Attitudes towards ICT-based interactions: A Bachelor of Education case study

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Abstract
This paper focuses upon describing and understanding the responses of a small case of undergraduate teacher education students (n=30) in a Western Australian University towards a planned information communication technology (ICT) interaction. The research was undertaken as part of an ongoing investigation into students' planned use of ICT in 2008 and required the sample to engage in an interaction with a purpose- built animation. Prior to the interaction the students were asked to participate in the completion of a questionnaire in order to elicit their intentions to use ICT, their attitudes towards such an interaction, their perceived social pressure to interact with ICT, their perceived control over their capacity to interact with ICT and their beliefs and expectations about the various factors that potentially assist or hinder their use of ICTs. During the activity the students were observed and at the completion of the interaction each participant was interviewed. The questionnaire gathered data relating to the Theory of Planned Behaviour in order to determine the students' planned use of ICTs. While the quantitative data revealed the students believed that interacting with ICTs was pleasant, helpful and easy, the qualitative findings indicated that a number experienced feelings of anxiety and intimidation while working through the interaction. Ongoing research will further investigate the relationships between variables in order to determine likely influences on ICT interaction behaviour and predictions of student success. This research reports on the slippage between the students' initial attitudes and feelings and their actual responses while working through the interaction. Implications for pre-service education programs, as well as instructional design which utilises animation and text are also discussed in the research.

Keywords: ***Information and communication technology***

Background

This research represents a pilot study which was undertaken in 2008 at a Western Australian University. Data were from a small group of undergraduate students in this higher education setting in order to determine their attitudes towards their use of and engagement in ICT interactions. The study employed a mixed methods approach with the intention of combining the strengths of both quantitative and qualitative paradigms. The students were asked to complete a questionnaire, individually work though a brief ICT interaction activity which involved a purpose- built animation and then participate in an informal interview which followed directly upon the completion of the interaction. The questionnaire gathered data on each on the components of the Theory of Planned Behaviour, which is commonly used in psychological research, in order to determine the students planned use of ICT. The participants in the study comprised thirty students from the Bachelor of Education program who were in the second year of their study.

The students were firstly invited to join the research sample and were asked to voluntarily participate in the completion of a questionnaire. This was conducted during class time and was deemed appropriate as the students were part of an undergraduate technology unit at the time. This first phase of the research was completed early in semester one 2008. The questionnaire items were based upon elements of the Theory of Planned Behaviour as initially designed by Fishbein and Ajzen (1980) and was aimed at illuminating the sample's intentions to use ICT, their attitudes towards such an interaction, their perceived social pressure to interact with ICT, their perceived control over their capacity to interact with ICT, their beliefs about the likely consequences of interacting with ICT, their beliefs about the expectations of others regarding the interaction and their beliefs about the various factors that potentially would either help or hinder their interaction with ICT. Following the completion of the questionnaire the students were invited to progress through a fifteen minute ICT interaction activity on an individual basis. During the activity each student was observed and at the conclusion of the interaction the students participated in a brief informal interview designed to explore their reactions to the activity and their overall attitudes towards the ICT interaction. Through informal discussions with undergraduate students throughout 2008 it became clear that there may have been an incongruence between how they intended to use ICT and their actual utilisation of the technologies in practice and so it was determined that a more formal approach to examining any difference between planned and actual usage would result in useful findings that could be possibly enhance ICT instructional design. The Theory Of Planned Behaviour has been used to investigate the influence of beliefs and attitudes towards a range of social and personal behaviours. As far as can be determined from current research the theory has not yet been applied to the planned use of ICT. The research was designed as a pilot investigation to explore students' planned use of ICT. The quantitative instrument will been refined in order to begin the second phase of the study late in 2009 in order to enable a causal examination of the factors that impact most strongly upon students' behaviour as it relates to ICT interaction. This paper reports on the findings from phase one of the research.

How we formulate attitudes

According to the available literature, attitudes find their roots in our beliefs and they influence our behaviour. They represent the way in which we view the world and organise our relationships. Attitudes are literally mental postures and guides for conduct to which each new experience is referred before a response is made. Droba (1933) described an attitude as a mental disposition of the human individual to act for or against a definite object. Krueger and Reckless (1931) defined attitude as a residuum of experience which conditions and controls further activity. In this way they can be viewed as acquired tendencies to act in specific ways, towards or against an environmental factor which is imbued with either negative or positive value. More recent research indicates that attitude represents a summary evaluation of a psychological object and is described both internally and externally in dimensions such as

good-bad, likeable-dislikeable, harmful-beneficial, pleasant-unpleasant (Ajzen & Fishbein, 2000; Eagly & Chaiken 1993). If this is the case, students who are approaching an interaction with elements of an online learning program such as an animation may have already based their attitudes towards the experience on past interactions such as formal learning situations which incorporate information communication technology (ICT) as well as the abundance of such technologies available on a daily basis through media in general. Their attitudes may also be influenced by their perceptions of the relationships between the sometimes conflicting dimensions of the visual representation before them. If Krueger and Reckless (1931) are correct, the expectations of the sample towards their interaction with the technology should match the eventual development of the attitudes they hold regarding its components.One of the main aims of this study was to investigate the attitudes that coincide with behavioural patterns that are associated with students' use of ICTs.

According to Markman and Brendl (2000), people evaluate objects in relation to currently active goals and attitudes are often designated as being the result of several major influences. The social group to which the individual belongs is perhaps the most influential. In this way, both the group to which the individual belongs as well as the groups to which he/she aspire to belong, exert an enormous influence on how attitudes develop. Student attitudes towards ICT which emerge through the interaction with the animation which was designed for this current research may have been determined through collaborating with peers, the administration of the project, and the influence of academic staff towards its conceptualisation. The idea that attitudes function to evaluate psychological objects would appear to imply that individuals hold only one attitude towards a given object at any one time. Recent research indicates however that this is simplistic and that when attitudes change, the new attitude may override but not completely replace the old attitude. Wilson et al., (2000) suggest that a model of dual attitudes is a more realistic conceptualisation in that people can hold two different attitudes towards an object at any given time. Wilson et al., (2000) posit that while an individual is capable of interacting with two attitudes at once, one can be viewed as implicit while the other operates more manifestly as explicit in expression. The implicit attitude is understood to be automatically activated when the individual is presented with an attitude object while the explicit is more likely to require cognitive effort. A number of studies of prejudicial attitudes (Bargh et al., 1989) revealed that while implicit attitudes could emerge towards a particular race of people for example, explicit attitudes could override these reactions under the influence of group norms and with access to cognitive resources. In such a way more favourable attitudes could be retrieved. Wilson et al. (2000) found that implicit attitudes exerted more influence than explicit attitudes over involuntary non-verbal behaviour signalling discomfort such as excessive blinking, avoidance of eye contact and spatial distance. During life, experiences lead to the formation of many different beliefs about objects, actions and events. These beliefs may be the result of direct observation or inference. Some attitudes may be stable over time, others may exhibit frequent shifts.

Throughout the 1970s to the early 1990s Fishbein and Ajzen continued to work further towards the development of the theories of *reasoned action* and *planned behaviour* as a means of explaining, predicting and changing particular behaviours. These theories have resulted in a useful conceptual framework which has at its centre the roles of beliefs, attitudes, norms, perceived behavioural control and intentions as crucial indicators of particular behaviours. Reasoned action is best described as a process by which an individual arrives at an intention. According to Ajzen and Fishbein (2005) behavioural intentions are thought to result from beliefs about performing the behaviour. Behavioural, normative and control beliefs that people hold about performing a certain behaviour are influenced by a range of background factors such as personality, mood, values, education, ethnicity and gender amongst others. The central premise of the model concerns the group of effects that start with the development of behavioural, normative and control beliefs. These in turn directly influence the formation of an attitude towards the behaviour, the subjective norm and perceived behavioural control which then produces intention (to behave) and the behaviour itself. Individuals who utilise this process are said to have engaged in *reasoned action* (Ajzen and Fishbein, 2005). While it is understood that shortcuts can be made in this process, it is also accepted that over certain periods of time, attitudes, norms, perceptions of control and intentions are rehearsed and therefore become readily accessible to each individual. In this

way a previously formed attitude towards interacting with technology for example, can be readily accessed without the need to debate all the perceived advantages and disadvantages of doing so.

Conceptual Framework for the study

A number of studies have utilised the theory of planned behaviour in an attempt to understand peoples' intentions to engage in a number of activities. These have been quite diverse and have included activities such as weight loss, engagement with leisure activities, likelihood of committing traffic violations, willingness to vote, hunting and gift giving. (Abelson et al., 1982; Ajzen & Timko, 1986; Ajzen & Driver, 1991; Hrubes et al., 2001). It appears that the application of the theory of planned behaviour deals with the antecedents of attitudes, subjective norms, and perceived behavioural control. These antecedents determine intentions and actions. Human action is influenced by a favourable or unfavourable evaluation of the behaviour (attitude towards the behaviour), perceived social pressure to perform the behaviour (subjective norm) and perceived capability to perform the behaviour (perceived behavioural control). In combination, attitude, subjective norm and perceived behavioural control lead to the formation of a behavioural intention. In general, the more positive the attitude towards performing the behaviour, along with substantial levels of social pressure to do so and perceived control over one's actions, the more likely the individual is to carry out the behaviour. Often behaviours pose difficulties with regard to execution. In this way it is useful to consider perceived behavioural control in addition to intention. Depending on how realistic people are in their judgements of the level of difficulty associated with behaviours, a measure of perceived behavioural control can serve as a proxy for actual control and as such can contribute to the prediction of the behaviour in question. When applied to the engagement with ICT, the theory of planned behaviour suggests that intentions to engage and interact with a particular program or software element is influenced by attitudes towards using ICT, perceived social pressure to do so and by perceptions of control over the interaction. The major components of the Theory of Planned Behaviour, as designed by Fishbein and Ajzen (1980), are presented in Figure 1 below.

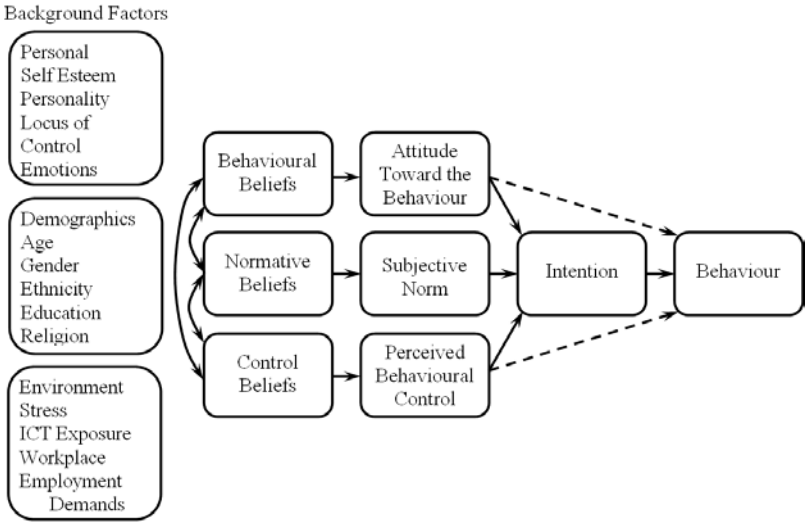

Figure 1: Theory of Planned Behaviour

Methodology

A mixed method approach was used in this study in order to gain both quantitative and qualitative insights into the students' interaction with the animation and their beliefs and attitudes towards using ICT. Mixed method research focuses upon 'collecting, analysing and mixing both qualitative and quantitative data in a single study or series of studies' in order to understand the problem better (Creswell & Plano Clark, 2007, p. 5). As this was a pilot study the focus was to examine a small convenient sample of students currently studying in the Bachelor of Education Program (n = 30). Stage one of the pilot study involved the development and administration of a 44 item questionnaire. The questionnaire was designed to assess variables associated with the use of ICT and contained sections which were derived from components of the Theory of Planned Behaviour (see Figure 1). The items within these sections were aimed at investigating the participants' behavioural beliefs, normative beliefs, control

beliefs, attitudes, subjective norm, perceived behavioural control and intentions. An initial background section was also included in order to collect information related to the students' perceived levels of ICT competence as well as their perception of the importance of ICT use to their future careers as teachers. The sample was also asked to respond to four items that sought to determine the value associated with ICT use in terms of its impact upon learning. The trial questionnaire served to gather baseline data on the attitudes and beliefs of the sample towards the use of ICT.

Following completion of the questionnaire the sample was invited to complete a fifteen minute ICT interaction. The interaction was designed to teach a single physics principle which was *average speed*. This activity was chosen for the study due to its suitability for complete student-centred learning and included reading text, viewing animations and understanding the information presented in order to complete the final task without the need for instructor intervention. The students agreed to be filmed as they worked through this activity. The participants were then asked a series of informal questions regarding how they felt about engaging with the interaction, what they were thinking as they viewed the animations and whether the animations were a help or a hindrance to their learning.

Analysis of the quantitative data

A total of 30 students completed and returned the questionnaires and these same students completed the ICT interaction activity. The respondents consisted of 47% males and 53% females. As the participants were asked to view an ICT interaction based upon a principle of physics, they were asked if they had studied physics in their high school; 53% indicated that they had studied physics in high school. Table 1 provides a summary of the respondents' perceived ICT competency levels (Q6) and their perceived importance of ICT-based learning to their future careers (Q7).

Table 1: ICT competency levels and importance of ICT-based learning to future careers

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	other
Q6. Please indicate your level of ICT competence	4.83	1.24	1.00	0%	3%	17%	7%	40%	23%	7%	3%
Q7. How important is ICT-based learning skills to your future career?	5.03	1.11	1.00	0%	3%	7%	13%	33%	37%	3%	3%

(N=30. 1 = Extremely low; 7 = Extremely high; other = null response)

Intentions, Attitudes, Subjective Norms and Perceived Behavioural Control

Table 2 shows the response rates to the Intentions, Attitudes, Subjective Norms and Perceived Behavioural Control scales. While the majority of the respondents indicated that they intended and planned to engage in ICT interactions (80%), more than half indicated that interacting with ICT was pleasant (59%) and that interacting with ICT was helpful (77%). Approximately one third (36%) of the sample perceived that people who are important to them think they should engage with ICT, while 60% thought that people important to them would approve of their engagement with ICT. Two thirds (66%) of the participants indicated that engaging with ICT was easy, while just over half (56%) indicated that they can interact successfully with ICT at all levels.

Table 2: Statements and response rates for Intentions, Attitudes, Subjective Norms and Perceived Behavioural Control

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	pol.
Intentions											
Q8. I intend to engage in ICT interaction	5.17	1.00	0.76	0%	3%	3%	13%	33%	47%	0%	+
Q9. I plan to engage in ICT interaction	5.13	1.02	0.76	0%	3%	3%	13%	40%	37%	3%	+
Attitudes											
Q10. Interacting with ICT is pleasant	4.83	1.34	0.39	0%	0%	23%	17%	27%	20%	13%	+
Q11. Interacting with ICT is helpful	5.23	1.23	0.39	0%	3%	7%	13%	30%	33%	13%	+
Subjective Norms											
Q12. People who are important to me think that I should engage with ICT	4.00	1.55	-0.10	7%	17%	7%	33%	13%	23%	0%	+
Q13. Most people who are important to me would disapprove/approve of my engagement with ICT	4.93	1.53	-0.10	7%	0%	3%	30%	17%	30%	13%	+
Percieved Behavioural Control											
Q14. I rate the difficulty of engaging with ICT extremely difficult/ extremely easy	4.77	1.26	0.22	0%	3%	20%	10%	33%	30%	3%	+
Q15. If I want to I can interact successfully with ICT at all levels	4.87	1.56	0.22	3%	3%	13%	23%	10%	33%	13%	+

(N=30. 1 = Extremely unlikely; 7 = Extremely likely)

Behavioural Beliefs – Outcomes and Desirability

The participants' responses to the Behavioural Beliefs' statements regarding their engagement with ICT producing outcomes and their desirability of each statement are presented in Tables 3 and 4. Overall, the participants responded rather positively regarding the outcomes produced by their engagement with ICT and their perceived desirability for ICT engagement. Engaging with ICT produced a positive outcome for the majority of students (73%) regarding a sense of competence and 84% indicated a desire to feel a sense of competence when engaging with ICT.

Table 3: Behavioural Beliefs – Outcomes

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	pol.
Behavioural Beliefs - Engagement with ICT produces the following outcomes											
Q16. Engaging with ICT makes me feel a sense of competence	5.13	1.33	0.69	0%	7%	10%	10%	13%	57%	3%	+
Q17. Engaging with ICT makes me feel tired and exhausted	4.80	1.68	0.71	23%	10%	27%	17%	13%	7%	3%	-
Q18. Engaging with ICT makes me feel angry	5.00	1.84	0.52	30%	17%	17%	13%	13%	3%	7%	-
Q19. Engaging with ICT makes me feel frustrated	4.57	1.80	0.60	20%	13%	20%	17%	17%	7%	7%	-
Q20. Engaging with ICT makes me feel a sense of achievement	4.90	1.25	0.54	0%	3%	7%	37%	10%	37%	7%	+
Q21. Engaging with ICT makes me feel as though I am in control	4.30	1.51	0.50	3%	10%	17%	23%	23%	17%	7%	+
Q22. Engaging with ICT makes me feel as though I can work more effectively	4.90	1.37	0.58	0%	3%	13%	27%	17%	27%	13%	+
Q23. Engaging with ICT makes me feel apprehensive	4.63	1.45	0.32	7%	23%	30%	20%	10%	7%	3%	-
Q24. Engaging with ICT makes me feel intelligent	5.03	1.22	0.54	0%	3%	7%	23%	27%	30%	10%	+

(N=30. 1 = Extremely unlikely; 7 = Extremely likely)

Table 4: Behavioural Beliefs – Desirability

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	pol.
Behavioural Beliefs - Rate the desirability of each statement											
Q25. Engaging with ICT makes me feel a sense of competence	5.00	1.53	0.61	7%	7%		3%	40%	37%	7%	+
Q26. Engaging with ICT makes me feel tired and exhausted	5.10	1.89	0.62	27%	30%	17%	3%	3%	17%	3%	-
Q27. Engaging with ICT makes me feel angry	5.23	1.71	0.73	23%	40%	7%	10%	10%	7%	3%	-
Q28. Engaging with ICT makes me feel frustrated	5.20	1.81	0.75	27%	37%	7%	7%	10%	10%	3%	-
Q29. Engaging with ICT makes me feel a sense of achievement	5.37	1.38	0.66	0%	7%	3%	17%	10%	47%	17%	+
Q30.Engaging with ICT makes me feel as though I am in control	5.00	1.44	0.52	0%	7%	13%	10%	27%	30%	13%	+
Q31. Engaging with ICT makes me feel as though I can work more effectively	5.50	1.23	0.55	0%	0%	7%	17%	23%	27%	27%	+
Q32. Engaging with ICT makes me feel apprehensive	4.67	1.72	0.54	13%	33%	7%	13%	23%	7%	3%	-
Q33. Engaging with ICT makes me feel intelligent	5.17	1.49	0.36	3%	7%	0%	13%	30%	30%	17%	+

(N=30. 1 = Extremely undesirable; 7 = Extremely desirable)

Normative Beliefs and Control Beliefs

The sample's response rates to the Normative Beliefs and Control Beliefs scales are shown in Table 5. The participants were almost evenly divided in their perception of normative beliefs regarding whether their friends encouraged them to engage in ICT use. They were rather positive with their perception of control beliefs regarding not being too busy (81%), having skills (76%) and having the knowledge (73%) to engage in the use of ICT. Approximately half of the participants indicated that they could afford the cost (53%) and that it takes a great deal of effort (50%) to engage in ICT use.

Table 5: Normative Beliefs and Control Beliefs

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	pol.
Normative Beliefs											
Q34. My friends encourage me to engage in ICT use	3.73	1.65	0.75	17%	10%	10%	23%	27%	13%	0%	+
Q35. My family encourage me to engage in ICT use	4.03	1.72	0.75	13%	7%	10%	33%	13%	17%	7%	+
Control Beliefs											
Q36. How likely is it that you are too busy to engage in ICT use?	5.30	1.24	0.44	17%	30%	33%	10%	7%	3%	0%	-
Q37. How likely is it that you have the skills to engage in ICT use?	5.23	1.54	0.60	3%	3%	13%	3%	13%	50%	13%	+
Q38. How likely is it that you have the knowledge to engage in ICT use?	5.23	1.23	0.62	0%	0%	17%	10%	13%	53%	7%	+
Q39. How likely is it that you can afford the cost of engaging in ICT use?	4.53	1.56	0.53	7%	7%	7%	27%	17%	33%	3%	+
Q40. How likely is it that it takes a great deal of effort for you to engage in ICT use?	4.40	1.65	0.15	7%	30%	13%	17%	13%	20%	0%	-

(N=30. 1 = Extremely unlikely; 7 = Extremely likely)

Background Factors – Values

Table 6 shows the response rates to the participants' perception of values. The sample's responses to these items were highly positive with regards to engagement with ICT enhancing learning (94%), making learning easier (83%) and the effective use of ICT in the workplace being essential (90%). ICT being essential for good education recorded a lower result (63%).

Table 6: Background Factors – Values

Item	mean	s.d.	cor.	1	2	3	4	5	6	7	pol.
Background Factors - Values											
Q41. Engagement with ICT enhances learning	5.73	0.81	0.47	0%	0%	0%	7%	30%	47%	17%	+
Q42. Engagement with ICT is essential for a good education	4.97	1.20	0.66	0%	3%	7%	27%	23%	33%	7%	+
Q43. High level ICT skills make learning easier	5.40	1.08	0.61	0%	3%	3%	10%	23%	53%	7%	+
Q44. Effective use of ICT is essential in the workplace	5.73	0.93	0.35	0%	0%	0%	10%	30%	37%	23%	+

(N=30. 1 = Definitely no; 7 = Definitely yes)

Summary of the Quantitative analysis

The quantitative analysis examined the responses to the seven-point bipolar adjective scales items in the questionnaire within the scales of Intentions, Attitudes, Subjective Norms, Perceived Behavioural Control, Behavioural Beliefs, Normative Beliefs, Control Beliefs and Background Factors. The responses to the Intentions items were very positive, while the responses to the Normative Beliefs were the least positive. Responses to the Attitudes items were also somewhat positive. There was a distinct difference between responses for most of the Behavioural Beliefs items; the sample's perceived Outcomes were slightly less positive than their Desirability.

Qualitative data analysis

The sample (n = 30) who participated in the questionnaire also contributed to a fifteen minute semi-structured interview following their completion of the ICT interaction. Figure 2 presents a screen capture of one of the images within the ICT interaction. Following a brief introduction and explanation of the process each member of the sample was invited to begin working their way through the program. Following the interviews a content analysis of the qualitative data was conducted and the major themes which emerged are discussed below.

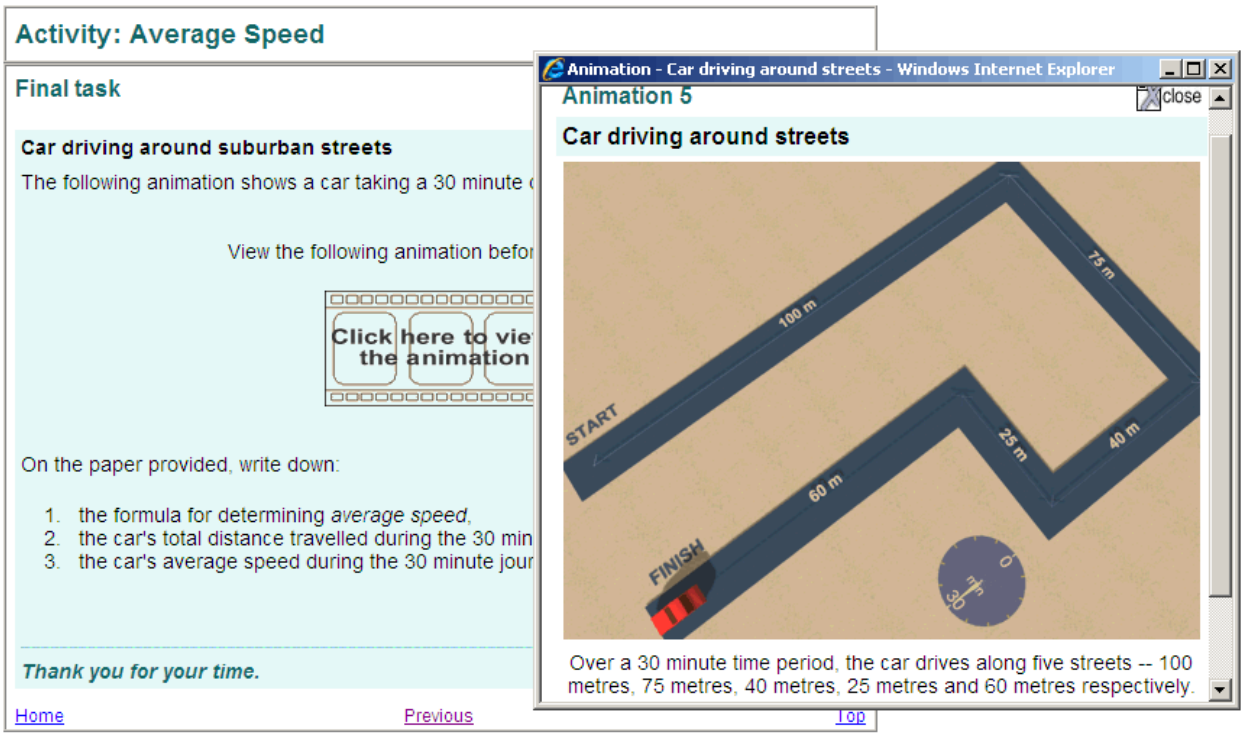

Figure 2: Screen capture of components of the ICT interaction activity

Overall attitudes towards the ICT interaction

The students were initially asked for their overall impressions of the activity and how they felt as they worked through the activity. Sixty three percent of the responses indicated that the sample believed the problem that was set in the animation was reasonable and standard in the level of difficulty. They mentioned that their overall feeling of control over the activity was high as they indicated that they had a sense of how to proceed with the problem solving as they had a reasonable background in mathematics as a result of their secondary school experiences. They were also comfortable with the process of being observed throughout the interaction. Students commented that the problems were clearly set out and the requirements were sequential and logical. It appeared that the use of the animation tended to support the information that students were able to glean from the written static text as well as the mathematical equations. The text did play a predominant role however in the participants' ability to fully engage with the problem solving activities and as such they tended to concentrate upon the animations only as a secondary component to double check understanding of speed and scope of the problem. They did enjoy working on the solutions as they were easy to visualise and this occurred as a result of the animations. These students also believed they were comfortable with the process as they were highly familiar with computers and that being asked to problem-solve using equipment other than their own did not pose a dilemma for them. Comments also indicated that these students felt 'normal' while engaging in the program and that they merely needed to be 'told what to do' in order to complete the task. They did not experience feelings of anxiety or apprehension and as a consequence maintained high levels of a sense of control throughout the procedure. These findings would seem to support the initial quantitative data which indicated that as far as Intentions, Attitudes, Subjective Norms and Perceived Behavioural control regarding the use of ICTs were concerned, the sample appeared to be comfortable with this engagement and expected to interact successfully with ICT. It would seem then that their expectations to succeed and their actual ability to do so were reasonably congruent.

> *'I felt OK doing this. I tended to rely on the written words to tell me what to do to solve the problem. I'm used to doing this through study at school. I quite enjoyed working through the program and didn't feel stressed. It was kind of what I would have expected when you first explained the process to me'.*

Twenty percent of the participants indicated that they experienced feelings of anxiety and stress associated with engaging in the ICT interaction. These were students who openly acknowledged that they had little background in mathematics and that they did not enjoy working on problem solving of this nature. They mentioned that they felt as though they would fail and perceived the activity as a 'test'. They demonstrated quite agitated behaviour when first settling into a comfortable and work-ready position at the beginning of the program and were more inclined to touch their face and hair with their hands while working through the animation. Breathing throughout the exercise was also noted as being uneven with exaggerated exhalation occurring regularly throughout the interaction. Even though they were assured that the program did not in any way represent a 'test' these students continued to mention this concept in their responses. One student mentioned that they had experienced feelings of intimidation as a result of taking part in the program. This is an interesting finding given that the overall response in the quantitative data indicated that these students believed interacting with ICTs was 'pleasant', 'helpful' and 'easy' and that they believed they would successfully engage with technology 'at all levels'.

> *'I felt really worried that I would get it all wrong and so I felt like I was intimidated by working through the program... I actually felt nervous as soon as I sat down to look at the computer and thought it was going to be awful'.*

Thirteen percent of the sample indicated that they felt confused. Interestingly these students felt agitated by the amount of written text at the start of the interaction and they felt under pressure to read through it all in a thorough manner. They suggested that once they were able to access the animations they 'way ahead' was more clear to them and they felt that in this way the animations were a supporting factor in their being able to problem –solve. Their comprehension was enhanced by moving backwards and forwards from written text to the animations and this occurred on a regular basis throughout the

interaction. They felt that this was at times confusing and time-consuming and having to jump between the two forms of information did lead to some confusion.

> *'I found some of it confusing. It might have been better to have the answers revealed right at the end instead of as you worked through each problem. I felt like I had to jump backwards and forwards between the movement and the text and I got mixed up sometimes having to do this'.*

> *'I skipped to the end first and then went back to the beginning. I'm not sure why I did this. I'm not very good at maths so maybe that's why I did it… I might have got a bit confused. At first I was wondering what type of tool it was going to be. I got confused at one point and lost my place which is maybe why I jumped ahead and then went back'.*

Two respondents (6%) revealed that they really didn't have any expectations of the program or their contribution to it. They were relaxed regarding their engagement in the process and indicated that once they had read through the initial information in the text they were reasonably clear as to how they were to proceed. One respondent suggested that he believed the program was going to represent problem solving at a more advanced level and a further two students indicated that they felt rushed and uncomfortable during the activity. These students experienced feelings of pressure as they believed that they needed to increase the speed at which they completed the tasks.

> *'I felt rushed… so I felt under pressure to get the problem solved in a much faster way than I normally would. This meant that I had to read faster. Normally I like to go back and re-read sentences and paragraphs but I felt under pressure not to do this. I like to break every sentence and go over it so I felt I didn't do as well as I normally would have done with this'.*

Usefulness of animations as opposed to text

Sixty six percent of the sample (20 respondents) felt that the animations were not essential in order for them to effectively complete the interaction. These students suggested that while the use of animations may be useful for some students, in terms of problem solving they were more inclined to concentrate upon the static text that was provided. There appeared to be a number of reasons for this. The sample suggested that as they had been used to relying heavily on text in order to solve mathematical equations during their experiences at school that these habits had remained with them into their higher education. It is acknowledged, however, that their perception of the usefulness of the animations may have differed with exposure to activities involving more complex dynamic processes, such as a combustion engine cycle, which might be difficult to describe with text alone. Other comments suggested that if the students had been able to stop the animations during their progression this would have been more helpful. Although the animations did continually repeat playback until the student closed the window, there appeared to be an element of frustration experienced by a number of students regarding their inability to stop the animations once started. Some indicated that they had already worked through the problem and were not in need of the ongoing graphics.

> *'If the animations could have been stopped they would have been more helpful. I actually don't like learning with moving images. When I was growing up I didn't watch much TV. I think these days there are too many images coming at us all at once. We are getting used to just getting a quick 'grab' at information. I feel as though I am being bombarded with information and I can't take it all in. I would prefer to be able to concentrate on one thing at a time.'*

Twenty six percent of the sample described themselves as visual learners and as such they had enjoyed problem solving with the assistance of moving images. These students indicated that the animations helped them to visualise the problem. They also suggested that as they did not have a strong background in mathematics the animations did help to make the problem clearer. They tended to move backwards and forwards between the animation, the static text and the mathematical equations which were provided. They also mentioned the fact that over time a useful problem solving pattern emerged and this

had been enhanced by the moving images. The repetition of what they were watching assisted in the problem solving process.

Three members of the sample (10%) focussed upon the positioning of the animations within the parameters of the screen. These students explained that as the animations had been set above the text that they were distracting as their attention tended to move upwards and then back down to the text. Through their peripheral vision they could still see the movement and as they were unable to turn the animation off once it had begun they found this impacting upon their concentration.

Two respondents (6%) mentioned that they had begun to skip forwards and backwards throughout the interaction and this had impacted on their ability to concentrate and problem solve. These students explained however that this was probably due to their perceived inability to succeed at mathematics and that the constant non-sequential movement could be explained by their lack of confidence.

> *'I skipped to the end first and then went back to the beginning. I might have got a bit confused. At first I was wondering what type of tool it was going to be. I got confused at one point and lost my place which is maybe why I jumped ahead and then went back. It was progressive though and I scrolled down to start with. I went to the equations first… I missed the text at the top and the animation box at the top so I went back up'.*

Summary of the Qualitative analysis

While sixty three percent of the sample responded positively towards the ICT interaction, thirty three percent indicated that they felt anxious, stressed or confused regarding their involvement with the program. The students who reacted positively indicated that they perceived the interaction to present a standard problem and given the fact that they had a reasonably strong background in mathematics they were confident that the activities would not present them with a problem. Thirty three percent suggested that they had felt anxious and stressed prior to their engagement. They indicated levels of intimidation with having to proceed through the program and had pre-empted a sense of unpleasant reaction to engagement. Six percent of the sample indicated that they had no pre-conceived expectations of the program and that following their initial reading of the text which was provided they believed they were clear as to the direction in which their problem solving needed to proceed. As far as the animations were concerned, the majority of the sample suggested that as they preferred to concentrate upon the static text in order to problem solve they felt that the moving images were not completely necessary. These students appeared to have a reasonably strong background in mathematics which may explain their focus on the text. They indicated that as mathematical problem solving during their school experience had concentrated upon reading and analysing text they were more inclined to continue this approach post school. For the students who described themselves as visual learners and/or who had a weaker background in mathematics the graphical information seemed to be of greater use.

Conclusion

The research represents a pilot study that has provided some interesting insights into the attitudes of students enrolled in a Bachelor of Education program towards their use of and engagement in ICT. The Theory of Planned Behaviour has not been applied to ICT use prior to this research and it is the intention of this study to proceed with a second phase of investigation as far as student attitudes and behaviours towards ICT are concerned. It appears from the quantitative data that overall the students believed that interacting with ICT was pleasant, helpful and easy. The majority indicated that interacting with ICT would result in positive outcomes and that most of the sample described a desire to feel a sense of competence when engaging with technology. This is interesting when compared to the qualitative findings which seem to indicate that at least thirty three percent of the responses suggested that the sample had experienced feelings of anxiety and intimidation when actually working through the ICT interaction. There may be a number of reasons for this. As the successful manipulation of ICTs is a key learning outcome in the Bachelor of Education program at this university, the students may have been influenced by the expectations of the group regarding ICT use whilst completing the initial

questionnaire. The questionnaire was completed during class time and the proximity to peers while completing the instrument may have impacted upon students' predictions of high level engagement. Only following the ICT interaction and in an individual interview situation could a number of students express their real and potential concerns regarding their ability to successfully navigate the program. The students may have wanted to predict confident use of ICT during their completion of the questionnaire. The ICT interaction was administered approximately five weeks following completion of the questionnaire and levels of confidence appeared to decrease in the individual setting provided for the completion of the interaction. Possibly a number of the students also felt intimidated by the fact that they were filmed during their interaction although this did not appear to be an overt issue for them at the time of the data collection. The quantitative data indicated that normative beliefs regarding ICT use were not of any significant importance to the sample. The results to items related to the expectations of others in the main recorded either 'low' or 'indifferent' scores. This would suggest that the expectations of others as to whether or not the sample engage in ICT use are irrelevant and if this is the case, items regarding the significance of the attitudes and beliefs of others towards ICT use may well be withdrawn from the ongoing refinement of the instrument for phase two of the research. Ongoing investigation into the relationships between the planned ICT use of students and their actual engagement will reveal valuable insights into their abilities to successfully use ICTs in a number of settings not least of which will be the implementation and embedding of technologies in their professional settings as teachers.

As a pilot study the research has provided baseline data regarding the responses of the sample towards the various components of the planned behaviour framework in relation to their attitudes towards the use of ICT. Phase two of the research will involve the refinement of the questionnaire and the withdrawal and re-writing of items in order to increase the reliability of the instrument. This will occur during late 2009. The second phase of the research will result further discussion regarding the relationships between the variables in the conceptual framework to determine which are more likely to influence ICT behaviour and interaction.

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