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DIMENSIONS FOR BLENDED LEARNING TECHNOLOGY: LEARNERS' PERSPECTIVES

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Abstract

This paper reports on a case study aimed at developing a better understanding of the different dimensions of blended learning technology. Drawing upon learners' experiences, it examines the circumstances in which learners are more likely to choose among different learning preferences and explores learners' preferences for human and online learning support environments and the factors driving their choices. Finally the paper describes an instructor's selection of and experiences in the use of technology to support students' learning and how technology has impacted face-to-face interaction with students. The study concludes with a summary of the different dimensions of blended learning and how an understanding of these dimensions impacts the theory and practice of blended learning within the educational environment.

Keywords

Learning preferences, blended learning, collaborative learning

Introduction

Recent research in the area of blended learning suggests it can provide a promising approach to support learning environments that enable individuals to adapt learning to their own preferences, schedule, and needs. Proponents of this approach argue that it can enhance learning both in classroom settings as well as in technology enhanced learning environments (Collis, 2002). Singh and Reed (2001) suggest that it can enhance learning experiences and increase learning outcomes within a cost-effective environment. Twigg (2000) corroborates these findings suggesting that when properly implemented, blended learning can improve learning outcomes in large classroom settings while reducing costs. Despite the promise of blended learning there is limited empirical evidence to support many of the claims. Moreover, no studies have been conducted to elicit information about blended learning from the learners' perspectives (Daniel, Matheos and McCalla, 2004). Oliver and Trigwell (2005) have further critically synthesized research into blended learning, drawing from both the corporate sector and academia and concluded that the notion of blended learning is seriously misguided and that it must be rebuilt and grounded on learning theory, shifting the learning emphasis from teacher-centred to student-centred.

This paper describes a longitudinal case study undertaken to better understand the different dimensions of blended learning from the learners' perspective. It builds upon the work of Collis

(1996) who suggests that a blended model strikes a balance in the choice of different instructional components in order to influence the integration of technology in teaching and learning. It extends the research on blended learning by investigating and reporting on students' perspectives and providing an explicit definition and categorizing the dimensions of blended learning.

The study draws upon the experiences of learners participating in a 13 week introductory level computer science service course (Service courses are those provided by an academic department to serve the needs of the general university population. Service courses generally do not constitute a requirement for a major or minor within the academic department offering the course. For example English departments may offer a written communication course to serve non-English majors across the campus) at a Canadian university. It examines the circumstances in which learners select from among different learning preferences over others, their preferences for human and technological support and the instructor's preferences and experiences in the integration of technology. The paper includes a review of current literature on blended learning research, a description of the research methodology along with the context and setting for the study, the results and findings from the study, and suggestions for future research.

Blended Learning Research

The articulation of the concept of blended learning began in the corporate world. Corporate researchers and practitioners noted that technology enhanced learning alone was not enough, arguing that people needed experiential learning for the mastery and retention of knowledge and skills achieved through the blending of technology and face-to-face interaction (Singh, 2003, Collis, 2002). Blended learning means different things to different people. There is a growing literature that associates blended learning with flexible delivery of instruction (Collis and Moonen, 2001). Others regard blended learning as an important building block of the new schoolhouse, which offers students both flexibility and convenience, important characteristics for working adults who decide to pursue postsecondary degrees (Rovai & Jordan, 2004). Collis and Moonen (2001) argue that blended learning is a hybrid of traditional face-to-face and online learning so that instruction occurs both in the classroom and online, and where the online component becomes a natural extension of traditional classroom learning. Hybrid is yet another term found in the literature. University of Wisconsin defines a hybrid course as one that combines face to face and online learning. Blended learning has also been treated as an alternative strategy to enhance knowledge transfer and performance support in order to attain better business results (Marsh, 2002; Driscoll, 2002; Valiathan, 2002; Collis and Moonen, 2001). There are several research activities on blended learning in the corporate sector. For example, Singh and Reed (2001) explore the nature of blended learning and the incorporation of blended learning approaches to support business success; Bersin (2003) focuses on the selection criteria for the use of media in blended approaches in a range of contexts; Julian and Boone (2003) show how blended learning solutions and robust learning services can help companies to develop their workforce and manage their intellectual capital; Marsh (2002) provides approaches for designing effective blended learning for the Brandon Hall Company. Further, Driscoll (2002) presents the notion of blended learning as a strategy for gradual movement from a traditional course delivery into Web-Based platform within IBM. Valiathan (2002) identifies three categories of blended learning for training and performance: skill-driven learning activities focusing on teaching a specific set of skills, learning activities geared toward change in attitudes, and blending performance support tools with knowledge management resources and mentoring to develop workplace competencies.

In academia, blending lectures with seminars, workshops, bulletin board discussions, and off-campus and on campus learning activities had existed prior to the construct of blended learning within the corporate world. Despite the preponderance of blended learning practices within academia, blended learning was not initially identified as a specific issue in the academy. More recently, however, "blending" emerged as a powerful force for campus-based traditional universities to improve teaching and learning. The permeation of blended learning ideas into academia is accompanied by several research activities. Voos (2003) and Collis (2002) have examined the notion of blended learning in academia, its current status and future directions. Troha (2003) has investigated a process-oriented blended learning design model, which presumes

performance analysis for examining a need for training, as opposed to performance improvement. Collis and Winnips (2002) have explored different pedagogical scenarios that can be embedded into web-based learning environments and traditional learning situations to produce productive and reusable learning outcomes. McCracken and Dobson (2003) have proposed a body of principles for blended learning design through the exploration of issues relating to teaching and learning, organizational factors, discipline specific factors, and learning technologies. Barnum and Paarmann (2002) have studied blended learning strategies to support new teachers during their induction period.

This growing interest in blended learning has been accompanied by many definitions so a universal definition has been neither developed nor accepted. The Collaboration for Online Higher Education Research (COHERE) consortium defines blended learning as the best of both worlds from the integration of online and face-to-face teaching, resulting in an enhanced learning experience. Garrison (2003) contends that blended learning combines the strengths of face-to-face and online educational experiences to provide unique inquiry-based learning. Within the context of this study the researchers build on the COHERE (2004) definition to include the commitment to provide every learner with the opportunity to learn in his or her best choice, within particular resource constraints (Daniel, Mathoes, McCalla, 2004). This commitment is based on understanding learners' preferences, use of technology, and available learning support.

In academia the use of blended learning strategies provides instructors and courseware designers with a comfortable non-threatening environment in which they can acquire the set of skills and knowledge necessary to fully function in technology enhanced learning environments. These claims are echoed by Driscoll (2001), who notes that blended learning by its very nature can allow teachers and learners to move from traditional classrooms to e-learning in small steps, allowing for the inclusion of aspects of both face-to-face and online learning. This blending of technologies affords greater flexibility in teaching and learning, and enables the delivery of high quality content and effective learning. Common technologies used within a blended learning environment include Web-based collaborative communication tools, such as chat boxes, bulletin boards, and instant messaging. Blending different technologies can also encourage wider and faster access to learning materials provided by instructors and peers. In a traditional classroom, instructor or peer support can only be obtained within a specific context (classroom or office appointment time).

An inclusion of technology-enhanced learning within a blended learning environment can allow students to access support at anytime and anywhere. For example, using peer-help support systems (I-Help) learners can increase their knowledge of the domain (Greer, McCalla, Collins, Kumar, Meagher, and Vassileva, 1998). They can post their own questions, read others' postings and responses, respond to others' queries and check whether others are experiencing similar doubts with the course content. Blended learning can also incorporate the social benefits of the classroom for learning activities requiring a face-to-face interaction with online self-individualized content (Marsh, 2001). Individualization of instruction can be achieved through an understanding of individual learning preferences, and how learners chose technology to enhance their learning. It is also possible to blend independent learning approaches with collaborative learning approaches to improve learning outcomes incorporating various technologies.

Despite these numerous apparent advantages to learners, little is known about the experiences of learners in a blended learning environment and what they consider a truly effective blended learning environment (Daniel, Matheos, and McCalla, 2004). Within this study we believe that an effective blended learning approach should begin with understanding the requirements for blended learning, learners' preferences, available tools, choice of tools to support the blend, and the available learning support to supplement the blending process. We focus on pedagogy, technology and the domain, and the circumstances in which students make choices within a variety of resources. Figure 1 outlines this process and the components necessary for a blended learning environment.

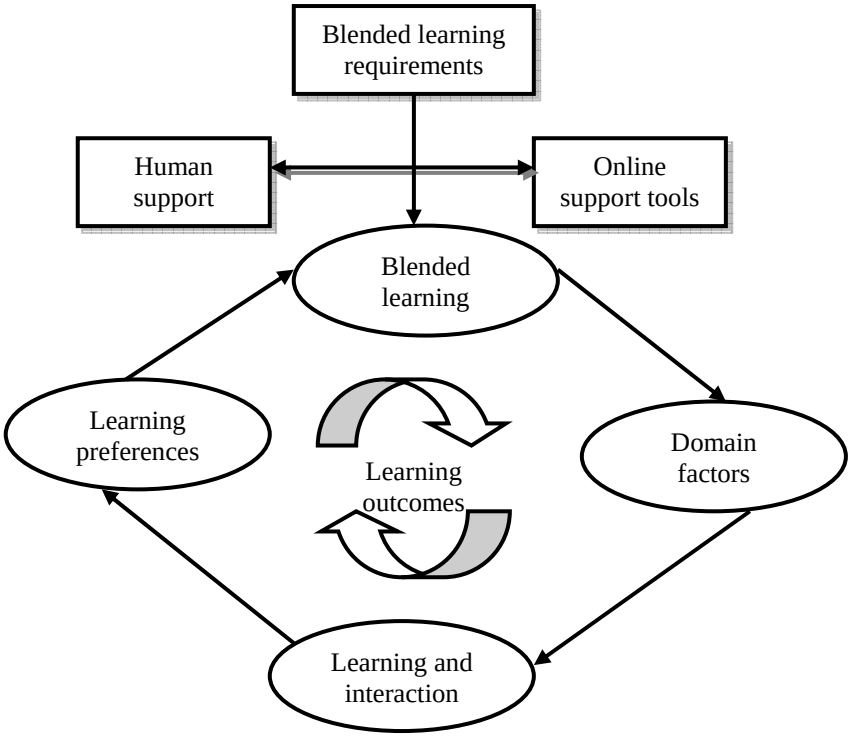

Figure 1. A Learner-centered Blended Learning Approach

Understanding why blending is needed is a first stage in developing an effective learner-centred blended learning approach. The initial step of this process is the identification of needs in the form of what is and what needs to be, clearly articulating the gap and proposing a solution that can bridge the gap between the present situation and the desired learning outcomes. Upon completion of this first step, learners' needs are determined, technologies and other learning support resources selected, and the learning implemented. However the critical part of this process is the ongoing analysis of the learning experience in order to understand how the different components of learning (domain issues, interaction during the learning process and learners' learning preferences) can be combined to meet learning objectives and learners' needs while remaining within resource constraints.

Learning Preferences

Learning preferences are the conditions in which learners prefer to work and learn. Learning preferences range from a preference to work and learn independently, in collaboration with others as in classroom settings, and with or without the help of an instructor. For Sadler-Smith (1997) learning preferences refer to individual propensity to choose or express a liking for a particular instructional technique or combination of techniques. Learning styles, on the other hand, are concerned with how learners mentally perceive, process, understand, and internalize new knowledge. Learning styles also refer to traits of learning that are unique to each individual learner (Grasha, 1996). Kettleborough (2004) found that people do not learn in a single manner, but rather select a combination of tools and processes with which they are most comfortable. Learning technology designers often overlook the fact that learners think, process information, and learn in different ways. However, these differences among learners have been found to affect the learners' selection of courses, their success within courses, their career choices and even the friends they select (Jonassen and Brabowski, 1993).

Studies within learning sciences and education have established that some learners prefer certain methods of learning more than others and some learners perceive learning environments

differently (Corno and Snow 1986; Felder and Silverman, 1988; Felder, 1993; Grasha, 1996). Although understanding learners' learning styles is critical for adapting and individualizing learning, how learners prefer some styles to others is a key to the building of more engaging learning environments. Research shows that learners who are actively engaged in a learning process can feel empowered and are more likely to achieve success (Dewar, Hartman 1995). Studies have also found that learning preferences can positively or negatively influence a student's performance (Birkey and Rodman 1995; Dewar 1995; Hartman 1995).

Research studies have pointed out that through understanding learners' learning preferences and identifying their learning strengths and differences, teachers can assist and enable learners to adopt different learning strategies that can engage them in different learning activities (Kolb, 1984; Duff, 2000). Furthermore as educators become aware of their learners' preferences, the effectiveness of the learning process is enhanced (Bloom, 1976). Wakefield has corroborated these findings stating that when learning activities are structured to motivate the learners, and are congruent with individuals' learning preferences, learning improves. If optimal learning is dependent on learners' learning preferences as many researchers have found (Birkey and Rodman 1995; Dewar 1995; Hartman 1995), there can be variation on students' learning preferences between a classroom-based learning environment and a technology-enhanced learning environment. Clearly understanding these variations between classroom-based and technology-enhanced environments is both critical and notably unstudied in previous research. Despite extensive research conducted on learning styles and preferences in the traditional classroom, there is a dearth of research studies addressing learners' preferences in technology enhanced learning environments. Central to our study is the exploration of learners' preferences in technology-enhanced learning environments as opposed to learning styles. In so doing we limit our study to understanding of how and why students make choices about learning resources within the constraint of a thirteen-week computer service course. The study does not touch on issues such as preferences learned from prior educational experiences and how they might influence learners' choices within the computer science course.

In blended learning environments both the learners' learning preferences and their choice of technology are critical. Singh (2003) reinforces the prevalence of differing learning requirements and preferences among learners. To meet these differing needs educators and learning technologists must use a blend of learning and technological support tools, appropriate to the content, the learners, and the time frame for the learning.

In our study learning preferences of adult learners are central since the students in the service course were adults. In addition to independent learning (sometimes referred to as self-directed learning) (Knowles, 1975), some adults may prefer collaborative learning activities; whereas others can be characterized as technology-centred, instructor-centred, or flexible learners. Table 1 associates these various learning preferences with respective definitions developed.

Table 1. Definitions

Preference Type	Definition
Independent/Self-directed	The learner is willing to learn with or without the help of others.
Collaborative	The learner prefers to learn with two or more students.
Technology-centred	The learner depends on technology to enhance the learning process.
Instructor-centred	The learner depends on an instructor to determine and direct learning needs.
Flexible	The learner needs to be able to make choices that can allow him/her to meet their own unique learning needs.

Research Methodology

In our study we used an explorative research design to determine when and why students migrate from a classroom-based learning environment to a technology-enhanced learning environment. Participants for both the survey and the focus groups were enrolled into a service course on computer science. The course is a survey of major areas of computer science, combining a breadth of topics with depth via specific examples within each topic. Topics include: history of computing, computer applications, analysis and design, high level programming, computer software, computer hardware, artificial intelligence, and the social impact of computers. The course is available to all majors except those intending to major in computer science. The course is intended to prepare students to acquire literacy in information technology, and broad knowledge of computer science in general. Students are also expected to learn how to develop interactive web applications for the internet using HTML and JavaScript.

Students have access to materials of an online version of the course in the form of digitized lectures (video clips), texts, jigsaws programming puzzles, online help support systems (I-Help). The I-Help system facilitates both synchronous and asynchronous interactions. In addition students were required to attend regular classroom based lectures on the same materials in the course, and they had access to an instructor and a teaching assistant. Assessment of students was based on quizzes, laboratory assignments, midterm and a final examination.

Two approaches for data collection were used: a survey; focus group interviews of a subset of the class. A 15 items survey instrument was administered to a self-selected sample of 48 students enrolled in a first year computer science service course. (See the Appendix I) Questions were partitioned into three sections (background information, learning preferences, and technology choices). The survey instrument had a 96% return rate.

More data were elicited from the two focus groups and an interview with the class instructor. The two focus groups involved a total of ten participants, all female. The focus groups were self-selected and comprised of both individuals who participated in the survey and those who did not. The focus group questions were open-ended, asking students to verbalize about their learning experiences and preferences, their use of online and face-to-face support and the impact of this support on their learning. Each focus group lasted one hour, with the discussions taped and transcribed. Transcriptions were analyzed for salient themes. In addition, trace data of students' technology use, meant to better understand students' interactions between technology and learning and teaching, were carried out. The class instructor was interviewed to explore why and how he selected and integrated technology into his teaching and his perceptions of its impact on the learning environment.

Result

The purpose of the survey was to a gain better understanding of learners' learning preferences in relation to online and classroom enhanced learning environments. It was also to identify when students are more likely to work independently or in collaboration with others given various kinds of learning tools and human support provided. The data collected in the initial part of the survey provided background information about the students, including age, gender, linguistic background and their academic department. The data revealed that over 50% of the students were under 19 years of age with over 90% of the students being under 24 years of age. (See figure 2).

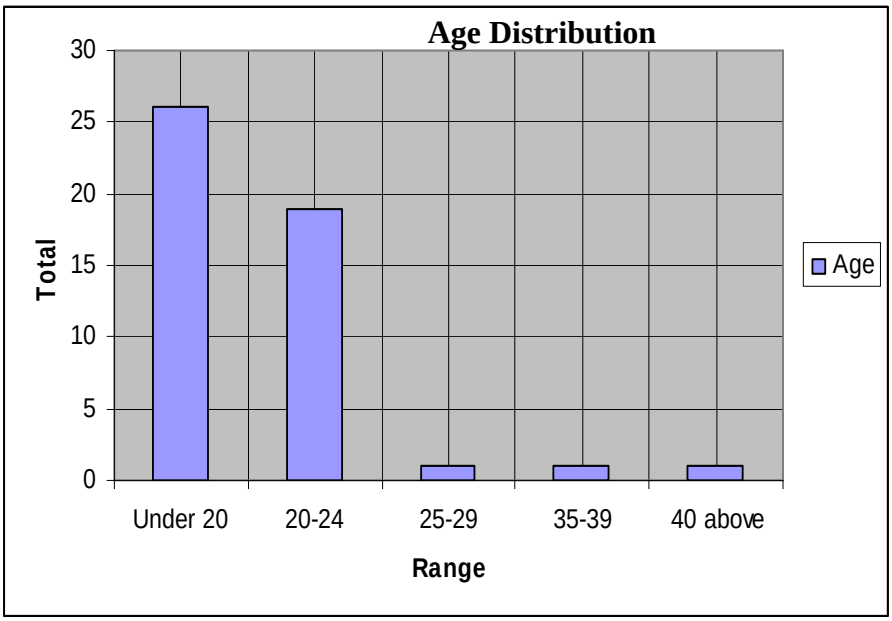

Figure 2. Age Distribution among Participants

Respondents were predominantly first year students (85%), with 10% in their second year and 5% in their third year**.** The respondents for the questionnaire were self-selected and the majority of them were female. (See figure 3)

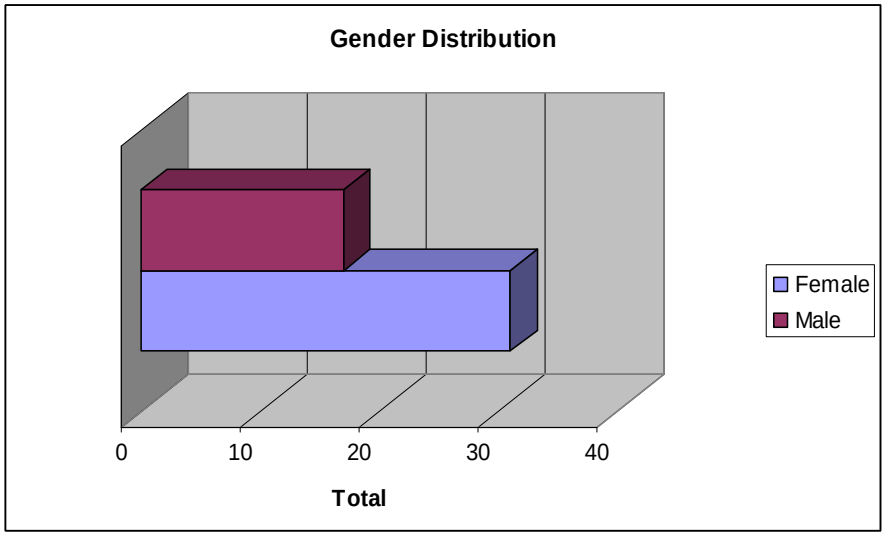

Figure 3. Gender Distribution

The linguistic background of the students was diverse reflecting first languages of English, Mandarin, Spanish, Bengali and Cantonese. The majority of the participants (over 90%) indicated English as their first language, followed by Mandarin and equal percentage distribution of Spanish, Bengali and Cantonese (see Figure 4).

As this was a service course, not available to computer science majors, participants came from a range of colleges (faculties) across the University of Saskatchewan. The greatest number of the participants, 39%, was enrolled in the College of Commerce, with slightly fewer 35%, enrolled in the College of Arts and Science. The remaining participants, 26%, were enrolled in various colleges across the institution, some of whom were registered in unclassified studies indicating they had not yet determined their area of specialization.

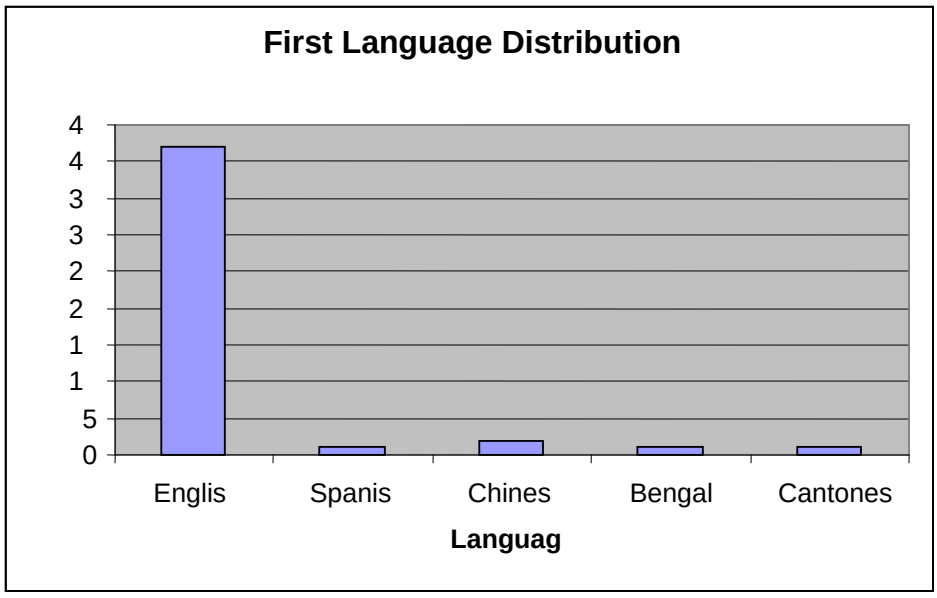

Figure 4. First Language Spoken by Participants

The second component of the survey sought information about the learning preferences of the students, including their choice of learning supports and tools. Students were asked to rank in priority order their reasons for attending classes. The data revealed that approximately 53% of respondents attended class for the lectures, ranking traditional classroom learning as their first preference. They indicated that they learned better in class when a teacher provided formalized lectures. These participants also suggested that the availability of learning resources and location of human support influenced their choice of classroom learning. Twenty-six percent of the students said they are more likely to attend classes when the instructors did not put the class notes and power point on the web. Others indicated that meeting the instructor to discuss class related materials was one reason for attending classes. A small number (10%) mentioned peer interaction as the primary reason for attending classes.

The survey also attempted to determine what learning supports (e.g. the instructor, the online learning technology, etc.) students were more likely to use when they were faced with particular problems. The findings showed that most of the participants (42%) were more likely to use collaborative learning technology (I-Help) (Greer, McCalla, Collins, Kumar, Meagher, and Vassileva, 1998) as the first source of help. Thirty percent reported they were most likely to ask the instructor, and 27% said they would approach their peers first. In addition the majority of the respondents would also use the web-based course resources. Only 10% of the respondents indicated they had sought such help from the teaching assistant.

The data also revealed a general variation in learning preferences. This variation was categorized into four major learning preferences: independent, collaborative, flexible, and instructor-centred. Drawing on the data, 40% of the students could be grouped as instructor-led learners; 30% as flexible learners; 18% as collaborative learners and 12% independent learners. The survey also explored the types of learning activities in which students were more likely to work with others in groups, and the types of learning activities students were more likely to pursue individually. Most of the participants 73% were more likely to work on assignments individually. When asked about examinations, 46% preferred working individually on mid-term exams. Fourteen percent of the respondents preferred to work in groups when reviewing and discussing class notes.

Participants used various sources of learning tools to enhance their learning when working on individual projects or activities. When asked about resources utilized, 69% of the students used web-based class notes, 43% used notes taken in class, and 31% used Internet-based resources. Seventeen percent of the participants chose the assigned textbook as a resource, while only 3%

used materials from the university library. For their collaborative activities, participants reported seeking support and resources from a number of sources including comparing class notes among peers (15%), asking the instructor for support (10%) and asking other students from other sections of the same course (4%).

The focus group corroborated the findings of the survey. Of the 10 focus group participants, nine of the students reported attending every class. One student attended 60% of the classes, attributing her absence to having taken computer science throughout high school and having the knowledge and understanding of the background and history of computers. She found reading the textbook a sufficient review of this material. However, she attended all classes in which HTML and JavaScript was presented. All students found the class notes and power point slides posted by the instructor prior to the class an essential and valuable learning resource.

All focus group participants printed and read the web material prior to the class allowing them to concentrate on comprehension and interaction rather than note taking. When asked about the classroom lectures, all 10 students were overwhelmingly positive, describing the instructor as well organized and articulate**.** Two students described his teaching as charismatic; all found him to be very approachable and willing to answer questions both during the lectures and out of the classroom in his office or online. Responses to online queries were always received within the same day. When students were asked about replacement of specific topics e.g. history of computers with web-based resources, their response was varied. Half of the focus group saw it as a possibility, while the other five participants reinforced the importance of regular structured lectures for all course topics.

All participants reiterated the importance of both the web-based materials provided prior to class with the class sessions used for explanations and clarifications. All participants found that the combination of online support and lectures provided them with choice to construct individualized learning experiences. None of the focus group participants wanted to replace the classes with online learning, but rather wanted the choice to incorporate online learning tools if and when appropriate to their learning.

Technology Enhanced Learning

The final component of the survey sought information about the students' choice of and purposes for technology usage. Figure 5 indicates the distribution of software usage among survey participants.

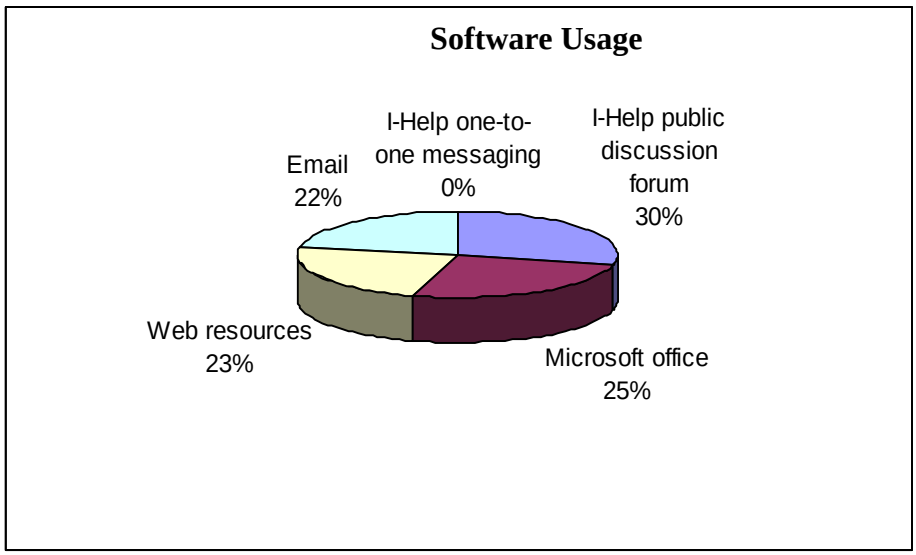

Figure 5. Software Usage

Besides the variation in learning preferences, a marked distinction in terms of preferences for different kinds of learning support was observed. The series of independent questions focusing on preference to and selection of learning supports constructed within the survey provided data reflecting these differences. Fifty percent of students said they were more likely to prefer human support, and 50% stated they preferred other kinds of support. In responding to another question 34% of the students said they would rather obtain such support through technology without physically approaching the instructor in class. Drawing on the focus group responses it appears this preference was based on the fact that the instructor promptly provided help online. In responding to yet another survey question 26% of the participants said they sought online support from peers, rather than the instructor through the I-Help system. Clearly these responses indicated the range of learning support preferences.

The data also reflected a relationship between age and technology usage and associated help-seeking behaviour. Younger students sought help online from both the instructor and peers more often than mature students. Within the focus group discussions all participants said that they accessed and read I-help discussion on a daily basis. Ninety percent of the participants in the focus group functioned only as lurkers, using the tool to confirm academic areas of difficulty; often finding their queries posed by and responded to by other students. When students within the focus group were not able to find answers from the existing discussion on the I-help, all preferred to email the instructor privately with their question. They expressed concern about posting questions that other students might think were “stupid”, having observed critical comments made when a learner asked a question that was obvious, or that had been asked already. All focus group participants said that the instructor provided quick feedback to email and that he always responded in a respectful manner. While all focus group participants accessed online support they stressed that they wanted the choice to access both face-to-face and online support, and did not want online communication to totally replace face-to-face interaction.

Technology and Pedagogy

In attempting to understand how technology affects pedagogy, the researchers explored the circumstances in which students prefer classroom learning to technology-enhanced learning environments. Previous research has indicated that new technologies are forcing pedagogical shifts from instructor-controlled learning to learner-controlled learning (Johnston, 2000). Results from our study suggest that not all learners are comfortable with this shift. More than half of the students 53% who answered the survey still preferred traditional instructor-led lectures situated in classroom settings. Twenty-three percent of the learners saw classroom learning as providing opportunities for interaction with the instructor that in turn enhanced their learning. However, 26% of the students were willing to forgo attending classes if the instructor could provide elaborate class notes on the class website, and providing they could ask the instructor if they needed help in an event that they cannot understand something. These results suggest that the majority of the learners already knew what kinds of environments they preferred for specific kinds of content. It becomes, necessary therefore, to perform content or task analysis to determine what topics, themes, or modules are better taught in classroom settings and those that lend themselves to the online setting. This is subject for future research in this area.

We also explored the situations in which learners are more likely to prefer classroom learning to technology-enhanced learning. It appears learners’ learning preferences, particularly their choice of learning resources and technological support, seemed to be directly related to the nature of the domain. Within the focus group half of the learners suggested that content that does not require problem-solving skills and deep synthesis e.g. “history of computers” might not require classroom presence and can be effectively delivered in a technology- enhanced environment. However, for problem solving e.g., Web programming (JavaScript), all focus group participants saw a classroom presence as critical.

In a post-course interview, the instructor stated that he selected and used technology as a way to enhance and expand the classroom, and not to replace it. To enhance the classroom he used technology in numerous ways to support learning. He made all lecture notes and power point slides available to students prior to each class in order to download, print and review before the

lecture, allowing students to focus on the discussion rather than trying to record all material presented. He also used technology to add variety to the class and to "surprise and get the attention of students" by providing movie trailers and sound effects interspersed with the lecture.

To expand the classroom he supported the use of the virtual help environment. He continually reviewed the I-Help discussion board for information on student areas of difficulty and to ensure responses provided by students were correct. Reviewing the student queries on the I-Help discussion board informed him of topics that may have needed additional time or explanation within the classroom. He responded daily to all private email questions, and continued to meet students face-to-face prior to classes, following classes and in lab sessions. He recognized all modes of course presentation and interaction as essential to an effective learning environment. He supported the students' entitlement to choose the modes most appropriate to their needs, and was an advocate of a blended learning environment and its concomitant incorporation of a variety of pedagogical approaches.

Technology Access

Earlier studies have confirmed that technological access is a critical determinant of learners' choice of technology-enhanced learning (Irons, Keel, and Bielema, 2002). Within our survey learners indicated they accessed online resources from various locations. Seventy-eight per cent of the respondents indicated they accessed their learning materials from home, while 40% accessed through school and about 1% from their place of work. Learners with Internet connectivity at home reported a higher use of learning resources online.

Discussion

Within the context of this study the researchers approached blended learning in terms of understanding students' learning goals, their learning context, the technology and human support available to enhance their learning, and how they made choices between technology-enhanced learning and traditional classroom settings. We believe the goal of any blended learning environment is to offer a wide range of learning resources and experiences, together with appropriate technological and human support based on learners' learning needs. With this goal the design of a blended learning environment requires a deep understanding of learners' characteristics and their learning goals. One important aspect of learners' characteristics is their variation in preferences for learning and learning support.

Research in the learning sciences has revealed that learners learn differently and that they process knowledge in different ways. Learners' differences suggest that learners learn more effectively when provided with certain kinds of learning resources and support. Observing and understanding learners' learning styles traditionally requires the use of standard psychometric tests to assess learners' cognitive processes. In this study we have distinguished between classical learning styles and learning preferences, where the latter refers to learners' preferences to pedagogical and learning support independent of their cognitive abilities.

Learning preferences can influence whether students would choose to work individually or in collaboration with others. Inferring from the results presented above, it appears that students would respond differently to learning (independent versus collaborative) depending on the nature of materials to be learned and the kinds of human and technological support available. We further observed that independent learners doing class assignments on their own with little support from their peers and the instructor of the class are more likely to use more technology support compared to the other types of learners. Collaborative learners on the other hand enjoyed learning and interacting with their peers and the instructor. They often collaborated with their peers when doing class assignments and discussing notes. Collaborative learners also noted that working in groups was essential to increasing their understanding of the domain. This collaboration with colleagues enabled them to exchange experiences and jointly solve difficult problems that they would have not otherwise solved individually.

Instructional design theory is critical to the development of appropriate blended learning experiences. Instructional design approaches most often focus on the arrangement and development of instructional resources to produce effective learning experiences. Traditionally, a sound practice of instructional design is based on a thorough analysis and understanding of learners, the academic content to be learned and the media in which the content is to be delivered along with the appropriate learning support. However, the design of blended learning differs from the usual practices of instructional design principles, given the wide range of pedagogical and technological options that could be combined for an effective learning environment than can serve diverse learners. The researchers were unable to locate recent research that thoroughly addresses the influence of instructional design and practice on blended learning environments.

Earlier instructional design approaches were based on objectivist principles, resting on linear design practices (Jonassen, 2000). In these approaches the design of instruction begins with an understanding of the content, a process known as content analysis. Content analysis often requires that an instructional designer work with a content expert to produce relevant learning content. The process of content analysis concludes with task analysis, and determining how learners can interact with the content in order to accomplish particular learning objectives. While early instructional design approaches were behaviorist based on the assumption that there is only one optimal way of learning, recent instructional design approaches were built on constructivist theory that encouraged an understanding of the learners and their particular context for the learning activity (Newby, Stepich, Lehman & Russell, 1996).

A fundamental assumption underlying constructivists' instructional design principles is that knowledge does not exist independently of the learner and that knowledge is constructed through interaction with either the content (Piaget, 1977) or other individuals (Vygotsky, 1978). In addition constructivist instructional design approaches are based on the understanding of learners' learning styles and their self-reflective cognitive skills. Constructivists consider both the content and context critical in the determination of pedagogical methods and strategies in a learning program. It seems the notion of blended learning environments based on the understanding of learners' preferences presented in this study is congruent with a constructivist instructional design approach. Fundamental requirements for blended learning such as learners' preferences, availability of human and technological support, the nature of the domain, and learning and interactions determine the particular blended learning strategy that is appropriate.

Drawing from the results of our study it appears domain issues are important to students when it comes to the choice of technology. In understanding domain issues in the context of blended learning requirements, the use of Bloom's Taxonomy (1976) is appropriate as it succinctly differentiates different levels of understanding based on various knowledge types. Bloom identified six levels of understanding knowledge within a cognitive domain: knowledge, comprehension, application, analysis, synthesis and evaluation. Certain parts of a domain require one or more of the knowledge types. For instance, consider the case of the participants who suggested that certain modules such as history of computers can be studied with little human support and can best be taken online. History of computers would be categorized as Bloom's comprehension knowledge type. In the context of a computer science course this implies an instructor would put class notes online and provide online support to students when necessary. The modules that require deep synthesis and evaluation in Bloom's terms such as Web programming (JavaScript in this case); can best be supported through a combination of classroom lecture and technology-enhanced experiences with both online and human support.

Conclusions and Research Directions

The notion of blended learning is increasingly gaining popularity as an effective pedagogical approach that integrates classroom and technology-enhanced learning. Our examination of work on blended learning has revealed that blended learning seriously lacks explicit definition, that the term is predominantly situated in the corporate sector and that it is more widely used by e-learning practitioners and writers than in the education system. However, the term is quickly permeating research discussions in the academic community. In our review of the literature and the evidence

gathered from this case study, we concluded that the success of the blended learning approach depends on the explicit clarification of the concept and the context in which it can be applied. We argue that the context in which blended learning can be applied is better understood by critically examining learners' individual differences and the circumstances in which they are most likely to make decisions on their appropriate learning preferences.

Moreover the conceptual and scientific rigor of the construct of blended learning depends on further examination and reconstruction of its nature and the contexts in which it is applied. Our work suggests that the issue is not blended learning per se, but rather it is pedagogy and learning preferences, technology choices are made to support pedagogical goals as appropriate to particular learning preferences. In other words blending is not a first order issue, but is derivative on pedagogy and learning preferences (Daniel, Matheos & McCalla, 2004). Oliver & Trigwell (2005) support this view. They point out that the term blended learning is ill defined and it should be radically reconceived, made theoretically coherent, philosophically defensible and pragmatically informative.

The requirement for blending is to be drawn from empirical evidence and positioned within available technological and human support constraints. Within this understanding it is best situated within a variety of learning preferences among learners and their use of online and human supports for learning. In addition factors such as access to technology, age, the nature of content and domain, types of technologies available, instructor's availability to provide support to students in person and online, and students' ability to obtain support from peers, remain critical. Although this single case study does not pretend to provide more explicit answers to issues around blended learning, we strongly believe the results can provide insight into how to achieve a blended learning approach. Such an approach would ensure effective, accessible, and engaging teaching and learning providing a range of technological and non-technological learning supports for learning and teaching. But perhaps more importantly, the results of our study can provide new insights to the debate on blended learning, moving from the approach itself to the requirements and factors that are more likely to drive blending.

Despite the enormous possibilities that blended learning provides as an effective instructional strategy, there are persisting and open-ended questions that remain unexplored. Blended learning is an emergent concept marked by ambiguity and unclear academic research cluttered with predominantly vague definitions and misinterpretations. Further, studies developing conceptual and practical principles that can guide decisions on why, what, when and how to implement blending learning are needed. New evaluation methods, tools, and units of analysis for blended learning environments need to be developed.

Another area which might possibly influence blended learning environments is mobile learning (M-Learning). M-Learning refers to use of mobile computational handheld devices, such as palms, laptops, Windows CE machines and digital cell phones in learning. A recent study of learners' preferences in M-Learning in the UK suggests that learners are mostly enthusiastic about M-Learning and its impact on their future learning (Attawell, 2005).The use of handheld devices and laptops raises new pedagogical and technological problems within the paradigm of blended learning. Pedagogical design problems will relate to contextual issues involving approaches that promote personalization of learning materials, while technical issues will include designing those materials in such a way that they are viewable in various screen sizes and resolutions and that they can interoperate and content can synchronize with other computing devices (Bull & Reid, 2003; Cui, & Bull, 2005).

The goal of this paper has been to develop a better understanding of the different dimensions of blended learning technology drawing upon learners' experiences. The aim has been not to provide ways to support the development of blended learning environments but rather to examine the circumstances in which learners are more likely to choose among different learning preferences and explores learners' preferences for human and online learning support environments and the factors driving their choices. The creation of a scalable, intelligent and effective adoption of blended learning within academia is dependent on the provision of empirical evidence about its effectiveness in enhancing the teaching and learning process. Moreover the need for instructional

design principles that better address blended learning approaches will continue to grow as blended learning becomes more prevalent throughout our institutions.

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Appendix

A sample of the survey Questionnaire

Technology Enhanced Learning Questionnaire

Thank you for agreeing to take part in our study. The purpose of the study is to find out more about your use of various software tools in this course, to understand why you select these tools, and to study how these tools help to support your learning in this course. One part of the study is this questionnaire. Later in the study we will be administering interviews to focus groups. We will also be looking at some summary statistics through tracking throughout the term students' actual technology use. We hope the information gathered in this study will provide the best technology enhanced learning environment possible for you.

In this part of the study, we would like you to fill out the following questionnaire. The questionnaire is divided into three parts. Part one asks about your background. Part two is about your learning preferences. Part three is about your technology use and preferences. Your answers to these questions will be anonymous. Neither your instructor nor your classmates will grade or see your responses. So please, feel free to express your true opinions on the questions. For questions with pre-specified options, place an "X" next to the single choice or (choices) that are appropriate to your situation. Answer discussion questions with a statement that is as clear and complete as possible.

1. What is your network student identification (NSID)?

2. Age

   [ ] Under 20
   [ ] 20-24
   [ ] 24-28
   [ ] 28-34
   [ ] 34-38
   [ ] 38-42
   [ ] 42 and above

3. Gender
   [ ] Male
   [ ] Female

4. First Language
   [ ] English
   [ ] Other, please specify

5. Year in the University
   [ ] 1st year
   [ ] 2nd year
   [ ] 3rd year
   [ ] 4th year
   [ ] Other, please specify

6. Study status
   [ ] Full time
   [ ] Part time

[ ] Unclassified

7. What is your major? ----------

8. Why do you attend classes?
   [ ] I learn better in class when a teacher gives a lecture
   [ ] I learn better when I interact with my classmates
   [ ] I want to ask for clarification from the instructor
   [ ] I want to keep up to date with others in the class
   [ ] Other, please, specify

9. When do you attend classes? On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you
   [ ] When there are no notes available on the class website
   [ ] When I am not working
   [ ] When I need instructor's help
   [ ] When I need to talk to my classmates about class notes
   [ ] Other, please, specify

10. If you have a problem with your class, where do you go first for help? On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you.
    [ ] Instructor
    [ ] Tutor
    [ ] Friend in the class
    [ ] I-Help
    [ ] The Web
    [ ] Other, please, specify

11. How much is your learning done on your own? Choose one answer.
    [ ] Very much
    [ ] Much
    [ ] Little
    [ ] None

12. What learning materials do you use to facilitate your learning when working on your own? On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you.
    [ ] Text books
    [ ] Library
    [ ] Internet—the Web
    [ ] Class notes in the web
    [ ] Notes taken in class
    [ ] Information from other class websites

13. What kinds of activities do you find usefully done on your own? On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you.
    [ ] Doing assignments
    Indicate your reasons for this choice.
    a)
    b)
    c)
    [ ] preparing for mid-term or final.
    Indicate your reasons for this choice.
    a)
    b)

c)
[ ] Reviewing what has been taught in class
Indicate your reasons for this choice.
a)
b)
c)
[ ] Other, please, specify
Indicate your reasons for this choice.
a)
b)
c)

14. Which activities do you find working with other students useful? On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you.
[ ] Discussing class notes with classmates
Indicate your reasons for this choice.
a)
b)
c)

[ ] Asking help from an instructor
Indicate your reasons for this choice.
a)
b)
c)

[ ] doing assignments with other students in the class
Indicate your reasons for this choice.
a)
b)
c)

[ ] Discussing materials with people who have taken this class before
Indicate your reasons for this choice.
a)
b)
c)

[ ] Discussing course materials with people from other sections of the same class
Indicate your reasons for this choice.
a)
b)
c)

[ ] Discussing with others, please, specify

Indicate your reasons for this choice.
a)
b)
c)

15. Where do you access your course materials online? Please, choose one or more of the following. On a scale of 0-5, please assign a weight against a choice on one of the following answers. 0 means a choice does not apply to you and 5 meaning a choice apply to you.
[ ] School
[ ] Home

SOFTWARE TOOL	0	1	2	3	4	5	Reasons
I-Help public discussion forum							
I-help one-to-one private messaging							
Email							
Web resources							
Office programs (Word, etc.)							
Others							

[ ] Work
[ ] Other, please specify

16. Here are a number of software tools that you have or probably will use in this course. Please rank how heavily you use them, 0 meaning no use or (anticipated use) and 5 meaning heavy use or (anticipated use).