Assessing the Factors Deemed to Support Individual Student Intrinsic Motivation in Technology Supported Online and Face-to-Face Discussions

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Executive Summary

Research has established that intrinsic motivation has a positive effect on learning and academic achievement. In order to investigate the phenomenon of intrinsic motivation in technology-supported learning environments, this paper investigates the factors deemed to support individual student intrinsic motivation in online discussions. A research model is presented based on research into motivation, and the specific areas of self-determination and curiosity provide a framework for the model.

Mean scores for both online discussions and face-to-face discussions were compared using a two-tailed t-test for the six constructs of perceived competence, perceived challenge, feedback, perceived choice, perceived interest, and perceived curiosity. Results from the study showed that online discussions provided significantly stronger mean ratings (t=3.2) for perceived choice than did face-to face-discussions, while online discussions gave somewhat significantly stronger mean scores for perceived competence (t=1.84) than similar face-to-face discussions. Feedback obtained identical mean scores for both online and face-to-face discussions, as did perceived interest, while the slightly higher differences in the online situation were not significant for perceived challenge (t=0.96) or perceived curiosity (t=1.19).

Assessing the factors deemed to support individual student intrinsic motivation may assist in enhancing intrinsically motivated behavior in technology-supported learning environments. This would assist Web course designers and science educators to create online learning programs that best utilize students' capacity for learning and academic performance. The Web, with no direct verbal face-to-face interaction, lends itself better to online discussion in a more structured manner by enabling students to communicate more comfortably with their peers and provides a more egalitarian environment, where participants share the same tools and opportunities to communicate. The creation of online learning programs provides students significant opportunities for learning, such as the extended exchange of ideas and expertise where students can read, respond to, or initiate comments in a virtual meeting space.

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Introduction

Little is known about the outcomes of different technology-supported learning activities on student intrinsic motivation (Gulikers, Bastiaens, & Martens, 2005; Martens, Gulikers, & Bastiaens, 2004). Clearly, technology-supported learning environments have the potential to provide the tools and structure to transform education, such that students are encouraged to actively engage in and shape their personal learning experiences (Hodges, 2004; Vogel & Klassen, 2001). Furthermore, technology offers the potential to help students effectively in the construction of their personal motivational strategies (Swan, 2003). To unleash the full potential of technology-supported learning environments, the technology should be designed and applied in such a way that it reinforces the students' intrinsic motivation (Keller & Suzuki, 2004). Through a systematic study of intrinsic motivation, we can thus shed light on how to design appropriate, viable, and effective technology-supported learning environments that are sensitive to individual differences. The research questions for this study are:

1) What individual-level factors are deemed to support intrinsic motivation in online and face-to-face discussions?
2) Are perceptions of these factors deemed to support intrinsic motivation higher in online discussions compared to traditional face-to-face discussions?

In the past, research on intrinsic motivation has mainly focused on assessing student intrinsic motivation in a traditional classroom environment (Dornyei, 2000). With respect to technology-supported learning environments, however, research focusing on students' intrinsic motivation is limited. As we create information systems to support programs and curricula, it becomes imperative that we understand the scope of technology-supported learning activities on aspects of intrinsic motivation.

It is believed that intrinsic motivation theory may provide important clues as to how e-learning technologies can become powerful catalysts for change as well as tools for redesigning our learning and instructional systems (Martens, Gulikers, & Bastiaens, 2004; Teo, Chang, & Gay, 2006). In addition to its theoretical contribution, (i.e. the development of a research model) this research presents important practical contributions through the identification of important factors deemed to support students' intrinsic motivation in technology-supported learning environments. The information that can be gained from assessment can be valuable in enabling students' higher-order cognitions, active learning, and self-regulated learning (MacLellan, 2001). The use of technology also has the potential to change the nature of learning environments and the ways in which we design activities to support intellectual development, including the motivational strategies involved in learning.

For the purpose of this study, intrinsic motivation is defined as an individual's ability to demonstrate competence (Elliot et al., 2000), a readiness to engage in an activity because of his or her own internal interests and curiosity (Lepper, Henderlong, & Gingras, 2000), and a desire to master the environment (Guskey, 2001). This definition has been taken from various theories of intrinsic motivation, which have been extensively tested and supported in academic settings (Rigby, Deci, Patrick, & Ryan, 1992). A better understanding of the nature of intrinsic motivation and the ability to gauge students' intrinsic motivation while interacting with technology-supported learning environments promises to contribute to the design of more effective educational programs and thus ultimately to higher educational performance.

Literature Review

Increasingly powerful software applications such as “Blackboard” and “WebCT” have put communication tools for knowledge creation in the hands of learners. These technology-based tools have tapped into students’ multiple intelligences and enabled them to demonstrate knowledge creation more effectively. The challenge of education is to apply technologies for learning and to draw from the knowledge of human behavior and cognition, as well as from practical applications of how technology can support collaborative and constructivist learning environments (Ocker & Yaverbaum, 2002; Tam, 2000). In addition, students may be motivated to learn due to the meaningful nature of these learning environments and activities.

Studies of electronic class discussions have revealed several additional advantages: they appear to be an effective vehicle for some students to communicate, especially those who are generally reluctant to engage in verbal dialogue in live settings and appear to be especially effective when controversial or sensitive material is encountered (Hettinger, 1995). Rather than being a “cold” medium, electronic communication appears to provide a forum for creativity, humor, and exchange of personal information and assistance. Students are able to express ideas when they feel motivated and they are able to do so at their own pace, taking the time to think and edit discussions/dialogues themselves, which is not normally possible in traditional face-to-face discussions.

Reviews of motivation in education (Ryan & Deci, 2000a) recognize increasingly the importance of intrinsic motivation and have emphasized the role of intrinsic motivational processes in individual learning and achievement. When educational environments provide challenges, rich sources of stimulation and a context of autonomy, learning is likely to flourish (Reis, Sheldon, Gable, Roscoe, & Ryan, 2000). For most students, there are significant portions of the academic curriculum that are not compelling or inherently interesting and, therefore, students do not appear to be intrinsically motivated in their respective learning activities (Renninger, 2000). Growing evidence in educational literature strongly suggests that such issues have significant implications that extend well beyond learning and achievement. Consequently, motivational strategies need to be assessed not only for their success in evaluating performance and achievement, but also for their impact in the broader and more significant areas of individual development (Howles, 2005; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004).

The central postulation of Self-Determination Theory is that individuals have a psychological need to feel competent, self-determined, and related (Deci & Vansteenkiste, 2004; Ryan & Deci, 2002). Addressing these needs of competence, self-determination, and relatedness promotes optimal motivation for a behavior. The three aspects of a motivationally supportive environment that correspond to these three psychological needs are structure, autonomy support, and involvement respectively. The structural dimension refers to the degree to which an individual is competent in an activity (i.e. able to understand the activity, with clear expectations from the same), finds the tasks within the activity challenging and where positive feedback is provided during the activity. In autonomy supporting contexts choices are given, pressure to engage in the behavior is minimized, and individuals are encouraged to initiate actions by themselves. Involvement, finally, is characterized by interest in a particular social context (Renninger, 2000).

The Need for Competence: The Structural Dimension

In the Self-Determination Theory, the need for competence involves the need to feel that one can reliably produce desired outcomes and/or avoid negative outcomes (Deci & Vansteenkiste, 2004; Ryan & Deci, 2002). This implies a necessity to understand both the relationships between a behavior and its consequences and what it takes to achieve certain outcomes (outcome expectations or strategy beliefs), as well as a need to feel capable of successfully engaging in the behavior (efficacy expectations or capacity beliefs) (Deng, Doll, & Truong, 2004). Therefore, the structural

dimension of a supportive environment will address both these needs. In a learning context, individuals need to have clear and realistic expectations about what learning activities can do for them, they need help to formulate achievable goals, they need encouragement to believe in their capabilities of engaging in the appropriate learning behaviors, and, finally, they need to receive positive informational feedback regarding their progress.

Perceived competence

Numerous studies have demonstrated that individual perceived competence is an important factor of intrinsic motivation research (Elliot et al., 2000; Reeve & Deci, 1996). Perceived competence represents the extent to which an individual believes that he or she has performed or is able to perform well in an activity and is similar to Bandura's theory of self-efficacy which pertains to an individual's judgment of his/her capability to organize and execute a course of action required to attain a designated type of performance (Bandura, 1982; Harter, 1981). For example, students can interpret comments from an instructor as positive information about their competence that serve to maintain or enhance intrinsic motivation toward the activity.

Perceived challenge

One construct that is critical for intrinsic motivation is adequate stimulation in the form of challenges. The concept of challenge is central to understanding the ways in which a task activity is intrinsically motivating (Csikszentmihalyi, 1988). In broad terms, challenge refers to individuals' perceptions that an activity invites them to perform to their full capacities. As such, individuals have a typical and customary level of task challenge they are willing and capable of handling. For any specific task, some individuals will be more challenged than others. From this perspective, an individual's subjective assessments will be more important than objective task characteristics. Fundamentally, challenge involves an individual's anticipatory self-appraisal of two factors - expectations about goal-directed accomplishments and a perceived ability to perform activities directed at achieving those goals.

Feedback

Deci and Ryan's (Deci & Ryan, 1985) second proposition from their Self-Determination Theory states that an individual typically succeeds in an activity when he or she receives positive feedback in the form of verbal praise. For example, students can interpret feedback from an instructor as positive information about their ability that serves to maintain or enhance intrinsic motivation toward the activity. Students may see extrinsic rewards as controlling or coercive, thus diminishing feelings of intrinsic motivation (Hidi, 2000). Hence, events that provide opportunities to satisfy an individual's needs through positive feedback will maximize intrinsic motivation.

The Need for Self-determination: The Autonomy Dimension

A wide range of evidence supports the view that the need for self-determination is an important motivator that is involved with intrinsic motivation (Deci & Ryan, 1985; Markland, 1999). Thus, a motivationally supportive environment provides supports for the need for self-determination.

Self-determination is concerned with helping individuals feel that they have choice over engaging in a behavior. In self-determining contexts, options are provided, pressure to engage in the behavior is minimized, and individuals are encouraged to initiate actions themselves. An individual can be encouraged to participate in the process of setting learning goals and to choose how, where, and when he or she participates, bearing in mind the need for learning activities to be effective and for the individual to feel capable of engaging in those activities (the structural dimension).

Perceived choice

Self-determination is the capacity to choose and to have choices, rather than permit reinforcement contingencies, drives, or any other forces or pressures to be the determinants of an individual's actions. When self-determined, an individual acts out of choice rather than obligation or coercion (Reeve, Nix, & Hamm, 2003). Such choices are based on an awareness of his or her desires as well as a flexible interpretation of external events and can be termed voluntary, since it is to some extent under conscious control (Venkatesh, 2000; Walker, 1964). When autonomy-oriented, individuals use available information to make choices and regulate themselves in pursuit of self-selected goals. Whether intrinsically or extrinsically motivated, behavior based on choice is self-determined and emanates from an integrated sense of self that underlies the autonomy orientation (Ryan & Deci, 2004).

The Need for Relatedness: The Involvement Dimension

In addition to competence and self-determination, relatedness is a further contributing factor in interpersonal settings, with intrinsic motivation more likely to flourish when social experiences contribute to feeling interpersonally connected. Although many studies demonstrate that individuals who feel satisfied with their interpersonal connections are happier than those who feel dissatisfied (Knapp, 2000), it is unclear what sorts of social activities actually contribute to these perceptions. Various alternatives have been proposed – intimacy, shared and interesting activities, and avoiding conflict – but empirical evidence concerning their relative roles has yet to be provided.

An increased sense of interest contributes toward developing a sense of relatedness that facilitates enhanced motivation. Interest is associated with feelings of relatedness, as it is thus characterized by involvement in a particular social context (Ryan, 1994). For example, technology-supported learning activities such as online discussions may allow for and promote the development of interest. As such, it is important to examine the contribution of learning activities that promote interest in predicting feelings of relatedness (Ryan & Deci, 2000b).

Perceived Interest

Interest is a construct that is full of rich meaning both for individuals and researchers. In everyday language, we use interest in three ways: "I'm interested in…;" "That looks interesting;" and "I had an interesting experience." In education, it is presumed that interest can integrate a student's experiences outside the school in the learning process, encourage the student to use prior knowledge in pursuing new knowledge, and motivate him or her to engage in learning tasks at hand (Dewey, 1913). Research findings support these arguments and clarify the function of interest in education, conceptually as well as empirically (Hidi & Anderson, 1992; Renninger, 2000). Interest is defined generally as a positive psychological state that is based on or emerges from person-activity interaction. In learning, this psychological state is assumed to derive from learner-content interaction (Hidi, 1989).

Theories of Curiosity

As we have seen, the Self-Determination Theory of intrinsic motivation posits that an individual seeks to satisfy three basic needs - competence, self-determination, and relatedness. This is a universal claim that is made irrespective of cultural or individual difference and has been supported by a series of studies undertaken in a variety of cultural settings (Reeve, Deci, & Ryan, 2004). Deci and Ryan (1985) hypothesize that the source of motivation is innate rather than learned or imparted and is fostered by functioning in environments that provide opportunities for feedback, conveying competence, and encouraging autonomy. Hence, environments that provide opportunities for these three needs are expected to result in a variety of positive outcomes for individuals

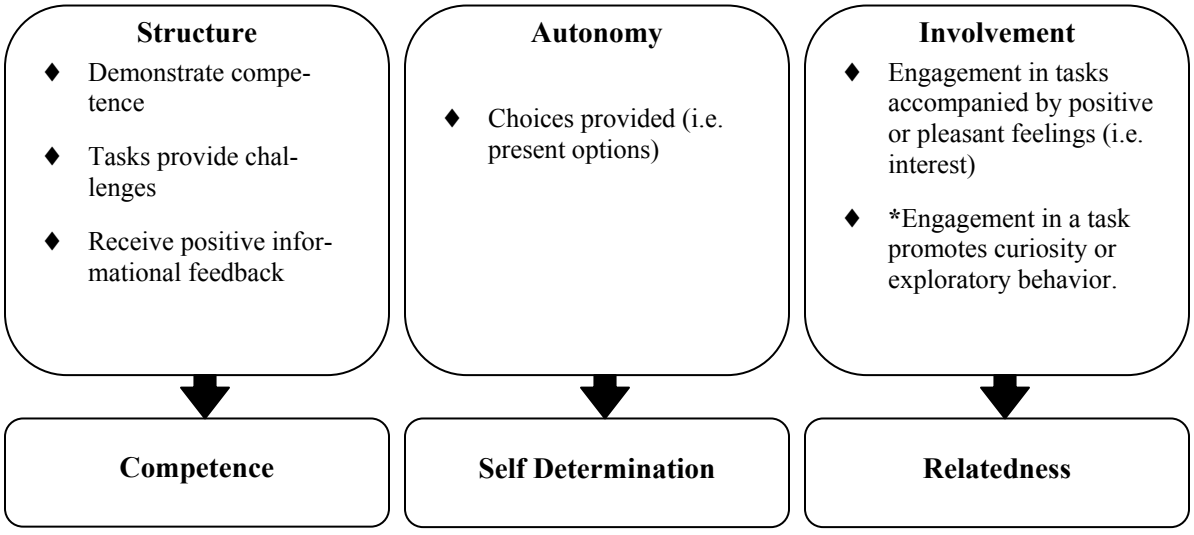
operating within them. Deci and Ryan (1985) highlighted the realistic emphasis of their theory by stating that evidence is indisputable - that intrinsic motivation exists and that it involves drive-independent needs.

Curiosity

Various research approaches deal with curiosity (Berlyne, 1960) in predicting feelings of relatedness. Curiosity is related to social engagement because exploratory behavior is a powerful contributor to individual well-being that can interfere with social relatedness. Curiosity appears to increase opportunities for fulfilling social relatedness needs and is associated with enhanced goal pursuit, performance, and well-being. Individuals have an intrinsic need to feel related to the environment, and this need provides energy to act on the environment. These desires to explore, discover, understand, and know are intrinsic to an individual's nature and are central motivators for his or her behavior. According to Beswick (1974), curiosity is a "prototypical example" of intrinsically motivated behavior.

Integration of the Theory of Self-determination and Curiosity

The Self-Determination Theory (Deci & Ryan, 1985; Ryan & Deci, 2000b) assumes that an individual has inherent propensities to be intrinsically motivated, to assimilate his or her social worlds, and to integrate external regulations into self-regulations (Brown & Ryan, 2004). Specific to the Self-Determination Theory is the proposition that these integrative tendencies operate in conjunction with the three basic psychological needs for competence, self-determination, and relatedness (see Figure 1).



* Integrated into Self-Determination Theory framework for this paper

Figure 1: Self-Determination Theory Framework for Intervention
Source: Adapted from (Markland & Hardy, 1997)

As we have seen, the construct of interest that falls under the involvement dimension and corresponds with the need for relatedness may not adequately account for other phenomena that should be addressed in the context of technology-supported learning environments. We believe that the construct of curiosity can reasonably be integrated within the conceptual framework presented in Figure 1. As previously discussed, curiosity, as a field, explains the importance of exploratory

behavior in promoting intrinsic motivation and, therefore, is an important construct to examine in the context of technology-supported learning environments such as online discussions. The work by Deci and Ryan (Deci & Ryan, 1980, 1985; Ryan & Deci, 2000b) and Berlyne (1960, 1978) provided the starting point for the development of our research model. The research by Deci and Ryan, and also Berlyne, directed the selection of appropriate variables for our model as well as the appropriate research paradigm. Hence, our research model is built on a motivational foundation that pulls elements from the Self-Determination Theory and Curiosity Theory of intrinsic motivation.

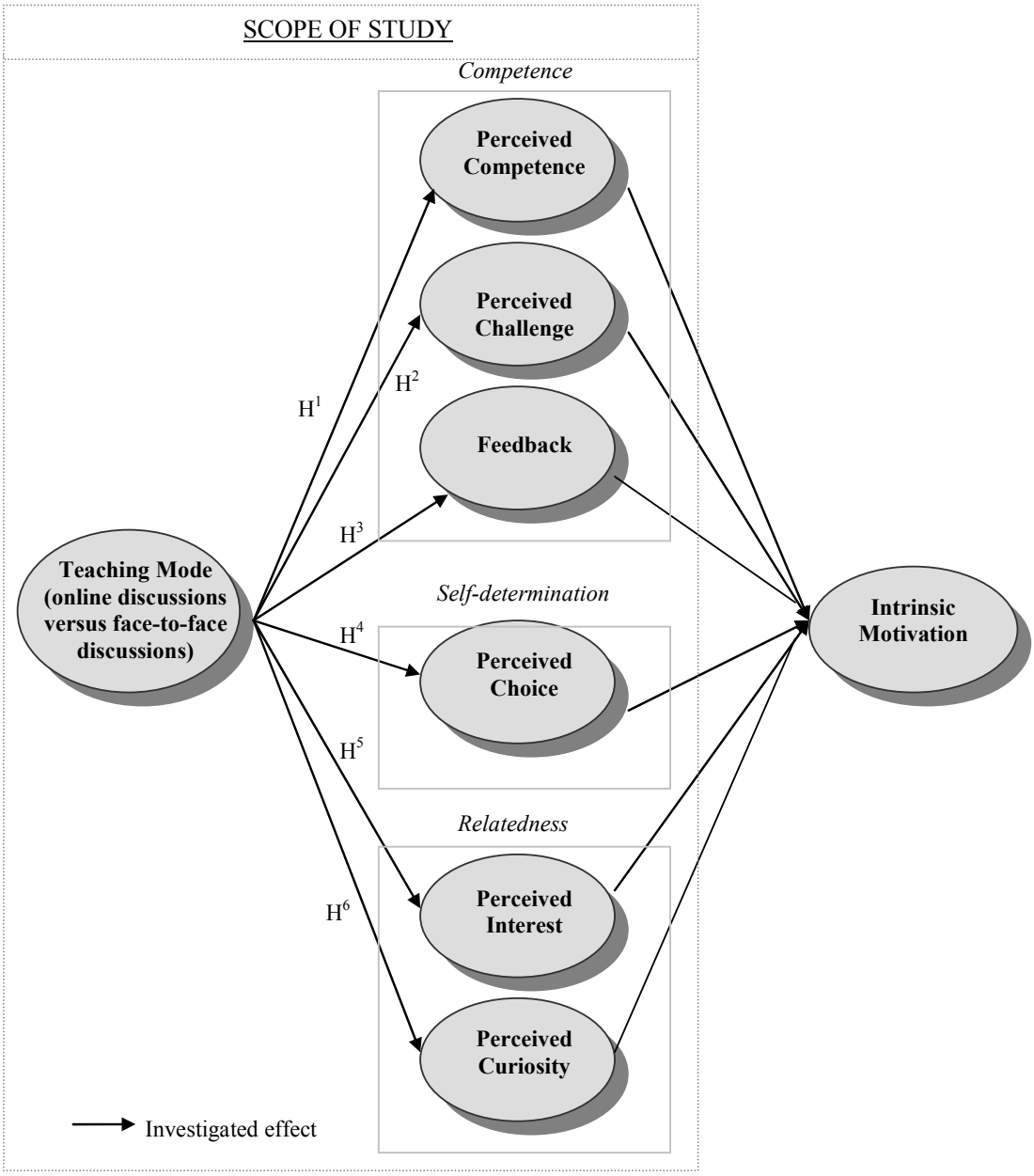


Figure 2: Research Model

Research Methodology

Research Model

The formalized research model shown in Figure 2 was used as a point of departure for this research and, thus, forms the basis of the hypotheses presented in this paper.

Research Hypotheses

Building on the preceding literature review, the following hypotheses are formed (alternate hypotheses are shown, while the null in each case is that there is no difference between mean scores for online discussions and face-to-face discussions):

H^1: *Perceptions of individual competence will be higher in online discussions compared to face-to-face discussions.* The use of online discussions may enable an individual to master the course content and feel competent by utilizing his or her cognitive skills to successfully interact in online versus face-to-face discussions, which are significantly different. Thus, online discussions facilitate individual cognitive and communication skills that create an individual learner who feels competent to achieve in the technology-supported learning environment.

H^2: *Perceptions of challenge will be higher in online discussions compared to face-to-face discussions.* Online discussions may increase individual perceived challenge because the interactive nature of the discussions challenges the individual learner to assimilate this new experience into his or her schemata. Hence, online discussions may generate a plethora of information in which users may find it challenging in exchanging information in terms of extending their current thinking, introducing alternatives, and facilitating new understandings for themselves and their group members.

H^3: *Online discussions will lead to higher positive feedback compared to face-to-face discussions.* The Self-Determination Theory (SDT) (Deci & Ryan, 1985; Deci, Vallerand, Pelletier, & Ryan, 1991; Ryan & Deci, 2000b) provides a theoretical context for understanding how an individual typically succeeds in an activity when he or she receives positive feedback in the form of verbal praise. Further, textual dialogue has been a standard mode of electronic discussion since the inception of online learning platforms such as "Blackboard" or "WebCT."

H^4: *Perceptions of freedom to choose from alternative methods of participation will be higher in online discussions compared to face-to-face discussions.* Online discussions may increase individual perceptions of choice because the interactive online nature of the discussions increases individual volition, that is, it provides a sense of unpressured willingness to engage in the activity.

H^5: *Perceptions of individual interest will be higher in online discussions compared to face-to-face discussions.* Online discussions may increase individual perceived interest because the task of engaging in an electronic discussion, for example, is novel and may lure the participant into action (i.e. entice or intrigue them). Thus, intrinsic motivation is enhanced when these characteristics associated with situational interest are high in interest in specific topics or activities.

H^6: *Perceptions of individual curiosity will be higher in online discussions compared to face-to-face discussions.* When activities heighten curiosity, then an individual is naturally involved and driven to learn because his or her intrinsic motivation is increased. If curiosity is to be stimulated, the role of the environment is to provide an individual with activities/opportunities to explore. Thus, online discussions can stimulate curiosity because the different dialogues and interaction patterns within the online discussions are conducive to facilitating effective communication and learner stimulation.

The Research Setting

The 749 students from the Bachelor of Business Administration (BBA) program taking the FB2501 "Management of Information Systems (MIS2)" course constituted a large pool of available subjects, who fit well within the context and purpose of this study. The selection of this course was based on the following criteria. Firstly, this course provided a rich opportunity for applying both technology and non-technology support to both online and face-to-face classroom environments. Secondly, learning activities in the form of online and face-to-face discussions were structured into the design and organization of the course.

Since quasi-experimental designs do not randomly assign subjects, for this study 77 subjects were selected, rather than randomly assigned, to their respective treatments. The participants who were in the treatment groups were there for a variety of reasons - self-selection (i.e. they signed up for the course), assignment by a person beyond the control of the experimenter (i.e. a principal assigns students to classes), or mandated to the group (i.e. course requirement). We expected students to engage in "expert-like" ways of thinking, acting, and problem solving (i.e. making interpretations, engaging in negotiations, providing rationales, and reaching conclusions) in the online and face-to-face discussions.

Technology

The "Blackboard" course management system was chosen to supplement this study for two reasons. Firstly, the software is an existing available resource acquired by the Faculty of Business at the City University of Hong Kong. The Faculty of Business has taken on the responsibility of software management, staff in-service training, and administration of "Blackboard." The reasons for choosing "Blackboard" also extend beyond the availability and convenience of the software. Secondly, this software provides various pre-built course management solutions as well as the addition of an Internet-based component to the course. The software also provides a structure of customizable tools. Using these tools is easier than programming a website on the Internet, which requires web page programming knowledge. In addition, "Blackboard" provides password-protected access using a standard web browser (i.e. "Internet Explorer" or "Netscape Communicator™"), which offers security for protecting student information.

Online discussion boards through "Blackboard Virtual Classroom" promote reflection and analysis, thus enabling discussions among all student participants. Knowing that their comments will be available at all time to the instructor, students should typically take more time to consider, write, and edit their thoughts, as well as support them using quotes, hyperlinks, and attachments. In addition, the online discussions help students learn to appreciate and evaluate positions that others express. This gives them the opportunity to be challenged, corrected, and questioned by their peers, thereby inviting students into a community of practice that motivates them to learn the subject matter and helps them to gain social skills.

Learning Activities

Once the overall course structure had been determined, learning activities were designed for online discussions. The definition of learning activity for the purpose of this study implies the tasks undertaken, specifics of the task, the techniques used, associated tools and resources, and the interaction and roles of participants involved. For example, online discussions using the "Blackboard Virtual Classroom" were structured around the case method to engage students in more expert-like ways of thinking, acting, and problem solving (i.e. searching for learning resources, making interpretations, engaging in negotiations, providing rationales, and reaching conclusions) (Collins, 1990). For example, four groups of students, each group comprising of four participants, were told to examine one of the processes of the Information Systems Development

Process and present to the class the pros and cons in the form of a "Microsoft PowerPoint" presentation. The purpose of this activity was to allow students an opportunity to share their knowledge, to constructively critique each other's work, and discuss improvements and new insights (Rosenberg, 2000).

Measurement & Data Collection

Sample Selection

The quasi-experimental design of this study consisted of two different treatment groups (technology-supported discussions versus face-to-face discussions), with each treatment comprising of 4 tutorial sessions. Students taking the FB2501 course in semester A represented a sample size (n=77) sufficient enough to operationalize this study (Cochran, 1963). For this study, a power test was conducted to find the appropriate sample size required to provide a test of the appropriate power.

Each tutorial had a class size of 17-21 undergraduate students. Four separate tutorials running consecutively within the same week resulted in the two treatment conditions shown in Tables 1 and 2.

Table 1: Treatment 1 (Technology-supported Online Discussions)

Treatment 1	Type of Activity	Sample Size	Duration of Exercise	Facilitated by
Tutorial 1	Technology Supported Online Discussions	19	Weeks 4-6	TA 1 (Researcher)
Tutorial 2	Technology Supported Online Discussions	17	Weeks 4-6	TA 1 (Researcher)
Tutorial 3	Technology Supported Online Discussions	20	Weeks 4-6	TA 1 (Researcher)
Tutorial 4	Technology Supported Online Discussions	21	Weeks 4-6	TA 1 (Researcher)

From weeks 2-3, the different students in each of the tutorials were trained in the use of the "Blackboard Virtual Classroom." In the first instance (see Table 1), 77 students from each of the respective tutorials (i.e., tutorial sessions 1-4), participated in the online "Virtual Classroom" via "Blackboard" from weeks 4-6 at different times and venues, facilitated by the Teaching Assistant (i.e. researcher). At the end of week 6, the online discussion version of the Intrinsic Motivation Survey was administered to the students. After completion of weeks 4-6, the four tutorials were switched around as shown in Table 2.

Table 2: Treatment 2 (Non Technology-supported Face-to-face Discussions)

Treatment 2	Type of Activity	Sample Size	Duration of Exercise	Facilitated by
Tutorial 1	Non Technology-supported Face-to-face Classroom Discussions	19	Weeks 9-11	TA 1 (Researcher)
Tutorial 2	Non Technology-supported Face-to-face Classroom Discussions	17	Weeks 9-11	TA 1 (Researcher)
Tutorial 3	Non Technology-supported Face-to-face Classroom Discussions	20	Weeks 9-11	TA 1 (Researcher)
Tutorial 4	Non Technology-supported Face-to-face Classroom Discussions	21	Weeks 9-11	TA 1 (Researcher)

In the second instance (see Table 2), the same students that participated in tutorial sessions 1-4 in weeks 4-6 (technology-supported online discussions) were then switched to the non technology-supported face-to-face classroom environment. They participated in traditional face-to-face classroom discussions from weeks 9-11, at different times and venues, facilitated by the Teaching Assistant (i.e. researcher). At the end of week 11, the face-to-face discussion version of the Intrinsic Motivation Survey was administered to the students.

Instrument Development

The Moore and Benbasat (1991) development procedure was utilized to create and test the survey instrument, since this instrument development process provides a high degree of confidence in the constructs and item content as well as construct validity and reliability. Based on Moore and Benbasat (1991), the following 3-stage development process helped clarify and refine the items and constructs of the survey instrument: 1) item creation; 2) card sorting; and 3) instrument testing.

Item creation

The method of item creation, proposed by Moore and Benbasat (1991), provided a high degree of confidence in the items content validity, construct validity, and reliability. The survey instrument (both online and face-to-face) used in this study was developed from several sources, including instruments developed by other researchers and literature on intrinsic motivation and theory (see Tables 3 and 4).

Table 3: Constructs and Proponents of Each Measure for the Online Discussions

Constructs	Measures	Sources
Perceived Competence		
COM1	I felt I was competent in my performance in the online discussions.	Adapted from Deci and Ryan
COM2	I felt that my engagement in the online discussions gave me competence.	
COM3	I felt I was skilled in the online discussions.	
COM4	I felt I was capable in the online discussions.	
Perceived Challenge		
CHA1	I felt the online discussions were challenging.	Developed from literature.
CHA2	I participated in the online discussions because they were challenging.	
CHA3	I like being challenged in the online discussions.	
CHA4	I like exerting effort in the online discussions.	
Feedback		
FEE1	The online discussions provided positive feedback.	Developed from literature.
FEE2	I received positive responses in the online discussions.	
FEE3	The comments I received in the online discussions were encouraging.	
FEE4	I received compliments in the online discussions.	
Perceived Choice		
CHO1	I believe I had some choice in the online discussions.	Adapted from Deci and Ryan
CHO2	I felt like it was my own choice as to how much I participated in the online discussions.	
CHO3	I contributed in the online discussions because I wanted to.	
CHO4	I could make alternative selections in the online discussions.	
Perceived Interest		
INT1	I would say discussing online is very interesting.	Adapted from Deci and Ryan
INT2	I enjoyed discussing online.	
INT3	I felt that discussing online held my attention.	
INT4	I felt discussing online was fun to do.	
Perceived Curiosity		
CUR1	I felt the online discussions encouraged me to explore a variety of different issues.	Developed from literature.
CUR2	I felt the online discussion aroused my curiosity about the topics being addressed.	
CUR3	The online discussions encouraged me to discover issues that I may not have otherwise considered.	
CUR4	The online discussions encouraged me to look into issues that I may not have otherwise thought of.	

Table 4: Constructs and Proponents of Each Measure for the Face-to-Face Discussions

Constructs	Measures	Sources
Perceived Competence		
COM1 COM2 COM3 COM4	I felt I was competent in my performance in the face-to-face discussions. I felt that my engagement in the face-to-face discussions gave me competence. I felt I was skilled in the face-to-face discussions. I felt I was capable in the face-to-face discussions.	Adapted from Deci and Ryan
Perceived Challenge		
CHA1 CHA2 CHA3 CHA4	I felt the face-to-face discussions were challenging. I participated in the face-to-face discussions because they were challenging. I like being challenged in the face-to-face discussions. I like exerting effort in the face-to-face discussions.	Developed from literature.
Feedback		
FEE1 FEE2 FEE3 FEE4	The face-to-face discussions provided positive feedback. I received positive responses in the face-to-face discussions. The comments I received in the face-to-face discussions were encouraging. I received compliments in the face-to-face discussions.	Developed from literature.
Perceived Choice		
CHO1 CHO2 CHO3 CHO4	I believe I had some choice in the face-to-face discussions. I felt like it was my own choice as to how much I participated in the face-to-face discussions. I contributed in the face-to-face discussions because I wanted to. I could make alternative selections in the face-to-face discussions.	Adapted from Deci and Ryan
Perceived Interest		
INT1 INT2 INT3 INT4	I would say discussing face-to-face is very interesting. I enjoyed discussing face-to-face. I felt that discussing face-to-face held my attention. I felt discussing face-to-face was fun to do.	Adapted from Deci and Ryan
Perceived Curiosity		
CUR1 CUR2 CUR3 CUR4	I felt the face-to-face discussions encouraged me to explore a variety of different issues. I felt the face-to-face discussion aroused my curiosity about the topics being addressed. The face-to-face discussions encouraged me to discover issues that I may not have otherwise considered. The face-to-face discussions encouraged me to look into issues that I may not have otherwise thought of.	Developed from literature.

The creation of the items was performed by listing each construct to be tested. For each construct, from a pool of relevant items, the most appropriate was chosen, taking into consideration that the results of the instrument must show a score in construct validity and reliability. Items were adapted from instruments developed by other researchers, with appropriate modifications to make them specifically relevant to the study (Tsigilis & Theodosiou, 2003).

Card sorting

In order to ensure construct validity, by knowing the extent to which the constructs may be ambiguous, a card sorting procedure was performed following Moore and Benbasat's (1991) development process. The objective of performing the two sorting rounds was to ensure construct validity, the first round being exploratory while the second was confirmatory. A third round was

conducted because of a reliability issue for the construct of perceived curiosity, which had a low item placement ratio.

To assess the reliability of the sorting, Cohen's (1960) Kappa coefficients were used as a measure of the judges' agreement when they categorized the different items. The results of the first round (see Table 5) showed scores of above 0.675 with an average of 0.769. The results of the second round showed scores of above 0.800 with an average of 0.863. The results of the third round showed an average of 0.950. According to Moore and Benbasat (1991), scores above 0.65 are considered as acceptable.

Table 5: Cohen's Kappa of the three Sorting Rounds

Agreement	First Round	Second Round	Third Round
AB	0.775	0.800	0.950
AC	0.675	0.925	0.950
AD	0.791	0.900	0.950
BC	0.823	0.825	0.950
BD	0.825	0.800	0.950
CD	0.725	0.925	0.950
Average:	0.769	0.863	0.950

During the first sorting round, the judges named the different labels fairly accurately, so the given labels in general were quite close to the real construct name. Most of the items were placed in the right category, with an overall placement ratio of 0.79 (see Table 6). No items were discarded, since they were often placed in the right category. In the second round, the overall placement ratio was 0.88. The results of both the first and the second round showed a high validity concerning the mode of classification and a high reliability of the items.

Table 6: Item Placement Ratio for First, Second and Third Rounds

Construct	First Round	Second Round	Third Round
Perceived Competence	0.81	0.93	1.00
Perceived Challenge	0.69	0.93	0.93
Feedback	0.93	0.93	0.87
Perceived Choice	0.81	0.93	1.00
Perceived Interest	0.75	0.93	0.93
Perceived Curiosity	0.75	0.62	1.00
Average	0.79	0.88	0.95

Examination of the results of categorization showed a high degree of agreement among judges. Content validity was assessed through card sorting results to show the extent of providing adequate coverage of the topic under study. Face validity was assessed during the card sorting, by demonstrating how the participants were able to judge if the instrument accurately measured what it was expected to measure. Inter-rater reliability was assessed using Cohen's Kappa (Cohen, 1960), a good indicator that examined the level of agreement by judges in the card sorting rounds, in terms of grouping the index cards in categories. A score greater than 0.65 was qualified as acceptable.

Convergent validity was assessed solely from the loading of constructs on indicators, then by the loading of each indicator and, finally, calculated through the path loading. The path loadings were considered to be acceptable if they were higher than 0.7.

Discriminant validity was assessed by inspecting the correlations between the six constructs (Bagozzi & Phillips, 1991). Table 7 shows the Average Variance Extracted (AVE) for each construct and indicates that the questions for each construct correlated with each other more than with those for the other constructs. Hence, the six constructs had good discriminant validity.

Table 7: Assessment of Discriminant Validity
Diagonal entries: average variance extracted; Non-diagonal entries: shared variance

Construct	CM	CH	FE	CO	IN	CU
Perceived Competence (CM)	**.231**					
Perceived Challenge (CH)	.102	**.218**				
Feedback (FE)	.241	.185	**.571**			
Perceived Choice (CO)	.187	0.98	.280	**.315**		
Perceived Interest (IN)	.220	.167	.301	.197	**.427**	.152
Perceived Curiosity (CU)	.118	.111	.245	.191	.152	**.200**

The survey instrument consisted of both formative and reflective items. The reflective items were generated from a comprehensive review of the literature and verified following the card sorting procedure proposed by Moore and Benbasat (1991) to further ensure discriminant validity. The measurement instrument was developed using a five-point Likert-type scale, from 1=Strongly Agree to 5=Strongly Disagree.

Instrument testing

The next stage of the development process was to perform a pilot study of the measurement instrument. The purpose of the pilot study was to test and refine the experimental design of the main study and to ensure that the respondents correctly understood the comprehensiveness of the survey instrument items. The pilot study finalized the development of the survey instrument by testing its validity and reliability and helped develop the survey (i.e. analysis of survey data). The respondents of the pilot study represented a fraction of the overall participants and, in order to ensure statistical validity, the sample size was kept small.

For ensuring a high quality assurance of the present study, a second pilot study was conducted under the same conditions. It was conducted with a sample of the students not included in the final survey to ensure that respondents understood the questions and the instructions. The pilot test resulted in the conditions shown in Table 8.

Table 8: Pilot Test
(Technology-supported and Non Technology-supported Face-to-face Discussions)

Treatment	Type of Activity	Sample Size	Duration of Exercise	Facilitated by
Tutorial 1	Technology Supported online discussions	6	Week 1	TA 1 (Researcher)
Tutorial 2	Non technology Supported discus-sions	6	Week 2	TA 1 (Researcher)

The pilot test was conducted in the tutorial sessions of weeks 1 and 2 by the Teaching Assistant (i.e. the researcher) and was carried out with 12 respondents, who were randomly selected. The participants were invited to fill in the survey instrument (both versions of the online and face-to-face) wherein the order of items was randomized. Upon completion of the survey instrument, they were further asked to comment upon the clarity and appropriateness of the instructions, response format (i.e. the measurement scale), item wording, length, sequence, design, and comprehensibility of the survey instrument.

Table 9: Cronbach ALPHA Reliability Coefficient for Main Sample

Construct	Items	Alpha
1. Perceived Competence	4	0.77
2. Perceived Challenge	4	0.72
3. Feedback	4	0.74
4. Perceived Choice	4	0.70
5. Perceived Interest	4	0.75
6. Perceived Curiosity	4	0.70

Reliability of constructs were assessed using Cronbach's (1951) alpha on the main sample (see Table 9). All of the constructs demonstrate good internal consistency, ranging from 0.70 to 0.77, thereby exceeding the reliability estimates ($\alpha = 0.70$) recommended by Nunnally (1967).

Results and Analyses

Table 10 displays the means and standard deviations of each construct for both online and face-to-face discussions. Means are identical for perceived challenge and feedback, but lower in the online situation for the four other constructs, implying stronger agreement for these in online discussions. Challenge obtains the least agreement for both types of discussion, while choice gets most agreement in online discussions and interest in face-to-face discussions.

Table 10: Means and Standard Deviations of Intrinsic Motivation Survey Constructs

	Competence M *(S.D.)*	Challenge M *(S.D.)*	Feedback M *(S.D.)*	Choice M *(S.D.)*	Interest M *(S.D.)*	Curiosity M *(S.D.)*
Online Discussion	2.31 *(0.56)*	2.60 *(0.62)*	2.45 *(0.53)*	2.25 *(0.53)*	2.31 *(0.62)*	2.30 *(0.53)*
Face-to-face Discussion	2.48 *(0.58)*	2.68 *(0.55)*	2.45 *(0.73)*	2.51 *(0.57)*	2.31 *(0.56)*	2.42 *(0.70)*
TOTAL	2.39 *(0.57)*	2.64 *(0.58)*	2.45 *(0.63)*	2.38 *(0.60)*	2.31 *(0.59)*	2.36 *(0.61)*

The collected data were analyzed using a two-tailed t-test for matched pairs, as it was possible to have differences in either direction. The results for each construct are illustrated in Table 11. The criterion level of $p < 0.05$ was accepted as support for all the hypotheses in this study, while partial support was acknowledged at significance levels between 0.05 and 0.10. Table 11 shows that there was significantly higher (at a 0.001 level) agreement about perceived choice in online discussions, while online discussions provided somewhat more perceived competence than did face-to face discussions. Results for the other four constructs were not statistically different in terms of discussion mode.

Table 11: Two-tailed t-test for difference in means between online and face-to-face discussions

	Variable	DF	t Value
H1	Perceived Competence	76	-1.84*
H2	Perceived Challenge	76	-0.96
H3	Feedback	76	0
H4	Perceived Choice	76	-3.2***
H5	Perceived Interest	76	0
H6	Perceived Curiosity	76	-1.19

*p<0.10; ***p<0.001

Discussion

Perceived Competence

The results indicated that subjects in the online discussions perceived themselves to be significantly more competent than subjects in the face-to-face discussions (at a 0.1 level). It is interesting to note that the behavior of the subjects in this study, for the two treatments, was very different. The participants in the online discussions seemed proficient, skillful, enthusiastic, adept at the use of technology, and interacted more in the online discussions. Whereas, the participants in the face-to-face discussions were not as eager to participate in the discussions and showed some resistance in initiating the discussions. This resistance may have been due to communication apprehension of the individual in engaging in the face-to-face discussions. The synchronous nature of the online discussions gave participants an opportunity to get their whole point across, whereas with the face-to-face discussions, they may have felt an inhibition to speak due to not being confident in expressing themselves verbally.

Perceived Challenge

The findings of the study indicated that participation in online discussions did not significantly increase individual perceptions of challenge over the face-to-face situation. We propose that instructors who want to challenge their students should encourage them to choose entry level tasks that are precisely suited to their abilities (i.e. neither too easy nor too difficult). The integration of online discussions into the course may fit nicely with this approach. A model that may be developed would be one in which learners start using online communication platforms, in order to develop experience and skill proficiencies in using the technology. From observation, the online discussions in our study seemed to emphasize how well the activity promoted individual learner stimulation, which in turn stimulated growth in individual understanding. When student were pleased with their efforts, especially when they saw improvement, they invested more effort. Improvement came through self-evaluation, practice, and more evaluation. The better the quality of their work, the more pleased they were and the more they engaged in the activity. This in turn enhanced success and perpetuated a positive learning atmosphere.

Feedback

The survey data from the study indicated that there was no statistical difference in individual feedback, in the form of verbal praise, between the online and face-to-face discussions. In fact mean scores for each were identical. The feedback offered to participants in the online and face-to-face activities in this study provided them with clear information about the success and quality of outcomes of their discussions. However, it was not so much the amount of feedback, but rather the meaning of the feedback, that was important to them. For instance, subjects in this study appeared more prone to interpret positive feedback as more controlling. Controlling inputs create pressure to perform in specific ways, while informational inputs support autonomy and self-determination. This appears to be the only probable explanation for the inconsistent findings in this study.

Perceived Choice

The overall findings in the study indicated that subjects who participated in the online discussions had a more positive perception of choice than subjects who participated in the face-to-face discussions. This was the most significant result of the study. The online discussions provided significant opportunities for extended exchange of ideas and expertise. Subjects in this study could read, respond to, or initiate comments in a virtual meeting space. They could exit the “Blackboard Virtual Classroom” and return at will. As such, an individual may invariably be intrinsically motivated in technology-supported contexts offering choice, whereas no-choice contexts may be associated with decreased levels of individual intrinsic motivation. Clearly, different individuals have different preferences and, certainly, the more choices there are available, the more these individuals will be able to find and select alternatives that best match their personal preferences. Finally, the mere exercise of making choices in the online discussions may also have psychological benefits - individuals may feel a sense of autonomy, control, and empowerment.

Perceived Interest

The findings of the study indicated no difference in perceived interest between online and face-to-face discussions – as with feedback the mean scores were identical. The online discussions may have been engaging in the first instance, but a more general interest in the discussions, whether online or face-to-face, may need to have been rooted in the individual, in order for that interest to endure over time. The online discussions seemed to help encourage subjects to be active learners, by providing them various opportunities to identify what they already knew, wanted to know, and had learnt. To conclude, highlighting the relevance of individual goals for a learning activity, may

increase individual intrinsic motivation, because the values and skills an individual possesses are relative to his or her perceived interest in that activity.

Perceived Curiosity

The findings of the study indicated that the online discussions were not found to lead to a more positive perception of an individual's curiosity. The survey data suggested that there was no statistical difference in perceived curiosity for both the online discussions and face-to-face discussions. Since most of the subjects in this study were experiencing online discussions for the first time, they may not have been able to assimilate this new experience into their schemata. As such, a cognitive conflict or disequilibrium may have been created (Piaget, 1985). Individual curiosity could have been further aroused, if the online discussions placed participants in active roles of exploration, investigation and discovery, to enable them to use the electronic interface in meaningful ways, so as to awaken their innate sense of curiosity. When activities heighten curiosity, then an individual is naturally involved and driven to learn because his or her intrinsic motivation is increased.

Future Work

A variety of avenues present themselves for future study. Future comprehensive research designs may also require attention to be paid to both environmental and individual variables. One environmental dimension, understudied but with likely implications for individual intrinsic motivation, is the social environment. Social information processing (Salancik & Pfeffer, 1978) may affect individual attitudes and responses and has been shown, along with objective task characteristics, to influence task perceptions and task behavior (Griffin, Bateman, Wayne, & Head, 1987). Opinions of in-groups may undermine intrinsic motivation or be a source of it, perhaps with more impact in collectivistic, rather than in individualistic cultures (Iyengar & Lepper, 1999).

Future research may also benefit from using other sources of data such as computer file exchange, electronic meeting logs, and online discussion transcripts. Data could be analyzed in relation to specific key participants, settings, behavior, and activities relevant to the theoretical framework and the emergent interests and outcomes. Additionally, other dependent variables, such as fantasy (Malone & Lepper, 1987; Parker & Lepper, 1992), control (Harter & Connell, 1984), and creativity (Amabile, 1996) could also extend the scope of future studies.

Limitations

There are several limitations of the present study that need to be considered. The key limitations centered on: (1) Generalizability between groups and individuals; (2) Mediating factors; (3) Potential for bias; and (4) Threats to validity.

To elaborate, firstly, the results of this study cannot be generalized between groups and individuals. For example, individual students that are members of the same age or gender status may have similar motivations, whereas the motivational structure of a group may be different, based on a different set of factors such as group size, amount of participation, and communication. Since the unit of analysis of this study is the individual student, the findings of this study cannot directly be generalized at the group level of analysis.

Secondly, this study does not take into account mediating factors such as individual beliefs and values. The fact that learners are individuals, with their own beliefs and values, may have a significant consequence on their motivational dispositions. In addition, this study does not take a sample size of members from every age group, socio-economic status, or different ethnic groups and, therefore, the results cannot be generalized for the entire population. Future research studies need to be conducted to analyze the effects of demographic factors such as age, groups, gender,

and ethnicity on factors supporting intrinsic motivation. Such future studies may also not support confident generalizations across various domains. These limitations (i.e. age, groups, gender, and ethnicity) demonstrate that more behavior-analytic research on factors deemed to support intrinsic motivation in educational settings may be warranted.

On the individual level, student success in other academic courses may have pronounced effects on this study. For example, an individual student may associate a low grade in this study with his or her level of performance in a previous course. Therefore, that student may attribute his or her perceived ability to poor success in that course, which in turn could have a negative impact on the student's motivational disposition during or before the start of this study. The experiences of subjects in the use of technology needed to be controlled for this study, because not all of them may have had prior experience/practice in use of computer technology. As a result, those subjects with previous experience may have been more motivated to use computer technology, as compared to subjects with little or no experience in the use of computer technology. Lastly, an individual student's attitude towards learning is an important mediating factor that needed to be controlled for this study, because each student may have had a negative or positive attitude towards learning that could affect his or her motivational dispositions.

Other variations that were required to be taken into consideration for this study were the differences in the academic levels between subjects in this study, as well as the gender and age of the participants. However, these factors were controlled for and measured as a scale of multiple-choice items and yes/no items administered before the treatment.

The third limitation we observed in this study was a potential for bias. Since the procedures used in this study were generated by self-report measures, questions may be raised that the findings may not represent true behavior. The perceptual measures created potential for psychological biases and confounds of common method variance. For example, because the construct of perceived interest was composed of an individual's perceptions of personal phenomena, self-report methods were necessary. Nonetheless, future work can reduce these potential confounds via longitudinal designs, objective procedures, and behavioral measures.

The fourth limitation addresses the following threats to internal validity, external validity, and statistical validity. Internal validity focuses on cause and effect relationships. Subjects in the study were exposed to each variation of the independent variable (i.e. online versus face-to-face discussions) at different times during the experiment. This was an ideal way to eliminate threats to internal validity when random assignment of subjects was not possible, because each subject received each treatment, thus eliminating the possibility that non-randomized subjects may not be equivalent and differences could be construed as an effect of an independent variable (i.e. online or face-to-face discussions). Statistical conclusion validity in this study was considered by forming conclusions based on proper use of statistics. Reliability in the way the treatment is implemented may differ from one researcher to another, if different researchers are responsible for implementing the treatment. This lack of standardization will inflate error variance and decrease chances of obtaining true differences. Therefore, in this study, the same researcher was responsible for implementing the treatments.

Conclusion

In our research, six types of individual perceptions of intrinsic motivation were examined – perceived competence, perceived challenge, feedback, perceived choice, perceived interest, and perceived curiosity. Students rated each of these in online and in face-to-face discussions. The most significant result was that students perceived higher levels of choice ($t=3.2$) with online discussions versus face-to-face discussions. Perceived competence was higher in online discussions (somewhat significant, with $t=1.84$). Perceived challenge ($t=0.96$) and perceived curiosity

(t=1.19) were not significant, and both feedback and interest had identical mean scores for the two types of discussions.

This study suggests that there is some difference in individual intrinsic motivation between the online and face-to-face discussions. The subjects in the online discussions were eager to engage in textual dialogue and, therefore, participated more in the discussions. In the observations of subjects engaged in the online discussions, this study found that these discussions allowed for individual assimilation, reflection, and critical thinking (Greenlaw & DeLoach, 2003). Further, these subjects were excited to start working with the "Blackboard Virtual Classroom." On the other hand, the subjects in the face-to-face discussions were not as eager to participate in verbal dialogue and displayed resistance towards participation in the same.

Within a technology-supported learning environment, an individual feels an increased amount of intrinsic motivation (Wang & Reeves, 2006). Technology-supported online discussions may be effective in stimulating individuals through the use of content and graphics and present challenges as well as stimulate individual curiosity and interest. The use of interactive technologies may provide us with a valuable guide for designing technologies where the individual learner may find him or herself in an environment that both instructs about subject matter and encourages the learner to construct knowledge from subject matter in more meaningful and effective way (Bendar, Cunningham, Duffy, & Perry, 1992). As such, these social interactions have the potential to enhance individual construction of knowledge by engaging the individual learner in activities that promote individual competence and arouse his or her perception of choice, thus permitting him or her to make decisions and allowing him or her to exercise control in terms of setting his or her own pace in technology-supported online activities (T. Duffy & Jonassen, 1992; T. M. Duffy & Cunningham, 1996).

In addition to the research on intrinsic motivation in this study, there were visual implications that can be drawn about the effects of online discussions. The subjects who were part of the online discussions were excited about the use of computers and, especially, the use of the "Blackboard Virtual Classroom" program. We noticed that the subjects seemed eager to arrive at the computer laboratory and work on their computers. Once in the laboratory, they would immediately log into "Blackboard" and enter into the "Virtual Classroom," to begin their online discussions, thereby generating comments and sharing ideas with the other participants.

In general, the use of online discussions may directly support individual learning goals that are meaningful and useful. For example, if the learning goal of an individual is to learn how to articulate and defend his or her ideas, the use of online discussions may support that goal. An individual may feel that online discussion tools help to extend the discussions that take place in class. In effect, this helps the individual to gain a deeper understanding of material, and it also provides an opportunity for him or her to apply course content to his or her own experiences. Finally, an individual may learn to appreciate the variety of perspectives that can be shared amongst all participants in online discussions.

This study is a cautious yet assured step towards an investigation of individual student perceptions of intrinsic motivation in online and face-to-face discussions. We have presented a framework to investigate individual student perceptions of intrinsic motivation in online and face-to-face discussions and tested the framework empirically. Undoubtedly, the framework may be open to further refinement, particularly with regard to other factors requiring examination for the support of individual student intrinsic motivation in technology-supported learning environments. Nonetheless, this study has offered some critical contributions for a lucid and logical understanding of individual student intrinsic motivation. In light of the limited research on intrinsic motivation in technology-supported learning environments, the framework presented in this study may provide constructive discussions for the future.

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