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An early investigation into factors in student's choice of technology for e-learning

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This paper presents an exploratory study identifying factors that may influence a learner's choice of technology for e-learning. These factors include learning style, technology acceptance, use and competence, as well as stage in course. The respondents were predominantly from Generation Y, were technologically competent and positively disposed towards e-learning technologies. Their learning styles were predominantly 'doing', with no 'diverging' students represented. E-learning appeared to be most useful in replicating face-to-face lectures, and the recreational popularity of social networking technologies appeared not to flow through into formal education settings.

Keywords: e-learning, educational technology, technology acceptance, learning styles

Introduction

Learners of today are inundated with technological advances designed to assist them with their learning, such as learning management systems (Weaver, Spratt, & Nair, 2008), M-learning (Duncan-Howell & Lee, 2007) and blogs (Farmer, Yue, & Brooks, 2008). Millions of dollars are spent every year developing resources that can be accessed through an electronic environment; however, little consideration is given to the learner's preferred choice of technology for learning in this e-environment. Engaging learners using technologies that are best suited to them, and those that they are most comfortable with (Lynch, 2006), should result in deeper learning and higher cognitive skills. But what factors influence a learner's preferred choice of technology for e-learning, and how can an educational organisation harness the most preferred technologies to improve the student experience?

The paper presents an overview of the influences to the study: e-learning, learning styles and technology acceptance models. The paper then explains the study design: participant sample and conceptual framework (Kolb's Learning Style Inventory, UTAUT, technology competence). The next section presents the survey results and discusses the findings. The

final section outlines the significance of the findings in developing a preliminary understanding of student's choice of technology for e-learning, and the influence this has on their university experience.

e-Learning

Fundamentally, e-Learning is teaching and learning that is empowered by digital technology (USC, 2007; Nichols, 2003; Govindasamy, 2001). It does more than introduce technologies into the classroom as in the 'computers in the classroom' era. It provides a 'learning space' through which materials are delivered to students. Enriching these e-learning spaces are social software such as blogs, wikis and podcasts, providing networking opportunities for learners and educators who are separated by time, place and space. The engaging nature of the social aspects of the Internet provides alternative technologies for higher education organisations to use to engage students in their learning; and hopefully to enhance their university experience.

Learning styles

A learning style can be described as an individual's preferred way of learning. Educationally, learning styles surfaced in the 1970s, and are used to develop teaching strategies that appeal to their learning styles. The advent of e-learning has renewed interest in learning styles as learning materials are being re-assessed for their suitability for electronic instruction (Axmann, 2001; Benham, 2002; Howard, Carver & Lane, 1996).

Instruments used to ascertain a student's learning style include the Felder and Solomon's Index of Learning Style, Kolb's Learning Style Inventory (LSI), Myers-Briggs Type Indicator, and Gardner's Multiple Intelligences. Each of these measure different aspects of a learner's preferred way of learning and therefore propose that, if the teaching method and learning materials are adapted to suit an individual's learning style, the individual's learning will be improved (Claxton & Murrell, 1987).

Kolb's LSI (Kolb, 1984) was selected for this study as it is short in length, free to use and is well recognised in the education community. Kolb's inventory emphasises the individual's learning style as the key to their achievement, and defines learning style as the way an individual consistently responds to and interacts with the world around them, which includes technology. Kolb's learning theory works on two levels – a four-stage cycle, which in turn can be formulated to a preferred learning style. These stages are the essence of spiral of learning, which can begin anywhere in the cycle, though typically concrete experience is the beginning of the cycle. The four-stage learning cycle involves:

- immediate or concrete experience (CE), which provide a basis for
- observation and reflection (RO), which are
- assimilated and distilled into abstract concept (AC), producing new implications for actions which can be
- activity tested in turn creating new experiences (AE).

A learner's place in the cycle indicates their preferred learning style:

- diverging (combination of CE and RO)
- assimilating (combination of AC and RO)
- converging (combination of AC and AE)
- accommodating (combination of CE and AE).

Technology acceptance

Educational technologies have been well received by students (Koohang & Durante, 2003), and can allow them to perform at higher levels than face-to-face teaching (Stansfield, McLellan, & Connolly, 2004). Studies have shown that a range of variables can moderate students' perceptions of e-learning. For example, Internet experience affects web-based learning, whilst age and gender do not (Koohang & Durante, 2003), and compulsory courses are perceived more negatively than elective courses (Smart & Cappel, 2006). Researchers also suggest that students' perceptions of ease of use drive their usage of the technology (Saade, 2003), and the frequency of their use of the technology drives their perception of value (Lynch, 2006).

Technology Acceptance Models (TAM) such as the Theory of Reasoned Action and the Theory of Planned Behaviour have been used to identify factors influencing acceptance of technology-rich applications. The Unified Model of Technology Appropriation (UMTA) (Lin, 2005), developed from TAM has been used to identify factors affecting student use of online learning, influence of others, students' perceptions of their own capabilities together with their required resources and perceived usefulness proving to be important (Lin, 2005). More recent acceptance models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al, 2003), have been used to determine educators' perceptions of learning technologies (Debus, Lawley, & Shibl, 2008).

The UTAUT uses four constructs to represent technology acceptance - performance expectancy (representing the perception that it will improve user performance); effort expectancy or usability; social influence; and facilitating conditions (in the form of technical and organisational infrastructure that supports its use). One key factor affecting online learning satisfaction (and therefore, student experience) is positive technology perceptions (Drennan, Kennedy, & Pisarski, 2005). Another factor that impacts upon students' use of e-learning technologies is learning style (Bush, 2006; Willems, 2007). The study presented in this paper looks at the four constructs of technology acceptance as described in the UTAUT together with self-perception of technology competence, and learning style of learners.

Study design

The study investigates a number of factors that could influence a learner's choice of technology for e-learning through exploring a learner's learning style, their educational technology preferences, and their acceptance, use and competence with e-learning technologies. The study extends the application of the UTAUT model (Venkatesh, et al, 2003) into the field of education, together with further investigating the relationship between comfort level and frequency of use of ICTs explored by Lynch (2006).

Sample

Data were collected from on-campus undergraduate students undertaking the same business subject at one Australian University in 2008. Eighty-three eligible responses were collected, however not all surveys were completed, resulting in only 41 complete cases. Participation in the study was both voluntary and anonymous. Most of the students were under the age of 23 (62.7%), were female (62.7%), and had completed more than one course (that is, had attended the university for at least one semester – 83%).

Questionnaire

The questionnaire gathered data about the respondents, including demographics such as age, course, progression through the course. They were also asked to respond to questions relating to the following:

- Preferred *learning style* using the twelve question Kolb's LSI.
- *Competence and use of specific technologies*. 22 items using a seven (recoded to five) point scale (1 "unknown" to 5 "currently use") were used to determine the students' likelihood of using common e-learning technologies – including if they currently use the technology. The list of e-learning technologies were derived from the pedagogically-defined learning products in Ambient Insight's Learning Technology Research Taxonomy (Ambient Insight, 2007 p3), together with those identified by Lynch (2006). The participants were also asked to rate their perception of their own level of competence in using learning technologies.
- *Acceptance of specific technologies*. 14 items using a five point Likert scale (1 "strongly disagree" to 5 "strongly agree") were used to determine the students' level of agreement with a number of statements relating to technology acceptance and use using the UTAUT four constructs representing a user's acceptance of a technology (ease of use, their attitude, social influence, and facilitating conditions).
- *Preference for virtual or face-to-face lectures*. Four items using a five point Likert scale (1 "strongly disagree" to 5 "strongly agree") were used to determine the students' level of agreement with a number of statements relating virtual and face-to-face lectures.

Results

There were 83 respondents to the survey, however there were only 41 completed cases, therefore neither regression or the alternative approach of testing for associations could be used. However, the study was exploratory and therefore preliminary analysis has been conducted to produce findings that could be used in determining pedagogical decisions, as well as a basis for future research.

Learning style

The study implemented Kolb's LSI questionnaire to determine preferred learning styles. The results are presented in Table 1 using a 2 by 2 matrix.

Table 1: Learning styles evident in the sample (matrix adapted from Kolb and businessballs.com)

(n=60)	Doing Active Experimentation (AE)	Watching and reflecting Reflective Observer (RO)
Experiencing and reeling Concrete Experience (CE)	Accommodating (CE/AE) 23.3%	Diverging (CE/RO) 0%
Thinking Abstract Conceptualisation (AC)	Converging (AC/AE) 46.7%	Assimilating (AC/RO) 30%

Table 1 indicates that the majority (76.7%) of the respondents are in the 'thinking' quadrant; that is their preferred learning style is either 'converging' or 'assimilating'. The next most prominent learning style is 'accommodating'. It is interesting to note that in this group of respondents there were no students whose preferred learning style was 'diverging'.

Competence and use of technology

Technology use was explored from three perspectives: the respondents perception of their own competence in using technology; their likelihood of using a particular technology (including their current use); and ranking of what they considered to be the most useful technologies for their learning.

Students rate themselves as reasonably competent in using e-learning technologies - given time. Seventy-eight responses were gathered, resulting in 39.7% claiming that they have a 'knack' in using technology, 57.7% claiming that they eventually figure it out and only 2.6% stating that they always get frustrated.

The participants were asked if the listed e-learning technologies/applications were available, what was the likelihood of using them in their learning; see Table 2.

Table 2: Technology preference responses (*n*= number of responses)

	<i>n</i>	1 Unknown	2 Unlikely	3 Neutral	4 Likely	5 Currently use
Results presented as valid %						
Online quizzes/ tests	82	1.2	7.3	7.3	47.6	36.6
Online static information, eg Course outline	83	0	9.6	7.2	28.9	54.2
Online tutorial/lab	83	2.4	21.7	13.3	53.0	9.6
Interactive Whiteboards (shared drawing space)	83	4.8	48.2	14.5	31.3	1.2
Computer simulation/games	81	2.5	39.5	13.6	42.0	2.5
Notification when online content changes eg Newsfeeds	83	0	13.3	12.0	54.2	20.5
Digital Libraries	83	0	6.0	6.0	27.7	60.2
SMS	83	0	27.7	10.8	33.7	27.7
Email	82	0	2.4	6.1	29.3	62.2
Discussion boards/forums	83	0	36.1	13.3	27.7	22.9
Chat	83	2.4	49.4	9.6	25.3	13.3
Announce	83	2.4	3.7	3.7	22.0	68.3
Instant Messaging	83	1.2	43.9	20.7	26.8	7.3
Blogs	82	1.2	43.9	20.7	26.8	7.3
Wikis	82	4.9	52.4	17.1	24.4	1.2
Synchronised (real-time) video lecture	83	2.4	25.3	22.9	45.8	3.6
Asynchronised (delayed) video lecture	83	1.2	15.7	10.8	63.9	8.4
Virtual lecture	82	1.2	20.7	17.1	59.8	1.2
Combined/aligned content (text, sound, slides)	83	1.2	9.6	14.5	73.5	1.2
Downloadable digital video of lecture	82	1.2	26.8	17.1	52.4	2.4
Downloadable digital audio of lecture	83	1.2	25.3	19.3	49.4	4.8
Downloadable digital transcript of lecture	83	1.2	9.6	12.0	63.9	13.3

The data indicates that more than 50% of the respondents currently use online static information, digital libraries, email and the announcement system (Blackboard). Further,

given the opportunity they would more likely than not use the following for their learning; online quizzes, online tutorials or laboratory activities, newsfeeds (RSS), SMS, online databases, synchronised (real-time) video of lectures presented in real-time, asynchronised (delayed) video of lectures, virtual lectures, combined and aligned content (text, sound, slides), downloadable digital video of lecture, downloadable digital audio of lecture, and downloadable digital transcript of lecture. Of these, combined/aligned content (text, sound, slides), asynchronised (delayed) video of lectures, and the availability of downloadable digital transcripts of a lecture were the technologies were most popular (73.5%, 63.9% and 63.9% respectively); this suggests that these students might use such technologies to replicate a face-to-face lecture.

The respondents' perception of the most, second and third most useful technologies (from a given list) for e-learning were explored using a simple ranking question. Of the 83 participants, the number of responses was relatively small (64, 54 and 42 respectively). This decline in responses could be attributed to the participants suffering survey fatigue. The data were correlated and a rank was determined according to the popularity percentage of the technologies. The results are presented in Table 3.

Table 3: The most useful technologies for e-learning (*n* = number of responses)

	Rankings		
	<i>n</i> =64	<i>n</i> =54	<i>n</i> =42
	Most useful	2nd	3rd
Online quizzes	1	2	2
Asynchronous video lecture	2	7	7
Combined content -text/audio/slides	2	6	7
Virtual lecture in real time	4	4	5
Downloading video lecture for mobile devices	4	7	7
Digital audio lecture for mobile devices	4	-	-
Downloadable transcripts	7	7	-
Computer simulations	8	13	5
Digital libraries	8	2	3
Synchronous video conferencing	8	7	12
Online tutorials/labs	11	1	12
Online static information	-	4	1
Newsfeeds	-	11	7
Discussion boards	-	11	7
Interactive whiteboards	-	13	-
Chat rooms	-	13	12
Announcements	-	13	12
Email	-	-	-
SMS	-	-	-
Instant messaging	-	-	-
Wikis	-	-	-
Blogs	-	-	-

The learning usefulness ranking of the technologies correlates with likelihoods of students using them or students currently using them. Online quizzes, asynchronous video of a lecture and the online presentation of content presented in a combined or aligned manner are ranked as the three most useful technologies. Online tutorials or laboratory activities and the broadcasting of a lecture in real time follow these closely. The continued presence of

multimedia content in the form of videoing a lecture and broadcasting it in real time, delayed or available for download emerges as a feature that these students would use if it was available to them for their learning.

Interestingly, applications that take advantage of online technologies within social spaces such as chat, instant messaging, blogs, wikis and discussion boards are either not considered as useful technologies for learning or are ranked low.

Technology acceptance

Participants were asked to rate their level of agreement with a number of UTAUT statements (Venkatesh, et al. 2003), covering ease of use, usability, attitude towards using technology, social influences and facilitating conditions such as support and access. The results are presented in Table 4.

The results indicate that the respondents generally did not strongly disagree with any of the statements in this section of the survey, with most either agreeing or tending to agree with the statements. The strongest agreement (tend to agree plus strongly agree) is with the statement 'I find e-learning technologies useful as a student' (91.6%), closely followed by Using e-learning technologies is a good idea (89.0%), It would be easy for me to become skilful at using e-learning technologies (86.6%) and I have the knowledge necessary to use e-learning technologies (81.7%). These responses suggest that the respondents find e-learning useful and a good idea, and if the resources and support are available within their institution, peers or others then they will develop the skills to master the technology for the purpose of learning.

The least positive statements were those exhibiting a high percentage of 'neutral' responses. The highest 'neutral' responses (51.9%) with roughly balance in respondents agreeing to disagreeing was for the statement 'People who are important to me think that I should use e-learning technologies' indicating that outside-institution (people) influences have little influence overall; however, the support at the institution is a greater influence and facilitator in supporting e-learning attitudes (59.8% agreed with this statement, and 26.8% took a neutral stance). Some respondents are neutral towards 'Working with e-learning technologies is fun' (39.0%), though 50.0% indicated agreement. This discrepancy could be linked to the respondent's competence in using technologies, though this association is not presented in this paper. 'e-Learning technologies make study/ learning more interesting' also generated a high 'neutral' response (32.1%), though again there is tendency to agree with this statement (64.2%). This may be related to the respondents' level of technology competence, or the lesson content/presentation.

Table 4: Technology acceptance responses (n = number of responses)

		1	2	3	4	5
	<i>n</i>	Strongly disagree	Tend to disagree	Neutral	Tend to agree	Strongly agree
Results presented as valid %						
Ease of use						
I find e-learning technologies useful as a student	82	1.2	1.2	6.1	39.0	52.4
Using e-learning technologies enables me to accomplish tasks more quickly	82	0	4.9	15.9	36.6	42.7
Using e-learning technologies increases my productivity	82	1.2	2.4	18.3	36.6	41.5
Usability						
My interaction with e-learning technologies is clear and understandable	82	0	2.4	22.0	52.4	23.2
It would be easy for me to become skilful at using e-learning technologies	82	0	2.4	11.0	45.1	41.5
I would find e-learning technologies easy to use	82	0	4.9	12.2	45.1	37.8
Attitude toward using technology						
Using e- learning technologies is a good idea	82	0	1.2	9.8	37.8	51.2
e-Learning technologies make study/ learning more interesting	82	0	3.7	32.1	28.4	35.8
Working with e-learning technologies is fun	82	2.4	8.5	39.0	28.0	22.0
I like studying/learning with e-learning technologies	82	0	6.1	30.5	34.1	29.3
Social influence						
People who are important to me think that I should use e-learning technologies.	81	9.9	9.9	51.9	17.3	11.1
In general, the Uni supports the use of e-learning technologies	82	2.4	11.0	26.8	42.7	17.1
Facilitating conditions						
I have access to the resources necessary to use e-learning technologies effectively	82	2.4	8.5	17.1	45.1	26.8
I have the knowledge necessary to use e-learning technologies	82	0	4.9	13.4	42.7	39.0

Virtual versus face-to-face lectures

Using the same rating schema as used for technology acceptance, the respondents were asked to rate their level of agreement with statements related to their opinion and preference towards virtual lectures as an alternative to face-to-face lectures. The results are presented in Table 5.

The respondents strongly feel more included in learning when attending a face-to-face (64.6%); however, they feel that attending a virtual lecture is a more efficient use of their time.

Table 5: Virtual lectures versus face-to-face responses (*n* = number of responses)

	<i>n</i>	1 Strongly disagree	2 Tend to disagree	3 Neutral	4 Tend to agree	5 Strongly agree
Results presented as valid %						
Face-to-face vs virtual lectures						
I understand the content better in a face-to-face lecture compared to a virtual lecture	82	4.9	9.8	26.8	20.7	37.8
I feel more included in a face-to-face lecture compared to a virtual lecture	82	2.4	13.4	19.5	25.6	39.0
Time efficient						
Attending a virtual lecture is a more efficient use of my time than attending a face-to-face lecture	82	6.1	11.0	25.6	23.2	34.1
Preference						
I prefer attending virtual lectures to attending face-to-face lectures	82	14.6	15.9	45.1	11.0	13.4

Discussion

This study has explored a group of predominantly technologically competent undergraduate business students, who are positively disposed towards the usefulness of e-learning technologies. The prominent learning style for this group was ‘Converging’, with the ‘Diverging’ style not represented at all. The students appeared most interested in using learning technologies to replicate face-to-face lectures. Indeed, although face-to-face lectures make students feel more included, they find e-learning technologies a more efficient use of their time. Despite its recreational popularity, social networking technologies did not appear to be popular for learning.

Despite the use, and at times enforced, use of e-learning technologies, the students generally have a high regard for their value in their learning. Although the researchers have not conducted any statistical associations between variables (due to low number of completed cases), it is interesting to observe that the technologies most used at the institution (Announcements, Email and Digital libraries), are not ranked high in the list as most useful, with the exception of digital libraries; these ranked well as the second or third most useful technology - but not first. Does this mean that these technologies have become ubiquitous and are no longer considered as learning aids? Furthermore, technologies associated with the mobile nature of students and their requirement of ‘just-in-time’ are evidenced by their desire to have downloadable content in a form that can be viewed on a mobile device.

The findings of this study lead us to believe that virtual lectures, podcasts, blogs, wikis, may not be the solution to educating the growing number of learners – even if they are predominantly from the ‘Generation Y’ (Gen Y) population. What we do know from this study is that the participants were generally tech-savvy, time short, diverse in their stages of learning and their learning style. Resulting in the not surprising finding that one e-technology does not suit all. A recent study conducted by Kennedy, et al (2008), reported on the diverse nature of students – not only in what have been the common diversity criteria such as age, gender, cultural background, school and experience, but also the technology diversity of their ability to transfer their technology skills from a social to a learning setting. Their study,

though thorough, did not look one important diversity factor - the influence of a learner's learning style on their choice and attitude towards technologies used in e-learning.

Furthermore, it is interesting to ponder arguments in reports by, for example Kennedy et al (2008) and Lynch (2006), for the need to further explore the transfer of technology skills between social and learning. The study reported here shows that this transfer, given that most of the participants are GenY who claim to be reasonably competent in using educational technologies, is not happening. The participants are not using, or do not see the use of modern social technologies as valuable for learning. The question is why? Are academics not taking advantage of the technologies and using effective pedagogies (digital pedagogies) in their classrooms? Or are the learners not accepting them as scaffolds and integral to learning, but only as a social tool? These questions still remain unanswered.

Conclusion and future work

Existing studies have identified many potential issues involved with online learning, such as limited face-to-face contact; involvement of teachers in encouraging learning and online discussions; and student participation in online discussions, all of which may be limited by technological competence and concerns regarding the communication environment and student motivation (Stansfield, McLellan, & Connolly, 2004). Similarly, factors influencing student uptake of lecture podcasting have not been fully investigated and form part of ongoing research (Hurst & Waizenegger, 2006; Oliver, 2007). Further, although Internet experience has been found to affect web-based learning (Koochang & Durante, 2003), calls have been made for further research into this issue (Smart & Cappel, 2006).

This study highlights a major challenge for university teaching; it must accommodate a technology-rich learning environment that is conducive to student diversity to improve learning and the students' university experience.

Further research is required to expand the sample size and examine how learning styles relate to technology acceptance. A potential goal is to develop a matrix identifying the most appropriate e-learning technologies for learning given a student's preferred learning style.

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