Using perceptual control theory to analyse technology integration in teaching

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Abstract

Contrary to the more traditional scenario of instructor-focused presentation, contemporary education allows individuals to embrace modern technological advances such as computers to concur with, conceptualize and substantiate matters presented before them. Transition from instructor-focused to student-centred presentation is prone to dissension and strife, motivating educators to assess elements of learner-centred teaching in conjunction with traditional teaching mechanisms and how individuals perceive and comprehend information (Andersson, 2008; Kiboss, 2010; United Nations Educational, Scientific and Cultural Organization (UNESCO), 2004).

Computers can assist when used in the traditional teacher-student interface, but consideration must be given to teaching method variations and the students embracing these learning applications. If learner-centred teaching is to become accepted certain elements need to be introduced: revision of educators' learning and teaching applications, time to facilitate knowledge and use of applicable contemporary technologies, and methods compatible with various technologies (Kiboss, 2010). Change is often not easy – while acknowledging the need to alter and revise methods they were taught to instil, educators may fail to embrace incorporation of technology into their teaching platform.

Why are educators, who are quite knowledgeable and competent in computer applications and their merits, failing to embrace the benefits of technology in the classroom? A critical assessment of this mandates a transdisciplinary disposition in order to come to an amenable resolution. Perception, inhibition, ignorance and goals are just some reasons why educators are reluctant to incorporate technology despite their proficiency.

Perceptual control theory (PCT) will be implemented to assess these reasons as a means towards achieving change and assessing how to move forward. Issues associated with educators' short- and long-term goals as well as their perceptions – and hence the essential need to comprehend PCT – are addressed.

Keywords: computer technology, teaching, student-teacher interface, learner-centered teaching, perceptual control theory, perceptions.

Disciplines: Computer science, education.

Introduction

Contrary to the more traditional scenario of instructor-focused presentations, contemporary education allows individuals to embrace modern technological advances such as computers to concur with, conceptualize and substantiate matters (Chitiyo & Chitiyo, 2007). Transition

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from an instructor-focused presentation to a student-centred embodiment is prone to dissension and strife. This scenario is motivating educators to assess elements of learner-centred teaching in conjunction with traditional teaching mechanisms, along with how individuals perceive and comprehend information (Andersson, 2008; Kiboss, 2010; UNESCO, 2004).

In all subjects computers can serve as an instrumental tool in conjunction with the traditional teacher-student interface, but consideration must be given to variations in teaching methods and the students embracing these applications (Chitiyo & Chitiyo, 2007; Tanui, Kiboss, Walaba & Nassiuma, 2008). If learner-centred teaching is to become accepted socially or by the mainstream, certain elements need to be introduced. These include revision of educators' learning and teaching applications, allowance of time to facilitate knowledge and use of applicable contemporary technologies, and methods compatible with various technologies (Kiboss, 2010).

The embracing of contemporary technology in conjunction with user acceptance is a saturated research topic under the auspices of Information Systems literature (Hu, Chau, Sheng & Tam, 1999). Results from this abundance of research are theoretical models with substantiation in Psychology, Sociology and Information Systems, which address a beyond 40% variation in an individual's own volition to incorporate technology (Davis, 1989; Taylor & Todd, 1995; Venkatesh & Davis, 2000).

The matter presented is why do educators, who are quite knowledgeable and competent in computer applications and their merits, fail to embrace the benefits of such technology in the classroom? A critical assessment of this statement mandates a transdisciplinary disposition in order to come to an amenable resolution. A need exists to assess the motivation towards educators subsidising expenditure on computers for use in the classroom, while others refrain from accepting computers, whether subsidised or provided by outside sources (Swain, 2006).

The need for a transdisciplinary approach is warranted when sources such as various technology adoption models prove inadequate in providing the needed justifications. In an Information Systems environment the transdisciplinary approach is viewed by the author as an atypical means of assessing value with regard to technology integration.

As to why an educator would decline use of an instrument such as the computer in the classroom, consideration must be given to the mind-set of an educator. The proceeding argument focuses on the integration of technology from the inner circle of an educator and is premised on perceptual control theory (PCT) (Powers, 1973; Powers, 1989). This stance is supported by research conducted by Zhao and Cziko (2001). The following serves as an analysis of their research work and its application to the respondents of this study.

Status quo of computer use in schools

Questions guiding the study were as follows:

- To what extent are educators using computers for general administrative use and/or in their teaching?
- What are the reasons for this use or non-usage?

The target population in this study was secondary school educators in the Ethekwini region of KwaZulu-Natal. A list of educators was extracted from the Department of Education's

Education Management and Information Systems (EMIS) list, which is maintained and updated annually by the Provincial Education Management and Information Systems Department. The total number of secondary schools in the Ethekwini region on the EMIS list was 403. Of these schools, 382 have staff numbers ranging from 2 to 60, and the balance of 21 schools showed no staff members. Leedy and Ormrod (2005) suggest that if the population size is around 500, one should sample at least 50% of them. From the population of 382 schools a random selection of every alternate school was made, giving a sample of 191 schools. This sample is representative because every alternate school in the district was chosen, representing 50% of secondary schools in Ethekweni region. Questionnaires were distributed to the selected 191 schools, an average of 20 questionnaires to each school.

Of the 191 schools in the sample, 18 indicated that they did not receive the questionnaires, 2 that they had misplaced them, and another 3 declined to participate. Returns from 93 schools were received, giving a 55.4% rate of return.

The questionnaire was created with items validated in previous research (Abdulkafi, 2006; Venkatesh, Morris, Davis & Davis, 2003; Venkatesh & Davis, 2000; Vannatta & O'Bannon, 2002; Davis, 1989) and adapted for this study. A five-point scale was used for all of the constructs, with 1 being the strongly negative end of the scale and 5 being the strongly positive end. Development of the questionnaire was guided by an extensive review of the literature. The data were analyzed using statistical package SPSS®.

The data were split into respondents in schools with computer rooms for teaching and those in schools without computer rooms for teaching. First an analysis of all respondents' general computer use was performed, irrespective of whether they were in a school with a computer room or not. General computer use means that a respondent uses a computer for simple word processing, for example creating worksheets or keeping track of learners' marks electronically.

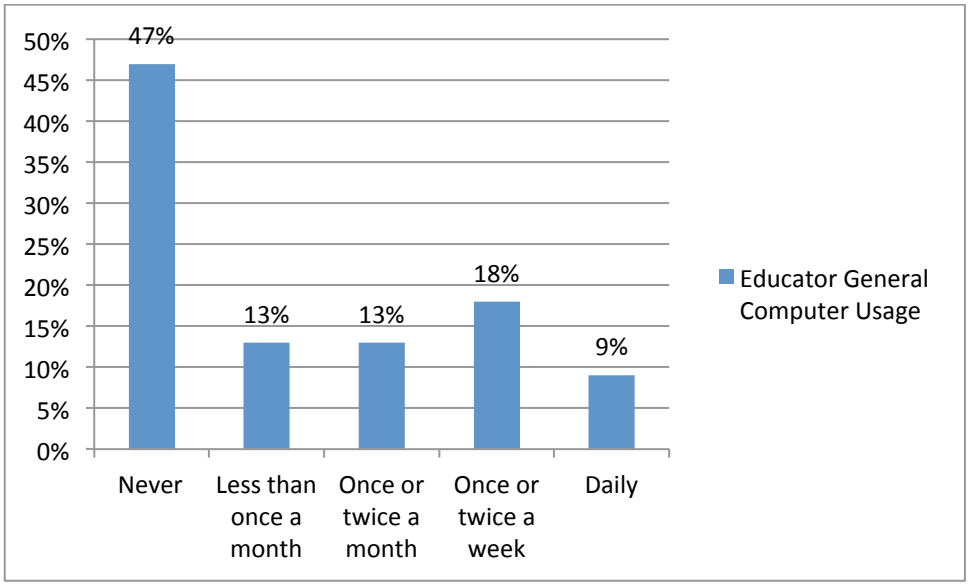

Figure 1: Educators' general computer usage

At least 47% of educators from this study sample do not use the computer at all for any general use, including simple word processing (Figure 1). Fifty three per cent (53%) of educators are using the computer in a general capacity, which could include simple word processing and email. However, only 9% use a computer daily (Figure 1). Educators who use

the computers daily indicated that they use their personal computers to "prepare worksheets" as well as "keep track of learner grades". Those educators who are using computers once or twice a week or month indicated that access to computers is a problem, and that they only use computers when they are available at school.

When the data were analysed according to schools with computer rooms and those without, it was found that in schools with no computer rooms for teaching a much higher percentage (66%) of educators are not using a computer for simple word processing (Figure 2). This could be attributed to lack of core proficiency as well as lack of access; 25% of respondents indicated that access to computers is a problem and that they use computers when they are available at school. However, it should be noted that there are at least 50% of respondents in schools with computer rooms who are not using computers for simple word processing.

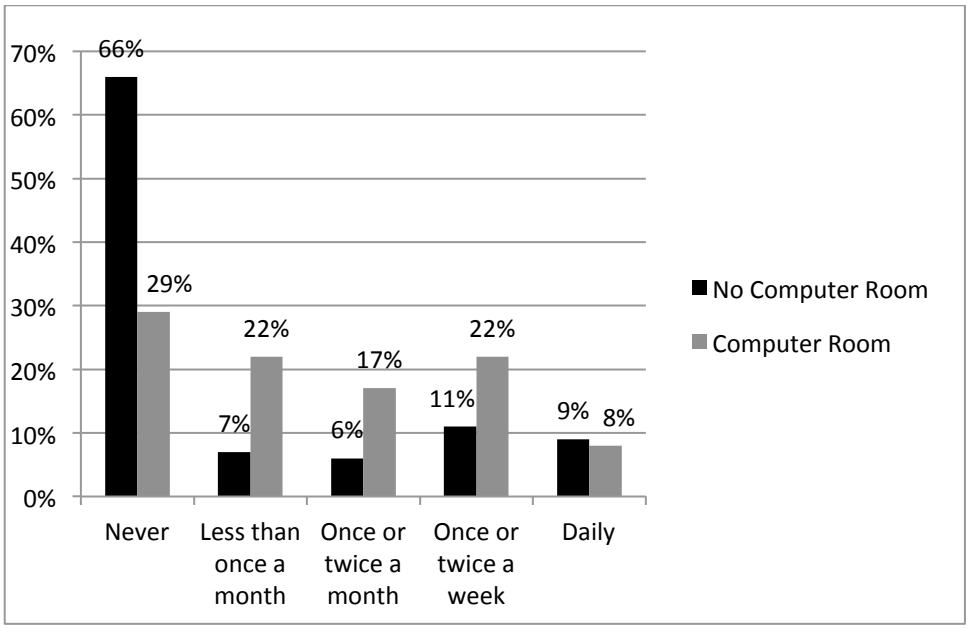

Figure 2: Educators' computer usage in schools with or without computer rooms

The data in this study are being used simply to show that there are a fair percentage of educators not using computers either for general use or for teaching and learning in the classroom. What is also shown is that even though some educators have computer competence and access to computers, they are not using computers for teaching. The author uses this as a basis for presenting an argument as to why educators choose not to use computers in their teaching and learning even though access and competence are not an issue.

Review of research databases indicates insufficient research with regard to the association of educators and use of contemporary technologies in the classroom. Of available research studies, most are premised on the influence of computers, calculators and accessories on students. The few that do address the association of educators and technology focus on a unique or unorthodox application not generally aligned with mainstream applications or those familiar with such technologies (Sheingold & Hadley, 1990).

There are core beliefs with regard to advancing technologies such as computers and the hesitation of educators to incorporate them into the lesson plan. These misguided beliefs serve as the foundation for reversing the mind-set of these reluctant educators. These

misguided (and even, in some cases, fictitious) notions include, but are not limited to: insufficient amount of hands-on-training; lack of proper and communicative technical and administrative support; traditional instructional beliefs; the belief that technology will replace educators; and inherent resistance to change (Office of Technology Assessment, 1995). To eradicate these beliefs, thoughts and notions, educational institutions are making tangible investments by providing their educators with opportunities for professional development in order to master required skills and broadening available resources to further enhance educators' ability in the classroom.

Although the argument against integration of technology due to insufficient training has some merit, concern still exists among many educators that once it has its 'foot in the door', technology will continue to grow and become an obstacle and hindrance to an educator's plan and vision in the classroom.

Further to the data illustrated in Figures 1 and 2, an analysis of the data for respondents who have computer competence and are in schools with computer rooms shows that even though computers are available for teaching, only a maximum of 16% of these educators are using them in their teaching (Figure 3). The question to ask is why are 84% of these educators not using computers in their teaching even though access and competence are not an issue?

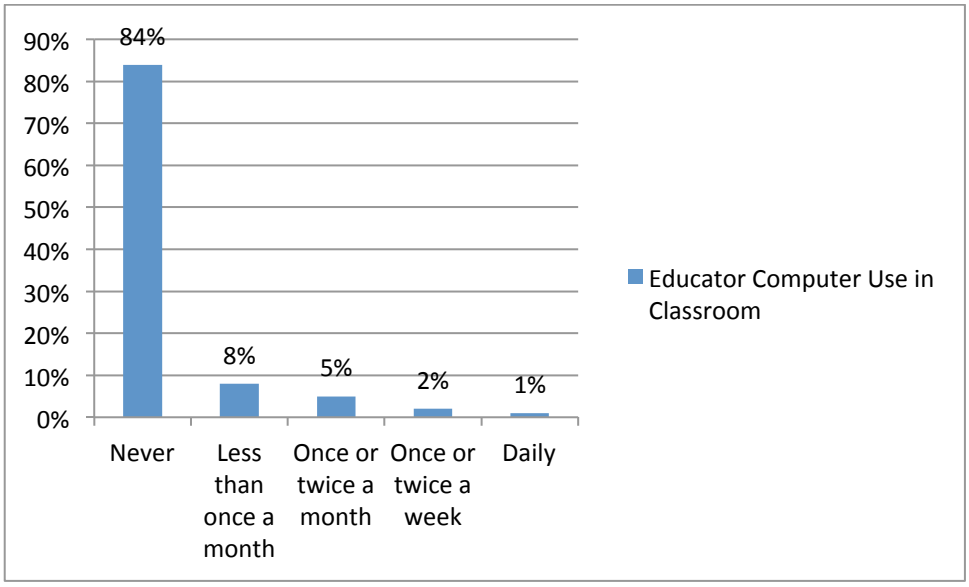

Figure 3: Educator computer use in classroom

As mentioned earlier, often overlooked and not given due consideration in these assumptions is the fact that most educators are goal-oriented, proactive, and passionate, dedicated professionals (Zhao & Cziko, 2001). Although much of the mentioned assumptions take into account the instructional beliefs of most educators, as well as their 'grasping' of what the technology is, the logic supporting these assumptions is cast in a deficiency of conducive environments to transition into or within the comfort level of the educator (Mumtaz, 2000).

With a well laid out plan and programme of technical integration of tangible investments in conjunction with educators, the crossing of the proverbial 'continental divide' will be made; thus teachers will become knowledgeable about the concept after comprehending the ideology of the modern day and embrace and promote it (Friedman & Friedman, 2011). The 'continental divide' approach, as good as it is, does have its detractors; approximately 20% of

educators responding to a particular statement in the survey indicated that they had a preference to continue to 'do business' in the old-fashioned way, with a hands-on approach in lieu of computer-aided means.

The following is a brief introduction to PCT, along with an outline of a conceptual framework to comprehend educator integration of technology from the perspective of this theory. It must be emphasised that the empirical work above only addresses the status quo – the rest of the paper is conceptual. The suggested conceptual framework has not been validated, and is a proposal that needs to be tested in follow-up work.

Understanding purposeful behaviour: PCT

Hirschi (1969, p 3) defines control theory as follows:

> *control theory is the view that people refrain from deviant behaviour because diverse factors control their impulses to break social norms. Control theory explains why people often do not act on deviant impulses. Some controls are internal, such as a person's conscience and motivation to succeed; others are external, such as one's parents, friends, and legal codes. For example, fear of potential embarrassment and store security might quell a person's desire to steal. Control theory links non-deviant behaviour to socialization and social bonds: those who are more socialized as children and maintain stronger bonds with others are less likely to behave in deviant ways.*

As a criterion for behavioural activity, the PCT contends that human beings and all other living organisms control perceptual input, or reference conditions, not motor output. The living elements seek to achieve goals, with individuals' actions aligned with reference conditions that are coordinated with their consciousness. Perceptions are arrived at when reactive responses interact with prevalent environmental agitation. Human beings' mind-sets are designed to have achievement attained in a hierarchical manner, with low-level goals manipulated to attain a more focused end result (Powers, 1989).

Understanding the theory that all living organisms, including educators, interact with life based on a set of hierarchical goals is critical to comprehending the basic concept of PCT. As an adjunct, contemporary technological advances are deemed an asset towards enhancing the learning experience. What elements or concepts influence whether an educator introduces or refrains from utilising said technology? Possible answers to such a scenario are addressed in the following three views as to how educators perceive technology in conjunction with their personal framework of hierarchical goals.

Effectiveness of technology in maintaining higher-level goals

Individuals are consistently responding and altering their means towards achieving their goals, according to specific elements of PCT. When a conflict or contradiction appears between the reference condition (sometimes referred to as the goal) and the position of the controlled variable, variation of the means becomes apparent as an element to minimize the perceived issue and re-establish control once again. A response is not necessary if an issue of concern is not present. There is a universal assumption that educators have an obligation and goal to create and present practical and applicable information to their students.

The hesitancy of educators to embrace contemporary technology can be seen as an invisible monitor overseeing the educators' work, making them feel that their current teaching must be elevated and in some cases comparable to information presented by contemporary technology. Hence the educator feels as if they are being scrutinized in addition to their career security being threatened. If the perception is that their instruction is up to par, the perceived input concurs with their reference condition (goal), and therefore will not alter the current plan set in action.

A cause for concern is a result of assessment of both the reference condition and the perception of the input, whereby a deviation in either of the two as a result of environmental agitation produces a deviation. The possibility exists of a discrepancy occurring when the standards of an educator are elevated as a result of their participating in professional development.

To the contrary, the discrepancy may also appear as a result of students not paying full attention to the subject matter or the students' assessments seeming overly negative, as well as if administration decides to implement curriculum revision. As uncontrollable factors encroach, educators must accept the realisation that how they were trained, educated and interned years ago have proven to be insufficient as a tool to maintain and achieve their goals. Change is imminent and present at the moment and must be evaluated and embraced (Budin & Meier, 1998).

A myriad of choices is available to educators in an attempt to refine and enhance their professional skills according to their goals (Zhao & Cziko, 2001). Case in point: an educator reads a publication that addresses the trend of students becoming more adept in subject matter taught as a result of the class instructor interjecting information gathered from the Internet to emphasise his lesson plan. As a result of this scenario the educator, hesitant at first about the introduction of contemporary technology in the classroom, comes to the realisation that this type of technology can prove to be a valuable asset, and that it will enhance teaching presentations. Their old, dated perception of being a proficient educator has been altered to where they now embrace available tools to engage students in a collaborative learning effort.

In order to stay the course with this revelation, educators must concede that their current ways must be cast aside to embrace and endure this reference condition. There are many available options to engage students in collaborative efforts, such as engaging students with others from different educational institutions to work on varied assignments (Luke & Sawyer, 1998).

Paramount to this model is the effectiveness of a low-level control system, for it has a two-fold ability: (a) to choose a goal at a higher level; and (b) to initiate agitation, therefore permitting an individual to change. In most cases more than one lower-level system is eligible to be altered to sustain high-level goals, in accordance with the hierarchy of control. Variation exists towards achieving a high-level goal as a result of influences such as overall quality as well as speed.

When change is present, as in the case of a more effective lower-level control system, a higher- level system seeks to take control of the situation. As a result, contemporary technology is able to sustain a current reference condition which can create a cause for concern within. Options abound; an educator may consider the benefit of email, not as a result of his mind-set but because he has become enlightened to the fact of the convenience

and time element associated with interfacing with students. Many educators now concede that this assists in sustaining their path towards achieving their goal in a far more efficient and effective manner (Anderson, 2008).

More and more educators are coming to the realisation of having to adapt to contemporary technology due to the fact it is on the low end of the goal hierarchy, which permits variation in contrast to refusing to alter the instilled educator beliefs (Anderson, 2008; Stockley, 2003; Bryant & Hunton, 2000). Although this position has raised the ire of many in the educational community (Mumtaz, 2000), consideration must be given to this approach if it serves as an effective or only means of introduction of contemporary technology into the classroom.

In this study the data show that respondents were positive towards the following statements: 'Computers can enhance a learner's learning', 'Using computers in the classroom will make the subject matter more interesting' and 'Computer use fits well with my curriculum goals'. This realisation of adapting to modern-day technology allows the educator to up his/her standards, thus supporting a higher-level goal of creating and presenting practical and applicable information to their students.

Potential disturbances to other goals

Crossing the threshold and embracing contemporary technology can be influenced by factors such as anticipated effectiveness of the application and envisioned agitation towards one's goal, with elements of the control system having an impact on the environment. In addition, said technology can initiate agitation of goals higher up the chain, without association with the intended goal.

A hypothetical scenario portrays an educator pondering the thought of altering or revising their method of teaching in collaboration with the fact that they must use a form of contemporary technology. They are faced with three choices: (a) use of email, (b) incorporating use of the Internet in the classroom; and (c) student collaboration. After careful assessment of the pros and cons, the educator chooses to go with student collaboration. The question is then posed as to why the educator made that choice. A possible answer may be that student collaboration is easier to manage and has been utilized before, requires fewer resources and does not infringe or create issues with other goals.

Although perceived by many as the ultimate goal of an educator – 'to present useful and relevant information' in the classroom – there are other essential goals an educator strives to maintain as well as control. Most educators want to be viewed not as a 'geek', knowledgeable in only one topic, but as an influential individual who is authoritative and compassionate. Making the transition into a realm that an educator is not familiar with exposes them (they feel) to arenas of knowledge that in most cases they should be familiar with. Yet they choose to veil themselves in the cloak of tradition. If such fear or deficiency were exposed at a greater level with students, students may feel they are being deprived of the education they are entitled to. The educator evaluates all available possibilities and settles for the least confrontational one: teaching with the assistance of contemporary technology.

Due to a multitude of excuses, Anderson (2008) contends that contemporary technology will present more issues than by avoiding them altogether. The anchor to the excuses and false justifications that educators have with regard to contemporary technology is that it will toss to the winds the years of education, classroom experience and professional development they

have accrued. This 'new' approach creates issues and takes full control and knowledge of the classroom learners away from the educator (Chitiyo & Chitiyo, 2007). While this may not seem a 'big deal' to most, many educators feel genuinely threatened by the encroachment of technology.

Research has revealed that new-age 'high-tech' educators subscribe to a learner-centred method of learning (Nicolle & Lou, 2008; Kalinga, Burchard & Trojer, 2007; Swain, 2006; Bryant & Hunton, 2000). This is because the high-tech educator who implements contemporary technology does not see issues arising that would interfere with other goals; they see it as an adjunct that can only enhance their performance in the classroom.

In this study the construct 'perceived behavioural control' was defined as "reflects perceptions of internal and external constraints on behaviour and encompasses self-efficacy, resource facilitating conditions, and technology facilitating conditions" (Govender, 2008). Data from the study showed that only 28% of respondents were positive towards this construct; it seems that the majority of respondents were not overly confident with aspects of 'perceived behavioural control'. Steps need to be taken to address the issue of interference with the goal of 'being in control' when adoption of technology is being considered.

Ability to control

The ability to embrace contemporary technology by educators is largely contingent on the sense of being in control. An element of PCT suggests that while the goal or reference condition is delivered to the low-level systems from the upper levels, the direction or handling of the goal is not provided to the low-level systems. The need to react to environmental factors is essential with low-level control systems in order solely to achieve the goal. An educator having the ability to control means two things:

1. Present is a structure which allows for perceiving, comparison and action when required.
2. Accessibility to required resources which enable ability to act and control.

When confronted with technology an educator may not have a functioning control system. To facilitate email applications students must convey an interaction with the educator as to the value of such technology. Continuing advances in computer technology mean computers have become more user-friendly. Personal computer-specific control systems are not essential in order to use technology; an educator can couple with another educator's control system to resolve the issue or task at hand, thus relieving them of any associated fear and burden.

External influences have a significant impact on an educator's ability to control from within. With certain tools needed, the educator perceives the necessity for him, while traditional beliefs can either expand or hinder an educator's use of contemporary technologies. Such concerns are not of primary importance, as they are not deemed essential to the overall effectiveness, potential and financial impact of the technologies.

As a result, the perception from a PCT view is that ability to control a form of technology is much lower in the goal's hierarchy to an educator than the use of technology is, and lower-level systems can be altered to sustain a high-level goal. An educator's goal can be attained if the educator determines that such technology can bring about the goal of beneficial teaching; they can adjust other low-level goals to bring fruition to the intended goal.

Data from this study revealed that educators agreed that the 'facilitating conditions' were lacking for technology integration to take place; such conditions are "objective factors in the

environment that observers agree make an act easy to perform, including the provision of computer support" (Thompson, 1991, p. 124).

Concluding remarks

Educators may express a reluctance to incorporate contemporary technology due to a perceived conflict with their goals at a higher level (Lawless & Pellegrino, 2007; Stockley, 2003; Bryant & Hunton, 2000). One must eventually come to the realization that technology can only be of benefit and does not act detrimentally, as many educators are led to believe.

Case studies and true-life testimonials can serve to advance eradication of myths associated with technology in the classroom. Erasure of traditional teaching methods in education should not be excluded when incorporating new technologies. As with other elements of society, change does not come easily – it needs to be gradually and gently eased into the mind-set of educators (Mumtaz, 2000). Tools and accompanying technical support for the benefit of educators can put control back into their hands and reduce or eliminate potential anxiety.

Several elements and criteria of a PCT-based framework for comprehending issues associated with educator adoption of technology have been addressed in this paper. It contends that to seek resolution one must take the perspective of educators as the lead in the issue at hand, instead of just attempting to address a solution to a problem.

The framework discussed here views technology as a possible way for educators to achieve their higher-level goals. However, the goal of using technology needs to be maintained by varying lower-level systems. Three conditions are required to ensure use of technology by an educator:

- the educator must believe that technology can sustain higher-level goals;
- the educator must believe that using technology will not initiate agitation of higher-level goals other than the one being sustained; and
- the educator must believe that they have or will be empowered to master the technology.

It is the opinion of the author that for an educator to use technology all three conditions must be exercised, otherwise it is unlikely that they will implement contemporary technology in the classroom.

As stated earlier, a transdisciplinary approach was necessary to try and understand why educators are not using technology even though they have the competence and access. PCT and its concepts, which have their foundations in Psychology, were used to suggest a conceptual framework to explain non-use of technology by educators. The author attempted to integrate perspectives from different disciplines centred around one problem, which is technology adoption.

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