 9.52, p < .01$. *Phi* of .21 indicated a moderate relationship between the two. The test also showed substantially unequal distribution in the w/ option treatment condition, $p < .001$, and in the w/o option control condition, $p < .001$. That is, part-time and full-time students were distributed disproportionately in the two conditions (w/ option vs. w/o option). Another multivariate analysis as a follow-up reported that student status of part-time or full-time ($M = .65, SD = .26$ vs. $M = .56, SD = .28$, respectively) surprisingly accounts for score differences in the Apply-Concept level, $F(1, 220) = 4.81, p < .05$ with Cohen's d of .33. Owing to the fact that adult learners tend to advance differently on sophistication of self-regulation, intrinsic motivation, and other metacognition skills (Cross, 1981), to explore critical factors between part-time and full-time students that deviate substantially in cognitive achievement is beyond the interest of this study.

Therefore, the findings that the option has a significant impact on cognitive achievement and specifically in the Apply-Concept level not only may be due to the treatment effect but also may be due to other confounding variances such as disproportionate student status (part-time vs. full-time) and course levels (graduate vs. undergraduate).

As for no substantial relationship between age and cognitive achievement, one study by Gadzella et al. (2002) implied that students older than 25 perform as well cognitively as those who are younger. In other words, age variance does not account for

difference in cognitive achievement. In addition, in their empirical study of underprepared adults at a 2-year college, with 40% of the sample of adults 25 or older and 60% age 24 or under, Miglietti and Strange (1998) also lend support to this research finding that the age factor is not of chief concern on composite course grades, regardless of course section and teaching style of instructors. In Thorndike's (1928) view, instructors should expect adults of age 25 or younger and those of 25–45 to learn one thing at nearly the same rate and in nearly the same manner. However, adult's motives and preferences tend to fluctuate as they age and as they adopt multiple roles (Cross, 1981). That is, as a function of age, adult learners tend to be less influenced by extraneous interruptions and situational characteristics but able to focus on the learning, *per se*.

Learning preference is substantially correlated with students' cognitive achievement and in particular on the Memorize-Fact level. In empirical studies examined, Wynd and Bozman (1996) documented that cumulative GPA of business school undergraduates is substantially associated with their learning preferences as measured by Kolb's (1993) LSI. From their findings, the business major students with higher GPA levels tended to be convergers and assimilators, whereas the students with lower GPA levels tended to be accommodators and divergers. This research finding also supports Shaughnessy's (1998) claim that learning preference is a function of achievement level and processing preference. Another study by Hsu and Dwyer (2004) investigated instructional effects of varied levels of adjunct questions within a hypermedia program on the comprehension of field-dependent and field-independent students. They found that the field-independent students achieved substantially better than the field-dependent on

the comprehension questions. The finding revealed that students' learning preference is associated with their academic achievement in both composition grade and cognitive hierarchy in a significant way. However, the present findings indicate learning preference only influences cognitive achievement to a very limited extent. Memorize-Fact is the most basic cognitive skill requiring drill and practice to remember and recognize factual knowledge (e.g., dates, names, and events). No advanced cognitive skills are involved and utilized.

Factors Influencing Self-Efficacy

The third research question inquired into whether the chat versus threaded discussion format option differentially impacts students' self-efficacy, and whether their ages and learning preferences are correlated with self-efficacy. As the findings suggested, the three factors—option, age, and learning preference—do not interact with degrees of self-efficacy.

Specifically, the option did not significantly impact any of the self-efficacy domains. However, it is worth noting that the w/ option group showed the strongest self-efficacy in the online communication domains as indicated by the greatest mean difference. This is intuitively understandable and encouraging. Even though the treatment, which provided students the option to choose either chat or threaded discussion forums, did not enhance or undermine the students' self-efficacy, the study lays a foundation for future studies that consider other variables (e.g., group composition) to frame research designs. To gain more insight, Bandura (1994) explained that people's beliefs about their efficacy are primarily accounted for through four major sources: (a) mastery experiences; (b) vicarious experiences provided by social models; (c) social persuasion; and (d)

reduced reaction to stress, emotional predispositions, and misinterpretations of physical states. These four sources of influence deal with collective parameters to a great extent. Because this study clustered four students in each group, one might inquire whether the group composition masked the treatment effect; by randomly assigning the students to the groups, the potential bias caused by group composition was controlled to the minimum extent.

As far as the age factor is concerned, the finding showing that age does not account for differences in self-efficacy is inconsistent with earlier studies (e.g., Daniele et al., 2003; Fernandez-Ballesteros et al., 2002) that showed levels of self-efficacy belief vary substantially as a function of age. Such an inconsistency may have several reasons. Most notably, the present study analyzed age as a dichotomous variable instead of a continuous variable. The age of 25 as a cutoff might have been inadequate for this particular study. In addition, the duration of treatment implementation in this study might have been insufficient as age-related differences in perceived efficacy reflect developmental changes over time (Fernandez-Ballesteros et al.).

Finally, the finding that learning preference is a factor affecting self-efficacy exclusively in the cooperative learning domain is concurrent with Qutami and Abu-Jaber's (1997) study on learning computer skills in the college of education at Sultan Qaboos University. Because the extroverts prefer to learn by explaining to others, they also enjoy working in groups (Quenk, 1999). The finding is plausible from the standpoint of the distinct differences between the introvert and the extrovert; the extroverts seek energy from socialization, whereas the introverts tend to reflect quietly and alone. This

implies that the extroverts should be more comfortable and have higher levels of self-efficacy than the introverts in a collective atmosphere such as that of cooperative learning.

Correlation Between Age and Learning Preference

The fourth research question looked for an association between students' ages and learning preferences. This study suggests that the two categorical variables, age (using 25 as the cutoff) and learning preference (introvert vs. extrovert), are not significantly related. This finding is consistent with a study (Miglietti & Strange, 1998) conducted in a remedial program at a 2-year college that concluded that student age is related to learning preference in a limited way. The above two findings appear inconsistent with one empirical study (Wynd & Bozman, 1996) conducted with a group of business school undergraduates. In that study, nontraditional and traditional college students with age 24 as the breaking point substantially differed in their learning preferences. Additionally, Shaughnessy (1998) claimed that learning preference often varies as functions of age and other factors. However, this incongruence might be attributable to samples from different majors. The study by Miglietti and Strange included adult students who majored in several subjects but were overrepresented in mathematics sections. It is of a concern that overrepresentation in one subject might unduly influence the result. On the other hand, Wynd and Bozman's study researched adult students in business major homogeneously.

It is worth noting that learning preference is a perplexing set of attributes that entail personal characteristics at varying weights with respect to different contexts. Future research would benefit from meticulously tracking intended context and essential characteristics of course disciplines involved to inquire into whether one's age is

correlated with other types of learning preference and whether one's learning preference shifts as the student grows older.

Relationships Among Satisfaction, Cognitive Achievement, and Self-Efficacy

This study suggests that self-efficacy is related to cognitive achievement and student satisfaction. That is, the more satisfied the students feel about the course, the more likely they are to have higher levels of self-efficacy. Likewise, the higher levels of cognitive achievement result in higher levels of self-efficacy. Supporting this finding, Lim (2001) reported that in Web-based courses, adult students with a higher degree of computer self-efficacy appeared to be more satisfied with the course and were more likely to say they intended to take a Web-based course in the future. She went on to describe a positive, reciprocal phenomenon existing among the factors: The more the students possess greater self-efficacy, the more they will feel more satisfied with courses, and in turn, they will have stronger confidence in academic competency. With positive academic competency, the students have greater self-efficacy the next time they take a course with a similar format.

The positive relationship between self-efficacy and cognitive achievement is consistent with prior research findings (Thomas, Iventosch, & Rohwer, 1987) showing that students' perception of self-efficacy is positively related to productive study and academic achievement. However, the Thomas et al. study measured academic achievement using a composite course grade rather than a stratified achievement measure based on a cognitive hierarchy, as in this study.

Limitations

The purpose of this study was to examine whether the instructional strategy of providing options has significant impacts on the three instructional outcomes. The unit of analysis of the study was the student, and each student was categorized based on age (less than 25 vs. 25 or older) and learning preference (introversion vs. extroversion). In addition, the subjects in this study included preservice and in-service teachers in two nearly identical instructional technology courses. Still, having two types of subjects, potentially different in life characteristics such as full-time vs. part-time enrollment or number of children at home, invited an additional extraneous variable. Yet, a large age variance increased the scope of this study. Aside from that, different instructors teaching the courses might be another extraneous variable that could contaminate the dependent measures, particularly on the student satisfaction variable. To aid control, specific teaching guidance was provided to all instructors at the beginning of the semester to help minimize differences that might be due to instructor influence.

As mentioned, by having students as the unit of analysis as well as using a control group, the possibility of the selection threat was controlled to a certain extent. Aside from that, because each unit of analysis was clustered based on the two identifications (age and learning style), the likelihood of varying personal characteristics of the subjects was greatly reduced. The treatment diffusion probably occurs when the subjects in the control group know about the treatment and share information with those in the treatment group. In such a case, the treatment may be confounded and not as experimentally distinct as intended, which may mask the treatment effect where there is a difference. On the other hand, if treatment diffusion occurs, demoralization threat in the control group may also

cause another masking effect in which the treatment seemed to have an effect when in fact it did not. That consequence can be serious and may lead to a false report. That is, if the control group perceives that the treatment group received preferential treatment, the control group likely could attempt to outperform the treatment group.

Because this study employed the cognitive assessment specifically developed and reviewed by the instructors to match the discussion content, the open-ended questions with the subjective scoring scheme provoked considerable concerns in the scorer reliability. To control, the researcher was responsible for the grading based on detailed rubrics. Although the number of assessment questions was limited, due to constraints of the existing course structure and schedule, and might not be sufficient for the split-half reliability test, Cronbach's alpha was still established during the data collection. The study established the achievement assessment's content-related validity with the discussion topics as a blueprint to determine whether each of the project-based discussion topics was covered by the test items. One of the instructors, who served as a subject-domain expert, also reviewed the assessment questions to ensure the content-related validity. Even though two of the discussion topics were not being covered in the assessment, the content validity is still considered adequate.

This study utilized a newly constructed questionnaire to indicate the introversion–extroversion attitude preference. Based on the results of the pilot test, the internal consistency was reported to be .75, which is satisfactory for the current number of subjects and questions. An examination of whether the Introversion–Extroversion Index correlates with MBTI could be made to strengthen the study's convergent validity. However, the cost of MBTI hinders such an attempt. To compensate, an extensive review

on the introversion–extroversion dimension has been an effort of this study to affirm the criterion-related validity of measuring the theoretical constructs.

The study was confined to an instructional technology course, and therefore results may not be generalizable to education students taking other courses. Moreover, although other extraneous variables like situational characteristics, gender, instructors, and grouping scheme might have confounded the study, these factors have the potential to provide another spectrum of future endeavors.

This study assumed that learners would make choices based on their learning preferences that embed aptitudes and ways of processing knowledge. Yet, over the course of the treatment, the uncertainty developed regarding whether the students in the treatment condition chose the type of communication medium primarily based on their learning preference. Based on informal solicitation from e-mails and face-to-face contact, most students in the treatment condition reported that they chose certain type of communication medium not primarily because of their preference in terms of learning, but because of time management issues. This discovery concurs with Anderson and Kent's (2002) study on interactive televised courses. Anderson and Kent found students rarely chose to take televised courses because of their learning preference; instead, their choices were based on travel and time considerations. Such motives often confound empirical studies because researchers tend to assume students make choices solely based on what the study hypothesized. An examination of student motivations, learning preferences, and options chosen would be an interesting line for future research.

Moreover, assume that students are able to make their educational decisions independent of various life barriers and situational constraints. If they are able to pursue

studies in their preferred mode, would they consider learning benefits in their decision? This clearly raises another important issue—sophistication of decision making. Decision making is a perplexing and mysterious process that involves motivation, self-efficacy (Gaffner & Hazler, 2002), understanding of self learning, and introversion–extroversion (DiRusso, Carney, & Bryan, 1995), to name a few. In light of distinctness between the introvert and extrovert, DiRusso et al. specified that the introvert is less decisive in thinking and takes more time in decision making; the extrovert is more decisive but tends to decide prematurely. All in all, what facilitates decisions in deep learning and what blocks such decisions have emerged as areas of interest in the instructional design arena. What is practical for an instructor to assist students in their decision-making process so that the students can learn more deeply and effectively? The efforts of this study have resulted in an interesting insight on how the discussion format option helps student advance in self-efficacy and satisfaction and additionally lends support to future research exploring such phenomena.

Owing to the design of this study, the cognitive achievement data were collected via the four quizzes intermittently over the course. The four quizzes focused on different subjects. Because of the intermittent administration of tests rather than a one-shot test, student dropout became an external factor affecting achievement results and the follow-up. As explained in the methodology section, each quiz contained questions in different cognitive levels due to the essence of the topics introduced. For instance, the first quiz on learning theories ranged from Memorize-Fact to the highest cognitive level, Apply-Principle. The second quiz on PBL and cooperative learning only covered the Comprehend-Concept level. The fact they were not balanced is a limitation due to

instrumentation. After the first quiz was given, several students dropped the course and, needless to say, did not complete the remaining quizzes. Moreover, several students also enrolled in the course after the first quiz was administered. In this case, because the Introversion–Extroversion Index and Self-Efficacy Questionnaire were arranged early in the semester, those students who added the course later missed taking the two surveys. In addition, for an intermittent measure like the cognitive achievement in the study, the drop–add issue is a concern and a potential threat to validity.

Finally, because the sample involved 13 classes including both graduate and undergraduate students and both face-to-face and online courses, it is very likely that some extraneous factors might have had an influence on the treatment effect to some degree. As described above, efforts were made to control for the potential biases, including a presentation to and meeting with the seven instructors. In addition, detailed written documents were provided to all participating instructors before the full study to assist them to understand the design and procedure. Even with these efforts, the instructors' different reactions to the students' needs might have more or less confounded the three outcome domains—particularly student satisfaction and self-efficacy.

Recommendations for Practice and Research

As an initial effort to explore the impact that providing students with an online discussion format option taking age and learning preferences into account, this study informs future research in number of perspectives. First, clustering age into different categories such as a higher age cutoff to adapt locality and corresponding urbanicity, a belt of gray zone around the cutoff age, or more than two age categories could identify

some differences. The nonsignificance phenomenon of age interacting with the three dependent variables does not necessarily negate the veracity of this line of investigation

Second, to pursue the potential advantages of providing students with online discussion forum options, future research might benefit from factors such as sophistication of decision making, course level (graduate vs. undergraduate), gender, course format (face-to-face vs. online), and, even more ideal, random assignment to conditions to inspect substantial differences. Instead of a focus exclusively on the impact that the option has on the three domains in this study, focusing on motives and rationales behind the choices students make might be informative. Are students capable of making beneficial choices for the sake of learning rather than based on lifestyle, familial responsibilities, work, and social constraints? Do graduate students tend to be more sophisticated in making such decisions than undergraduates? Are the choices they make greatly influenced by other situational factors? Do women and men choose differently? This study has brought such uncertainties to the surface, and future research embracing these factors would inform instructional design. To extend this line of thinking, consider students who are not good at making the decision that would be beneficial to learning rather than just convenient; future research could be conducted on instructor-assisted option selection. Instead of letting the students choose, the instructors could assist the students to make a choice based on their learning preference. Additionally, instructors could use an appropriate learning preference instrument in the beginning of a semester and review the results with students, not merely relying on letting students read and decipher the preference description on their own. Helping students interpret the preference description would be one way for instructors to enhance students'

sophistication of decision making. The merit of instructor-assisted decision making is twofold. First, problems associated with making learning choices based on the non-instructional reasoning could be controlled. Apart from the situational considerations, instructors could take the opportunity to promote students' metacognitive awareness, which likely advances deep and effective learning. This way, students would be gradually proficient in recognizing right decisions to augment their intrinsic motivation. Along the same line, it would be interesting to examine whether instructor-assisted decision making influences cognitive achievement and learner motivation positively, compared to no instructor assistance. It is also of a chief concern to investigate any paramount difference in degree of decision-making sophistication between those with instructor-aided interpretation of learning preference outcomes and those without.

Overall Conclusions

In conclusion, this study adds important new evidence of the effectiveness and impact of providing students with the option to choose text-based chat versus threaded discussion forum. First, this study provides new information on how the option affects students' cognitive advancement specifically on the middle levels—Comprehend-Concept and Apply-Concept. As far as personal characteristics are concerned, the age factor does not influence cognitive achievement, but learning preference is a factor associated with overall cognitive achievement and, more specifically, Memorize-Fact. The findings may be beneficial to classroom instructors as well as instructional designers. Instructional designers can construct and advance their course planning based on the findings, knowing that such a strategy could substantially affect students' cognitive achievement at middle levels. As discussed earlier, because cognitive achievement at all

levels is related to the course level (graduate vs. undergraduate) and student status (full-time vs. part-time), these findings ought to be interpreted with caution. Unfortunately, influences from the two sources of extraneous variables might have masked the treatment effect, leading to results opposite to what this researcher had expected. This indeed warrants future research. In closing, this study validates the intuitive notion that positive relationships exist among student satisfaction, cognitive achievement, and self-efficacy.

Second, this study added important new evidence that providing adult learners an option of synchronous versus asynchronous online discussion platform can substantially increase their satisfaction. The finding is vitally important in urban contexts. Martin (2004) defined *urban context* as recognition of the population density attribute and as “densely populated low-income neighborhoods located in cities that are dominated by racial and ethnic minorities” (p. 4). He noted a tremendous need for urban contexts to deliver educational programs to the entire range of potential learners, and educators ought to take a proactive stance to keep up with this concern. Owing to a wide array of cultural and socioeconomic backgrounds, educators can fine tune their course instruction by offering their adult students the option to choose different online discussion platform to adapt to their life and situational characteristics. In brief, it is worth noting that utilizing the option for type of online discussion format can increase adult students’ satisfaction and in turn motivate them to persist in educational training programs.

Third, this study contributes to the new evidence that providing adult learners an option of synchronous versus asynchronous online discussion platform does not considerably undermine or enhance their self-efficacy in general. However, it is worth noting that the option tends to make adult learners feel more efficacious when it comes to

online, text-based communication.

Fourth, this study provides valid and reliable self-efficacy, student satisfaction, and learning preference instruments for use in the field. These instruments are provided as appendixes to the dissertation.

Finally, the findings of the study provide insight to instructional advice that may be of use and value in both undergraduate- and graduate-level courses. A solid course structure can compensate for most students' negative, experientially based expectations. As students' satisfaction toward the course grows, their self-efficacy should be augmented consequently. To reinforce students' self-efficacy, course instructors should at least ensure that students understand the course structure. In addition, although no predominant difference was found between the w/o option and w/ option group in light of online communication appraisal of student satisfaction, both groups were more satisfied with online communication as opposed to course appraisal. Hence, this study concludes that to fulfill student satisfaction particularly on online communication, providing students an option of choosing their favorable online discussion format is indeed associated with satisfaction utilizing online communication.

Overall, these findings provide empirical evidence for the instructional strategy of utilizing the option that allows students to choose text-based chat or threaded discussion forum. The findings show that such an instructional customization—providing the online discussion forum option—has positive impacts on student satisfaction and self-efficacy. The results of the research are limited by the educational environment of the study and thus should be generalized cautiously. Therefore, further research is needed to further

extend the generalizability of the research on instructional customization and its accompanying impacts.

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Appendix A

Cross-Reference of the Learning Style/Preference Inventories Discussed

Type	Reference	Learning style/preference	Implication
Learning Style Inventory (LSI)	Kolb (1993)	Two bipolar dimensions: (a) Concrete/Abstract (b) Reflective/Active	For counseling education (Coffied, Moseley, Hall, Ecclestone, 2004)
Gregorc Style Delineator (GSD)	Gregorc (1982)	Two bipolar dimensions: (a) Concrete/Abstract (b) Sequential/Random	For adults' disposition toward media and pedagogies (Coffied, Moseley, Hall, Ecclestone, 2004)
Group Embedded Figures Test (GEFT)	Witkin, Otman, Raskin, & Kats (1971)	One bipolar dimension: Field-Independence/ Field-Dependence	Not helpful in distance education (Richardson, 1998)
Myers-Briggs Type Indicator (MBTI)	Myers, McCaulley, Quenk, & Hammer (1998)	Introvert/Extrovert Sensing/Intuitive Thinking/Feeling Judging/Perceiving	Personal preferences in decision making, social interaction, and environment interaction (Duck & Ogden, 1990)

Appendix B

A factorial 2x2x2 design on three dependent variables (1) Student satisfaction, (2) Self-efficacy, (3) Cognitive achievement

Dependent Variables

Student satisfaction

Self-efficacy

Cognitive achievement

Independent Variables

	Introverted		Extroverted	
	-25	+25	-25	+25
Option				
No Option				

Appendix C

Blueprint for the Self-Efficacy Questionnaire

Research questions:

1. Does the chat vs. threaded discussion option differentially impact self-efficacy as a function of students' age and learning preference?
2. Are there relationships among the three instructional outcomes: (a) cognitive achievement, (b) student satisfaction, and (c) self-efficacy?

Subskills	Number of items
Web activities	5
Information literacy	5
Learning theories	5
Problem-based learning	5
Cooperative learning	7
Online communications in general	6

Appendix D

Blueprint for the Student Satisfaction Survey

Research questions:

1. Does the chat vs. threaded discussion option differentially impact student satisfaction as a function of students' age and learning preference?
2. Are there relationships among the three instructional outcomes: (a) cognitive achievement, (b) student satisfaction, and (c) self-efficacy?

	Number of items
Course Appraisal	12
Website	
Course materials/Instruction	
Online activity and assignment	
Technical difficulties	
Online Text-Based Discussion Appraisal	15
Participation	
Reflective thinking	
Collaboration/ Interaction	
Communication effectiveness	
Communication satisfaction	

Appendix E

Blueprint and Scoring Scheme for the Introversion—Extroversion Index

Research questions:

1. Does the chat vs. threaded discussion option differentially impact student satisfaction as a function of students' age and learning preference?
2. Does the chat vs. threaded discussion option differentially impact cognitive achievement as a function of students' age and learning preference?
3. Does the chat vs. threaded discussion option differentially impact self-efficacy as a function of students' age and learning preference?
4. Is there a relationship between the students' age and learning preference?

Foci	Number of items
Source of seeking energy	9
Application in learning situations	

Scoring scheme:

Total the letters in each question by counting the total number of "a"s, and the total of "b"s.

a _____

b _____

if $a > b$, the preference is introversion
 if $a < b$, the preference is extraversion

Appendix F

The Self-Efficacy Questionnaire on Use of Online Text-based Discussion

The Self-Efficacy Questionnaire
Use of Online Text-based Discussion

This survey has 33 statements regarding the use of text-based communication tools to assist cognitive advancement as a result in effective learning, with respect to six skill domains: (a) Web activities (5 items); (b) Information literacy (5 items); (c) Learning theories (5 items); (d) Problem-based learning (5 items); (e) Cooperative learning (7 items); (f) Online communications in general (6 items). After reading each statement, indicate the extent to which you feel confident or unconfident, by checking the button to the right of each sentence.

Your responses should reflect your level of confidence with the skill/ activity described in each statement. For example:

I feel confident I can...

Create web pages with Netscape Composer.

Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

By checking “somewhat confident”, you indicate that you have some degree of confidence in creating web pages with Netscape Composer.

Based on your perceptions, please respond to all the following questions by indicating your level of confidence with each statement on a 5-point scale, ranging from (1) *strongly not confident* to (5) *strongly confident*.

Because this course uses of online text-based discussion (e.g., asynchronous threaded blackboard discussion, synchronous chat sessions),

[Web activities]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
use the digital drop box in Blackboard© to send and retrieve files.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
use the discussion board in Blackboard to post information and attachments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
use the threaded discussion feature in Blackboard to create “grouped” postings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
use the chat feature and archive in Blackboard.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
solve technical difficulties.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Information literacy]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
utilize search engines for research and information obtaining.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
evaluate the content of the various websites.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
evaluate the accuracy of the	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

various websites.					
identify biases of the various websites.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
evaluate currency of the various websites.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Learning Theory]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
differentiate key principles and goals of instruction among the three major learning theories.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
give an instructional scenario to justify the use of <u>Traditionalism</u> in my classroom or a prospective classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
give an instructional scenario to justify the use of <u>Cognitivism</u> in my classroom or a prospective classroom?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
give an instructional scenario to justify the use of <u>Constructivism</u> in my classroom or a prospective classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
effectively use the major learning theories to design instruction.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Problem-Based Learning]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
think critically while interacting with other students on PBL during online discussions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
differentiate between a PBL classroom and a “traditional” classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
develop enticing questions to engage students in a PBL structured activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
provide resources that facilitate research efforts in a PBL structured activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
integrate my content area SOLs in a PBL structured activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Cooperative Learning]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
trust views and judgments proposed by my peers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
establish a positive interdependence with my	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

classmates.					
be an effective collaborator.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
prompt myself to generate discussion synergy.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
manage/ resolve conflict among the group members?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
contribute to the collaborative efforts based on my prior knowledge.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
help facilitate learning in a collaborative setting with my own views and actions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[Online communications in general]

<i>I feel confident I can...</i>	(select only one response per question)				
	Strongly Not Confident	Not Confident	Somewhat Confident	Confident	Strongly Confident
discuss course content frequently in text-based online forums.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
share my thoughts with my peers via online discussions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
effectively utilize online discussion in conjunction with my life responsibilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
choose the online discussion mode (asynchronous vs. synchronous) that best matches my learning style.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
learn effectively via online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

discussion.					
benefit from my peers' contribution in online discussion?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

First name

Last name

Please enter your age in the space provided

Age:

Gender: (select only one)

 Male Female

Appendix G

*Student Satisfaction Survey on Use of Online Text-Based Discussion***Student Satisfaction Questionnaire**

This is a student satisfaction survey on the use of online text-based discussion. This survey is intended for research purposes. Your identity will be filtered out by the researcher and kept from your instructor.

Please answer each of the following questions. Again, your confidentiality will be respected.

Indicate how strongly you agree or disagree with each of the following statements:

Course Appraisal

		(select only one response per question)				
		Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
1	The course syllabus and handouts were helpful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	The course goals and objectives were clearly specified.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	The course readings were helpful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	The course website was welcoming, well-organized, and helpful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	The course website layout, graphics and navigation were clear and intuitive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	The online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	activities were useful and adequate.					
7	The course assignments were related to the course objectives.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	Instructional methods in this course facilitated my learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	I know significantly more about this course than before I took this course.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	I missed important information because the technology didn't work correctly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	I spent too much time trying to gain access to a computer or computer terminal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	Overall, in terms of content, design, and structure, I would rate this course as "excellent".	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Online Text-Based Discussion Appraisal

Because of the way this course uses online text-based discussion--synchronous chat room or asynchronous threaded discussion with Blackboard, indicate how strongly you agree or disagree with each of the following statements:

		(select only one response per question)				
		Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
13	I benefited from active participation in the scheduled online (chat room or discussion board) discussions about given topics.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	The guidelines for conducting online discussions were clear.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	Online discussion helped me learn how to solve problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16	When engaged in online discussions, I put a lot of thought into my comments.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17	I felt more comfortable asking questions online.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18	I felt more comfortable discussing the ideas and concepts taught in this course with other students online.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19	I worked productively on assignments with other students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20	It was difficult to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	relate to the other students in the class.					
21	I wasted too much time communicating with others on topics that are not directly related to my course work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22	I wasted too much time sorting through my messages to find the few that are useful.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23	My learning satisfaction is undermined because I did not possess adequate typing skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24	The online discussion mode didn't fit well with my other life responsibilities.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25	I would appreciate (or would have appreciated) choice in discussion mode (chat room or threaded discussion boards) that suits my learning style.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26	I enjoyed studying for this course because my interaction with other students was effective.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27	Overall, in terms of interaction and collaboration, I would rate online discussion as "effective".	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

First name Last name

Please enter your age in the space provided

Age:

Gender: (select only one)

Male Female

How many credit hours have you completed at the college level (including courses from this and any other institution you have attended, but not including your current courses)?

How many credit hours have you completed at the college level (including courses from this and any other institution you have attended, but not including your current courses)? (Write your response in the spaces provided.)

semester hours quarter hours

How many credit hours are you currently taking? (Write your response in the spaces provided.)

semester hours quarter hours

Appendix H

Introversion—Extroversion Index

Introversion—Extroversion Index

This is an indicator of your attitude of seeking energy. There are no right or wrong answers, only your best answer. Please answer each of the following statements as honestly and promptly as possible to show your natural preference. When in doubt go with your first instinct. There are only 9 questions that will take but a couple of minutes to complete.

Your confidentiality will be respected.

1. To work effectively, you usually
 - a) prefer to work quietly and independently
 - b) prefer to work collaboratively
2. You have a tendency to
 - a) concentrate more on thoughts, concepts, and ideas
 - b) concentrate more on people, objects, and places
3. You think most effectively when you
 - a) work quietly without interacting with others
 - b) interact with others and spell out your thoughts
4. When it comes to a new learning task, you usually
 - a) think first, then act
 - b) act first, and reflect later
5. You perceive yourself as a
 - a) reflective thinker
 - b) “on the fly” thinker
6. In real-time, face-to-face discussions, you are usually
 - a) reluctant to share your ideas
 - b) inclined to share your ideas and accept the ideas of others

7. In a group discussion, you are usually
 - a) slow to volunteer your ideas and thoughts
 - b) ready and willing to volunteer your ideas and thoughts

8. In face-to-face discussions, you usually
 - a) listen more and talk less
 - b) do a lot of talking

9. With regard to online communication, you
 - a) prefer delayed interaction
 - b) prefer real time, immediate interaction

CURRICULUM VITAE

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- Overbaugh, R. C., & Lin, S. (October 2003). Cognitive hierarchies and the need for curriculum-referencing assessments for constructivist achievement. Presented at the annual conference of the Association for Constructivist Teaching Conference, Portsmouth, Virginia.

U.S. REGIONAL:

- Overbaugh, R. C., Lin, S., & Rikard, L. A. (February 2003). Student characteristics, sense of community, and achievement in traditional and distributed learning environments. Presented at the annual conference of the Eastern Educational Research Association, Hilton Head, South Carolina.