

Integration of CAT Skills into Mathematics and Other Learning Areas: Case Study of a Township School in South Africa

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ABSTRACT This study presents perceptions of learners of Computer Applications Technology (CAT) learners as well as CAT educators at a township school in South Africa with respect to application of acquired competencies from CAT in other learning areas. It also examined factors that impede integration of acquired competences from CAT into other learning areas. A mixed method research design is used where questionnaires were administered to participating learners and semi-structured interviews were conducted with CAT educators. The results showed that current educators' practices do not encourage the transfer of skills from CAT to other learning areas. Most of the learners believed that additional computer resources are required for smooth running of the subject at their school. A Significant proportion of the learners felt confident in the use of computers. Reorientation of educators across subject areas on the need to integrate practices that encourage the use of acquired competences from CAT is recommended.

INTRODUCTION

Globally, integration of computer technology into teaching and learning practices in school systems has come with confronting challenges both in industrialised nations as well as developing countries. Wozney et al. (2006) observed a numbers of factors that hindered the integration of computer technology into teaching and learning in Canadian schools. They also reported relationships between these factors and readiness of schools for the integration of computer technology into teaching and learning processes. The factors include; demographic characteristics of teachers and their reported use of technologies; age, gender, race, education level, socio-economic status of students taught, teaching experience, years of technology use, specializations and size of school. For developing countries like South Africa, the major challenge lies in the preliminary strategic decision on allocation of scarce resources to relatively capital intensive computer education requirements in the midst of other fundamental needs in schools such as adequate, classrooms, teacher training, laboratories and school libraries amongst other needs. For this, Osin (1998: 2) recounts that;

"In developing countries, with large segments of the population living at extreme levels of poverty, the first question that must be asked is whether it is reasonable to invest money in technology for the educational system, instead

of using the same money to improve the living conditions of those in dire need."

Osin (1998) further argued that the problems are not contradictory and describes advancement in technological education as a veritable tool for sustainable economic development of developing regions of the world. More so in this information age where most aspects of human development hinges on application of computer technology. The study by Solomon (2014) indicated that, though the teachers and school leaders have a positive outlook to computer education in Western Nigeria, this has not translated to authentic learning as a result of lack of funding and teacher preparedness.

The major prominence of government policies and program of the new democratic order in South Africa is the redress of socio-economic inequalities of the apartheid era. The education sector is perceived one of the anchor points of the envisaged socio-economic transformation of South Africa. Consequently, there have been remarkable changes in terms of curriculum, infrastructural development of schools, human capacity development and integration of the previously fragmented education departments. The above changes are all guided by the philosophy of equity, human rights, democracy and sustainable development. The main goal of new educational policies in South Africa is the production of future South Africans that are responsible, participatory and reflective citizens that would

contribute to an emerging democracy in the global context of rapid change that is enforced through technological innovations, increasing information access and globalization.

Against this backdrop, learning areas (subjects) were revised and new learning areas emerged. Computer Applications Technology (CAT) is one the learning areas that were introduced into the system in the light of the central role that computers play in all aspects of human endeavour in this information age. In this article, the researcher discusses the perception of learners with regard to the integration of CAT skills into other learning areas and educator practices towards integration in light of the fact that CAT is meant to be an application orientated subject where learners should be exposed to hands-on real problem solving (Abramovich and Brown 1996).

The motivation for and identification of the research problem was conceived during the researcher's teaching period at a township school in South Africa. The teaching specializations of the researcher were CAT and Mathematics. Motivated by this combination of subjects, the researcher thought that in a technology-rich environment, a problem in CAT could easily serve as a stimulus for mathematical exploration in the mathematics classroom while mathematics problems can be used in CAT classes. Contrary to expectation, it was observed that learners struggled to do exercises and tasks in mathematics using their knowledge from CAT. Surprisingly, the issue was not that learners lacked the required CAT knowledge for solving such problems as similar tasks that require same level of CAT competency were solved by the same learners in the CAT lessons, but presenting such problems in a mathematical context confused the learners. For instance, the researcher observed that in the mathematics class, grade 10 learners struggled with drawing and analysing the graph of a function using MS Excel. The learners struggled to handle such problems with technology not being aware that the CAT skill required for such problems was almost the same as doing the line graph using the graphing function in MS Excel which they did easily in the CAT class.

Research Questions

This research discusses factors that could contribute towards the lack of integration of CAT

skills into other learning areas for townships schools in South Africa. The emphasis is on investigating current perception of learners as well as teachers on the notion of integration of acquired competencies from CAT into other learning areas and for problem solving. In order to investigate these issues the following major research questions were posed:

First, what are learner experiences/perceptions on the integration of CAT skills into other learning areas and real life applications at Um-lazi Commercial High School?

Second, are learning conditions at the school supportive in terms of integration of CAT knowledge? and, third, are educator practices supportive in terms of integration of CAT Knowledge at the school?

The above research questions were explored based on the following hypothetical stands: Current educator practices at the school do not promote integration of CAT skills across learning areas or outsidethe school; secondly, learners are of the view that CAT lesson is just one of those school activities with no authentic use.

This research is organised as follows: the next section provides a conceptual framework and brief literature review. This is followed by the section on the research methodology. The results and discussions follow next and lastly the conclusion and recommendations on possible ways of improving integration of CAT skills are presented.

Conceptual Framework: CAT in South African Schools

Progressively, integration of technology into education has gained acceptance in recent years as the world continues to embrace information and communication technology (Hennessy et al. 2005). Thus, it becomes reasonable to infer that the integration of information technology as a learning tool would better prepare learners for their future. It could make them globally more competitive as the world continues to strive toward application of information technology into many areas of human enterprise.

Integration of information technology and the effective use of computers in schools have met with several challenges especially in the developing world. These challenges include inadequate availability of computers, insufficiently trained educators and lack of internet access

(Anderson 2002). There are many instances where computers are used only for administrative purposes leaving out teaching and learning. In some schools where there are relatively good number of computers, educators are not well trained to use them for teaching and learning practices. Further, the high cost of internet connectivity and telecommunication inhibits the use of internet for teaching and learning purposes for many schools especially schools in poorer communities (Anderson 2002).

Despite the above inhibitions to integration of information technology into the school systems in the developing world, there has been the drive towards increased participation of school in offering CAT as one of the learning areas in South Africa. Officially, CAT is defined as “the effective use of information and communication technologies in an end-user computer applications environment in different sectors of society” (DOE 2003). The name of the learning area “Computer Applications Technology (CAT)” suggests that the main aim of the subject is to expose learners to various applications of computers for problem solving. Amedzo (2007) observed that the introduction of Information and Communication Technologies (ICTs) into the South African school system would enhance the capacity of the youth to function in the information age. CAT is used for this purpose in many schools. To achieve this, the structure of CAT curriculum as well as pedagogy are supposed to propel learners in the direction of applying skills that they have gained from their CAT lessons towards solving problems in other learning areas or even at home. It is assumed that versatile application of acquired competencies in CAT would consolidate their knowledge and enhance their confidence in the application of computer for problem solving.

Gone are those days in which school subjects are perceived as independent stand-alone bodies of knowledge. The nature of CAT being an application-based subject should position it as the link to integrate other learning areas in this information age where computers play vital a role in all aspects of human endeavour. Further, it is stated in the learning program guidelines for CAT that one of the key relationships between CAT and the principles of the national curriculum statement is integration of applied competence (DOE 2008). The integration of applied competence means that assessment stan-

dards within and across the three learning outcomes within CAT enhance the learners’ language, research, thinking, creativity, problem-solving and decision making skills. At the same time, applied skills acquired within the CAT subject should enable the learners to transfer these skills to other subjects (DOE 2008).

The above guidelines could be aligned to some of the prominent teaching and learning theories such as the behaviourist theory and the social constructivist theory (Ranjeeth 2011). Most outstanding for this research is behaviourism for the fact that the major interest here is the measurable ability of learners to solve problems upon exposure to CAT combined with proper constructive guidance of the educator. In behaviourist theory of learning, Burrhus Frederic Skinner (1904 – 1990) proposed that the learning process is totally outwardly with measurable behavioural change. This theory focuses on what can be observed as learning outcomes based on the principles of ‘reinforcement’ in different learning contexts (Ranjeeth 2011). It considers all behaviour as being learned in accordance with the rules which determines it. From this point of view, the CAT teaching and learning approach should be associated with measurable outcomes in terms of observable skills that learners would have achieved at the end of the teaching and learning processes in CAT. In addition, Vygotsky (1896-1834) in the social constructivist model underscores as fundamental the role of social interaction in the development of cognition. He proposed that learners are enabled to apply what he refers to as “tools of intellectual adaptation” to access the basic mental functions in very effective and adaptive ways which are culturally determined in such a manner that the teacher plays the mediative role of helping the learner direct the acquired competencies from CAT to authentic problem solving as perceived by Ranjeeth (2011).

One of the main challenges of implementation of CAT in schools across South Africa is the fact that the majority of the schools are considered under-resourced especially those in the townships and rural areas where access to computers is very low (Fourie and MacNamara 2008). Schools in the system that have the privilege of having CAT offered in their classrooms are supposed to make optimal use of the opportunities. That involves CAT specialist teachers, computer facilities and of course learners who are tak-

ing the subject. It is estimated that less than 25 percent of schools in South Africa have computer facilities according to the Censuses at Schools report by Statistics South Africa (Stats SA 2001). Thus, subject teachers in various learning areas in those schools that are privileged to have computer facilities are supposed to be enthusiastic about giving their students exercises, tasks, tests and examinations that would require the use of computer skills to optimize the rare opportunity of offering CAT. However, this is not always the case and the reasons for this are not clear.

Further, the prime focus of this research is to present the perception of CAT learners as well as CAT educators at a township school with respect to application of skills from CAT in other learning areas and outside the school.

METHODOLOGY

This study was done using mixed methods where quantitative and qualitative complementary data were collected and analysed. The data collection process involved self-administered questionnaires to learners, semi-structured interviews with the CAT teachers and personal observation by the researcher regarding state of teaching resources and educator practices.

The target population for the questionnaire was learners that are registered for CAT in grades 10 and 11 at a township school in Kwazulu-Natal. There were a total of 60 learners of which 40 learners registered for CAT in grade 10 and 20 in grade 11 at the school. The intention was to use all learners in view of the relatively manageable number, however, on the day of data collection, 29 learners turned up for the exercise for grade 10 and 13 learners for grade 11. The learner response rate was satisfactory even though all did not participate. There was 100 percent response rate as all learners who were given questionnaires returned them with responses to all questions.

Participating learners comprise 100 percent African learners with an age range between 15 to 19 years for both grades. Semi-structured interviews were held with the two CAT teachers at the school. The data set obtained using questionnaires was coded and captured using MS Excel and analysed using IBM-SPSS version 19. In analysing the data, descriptive statistics of respective variables were computed to establish dominant perceptions and some of the re-

sults are also presented in tabular and graphical displays. A Chi-Square test was conducted to test whether there was statistically significant similarity in opinion or perception between male and female students to test the assumption of one of the CAT teachers from previous communication that boys were more comfortable with working with the school computers than girls. The Chi-Square test was also used to test difference in perceptions of skill level of learners between those that have computers at home and those that do not have computers at home.

The interviews were transcribed and analysed using deductive methods. The main information that was sought from the interviews was teachers' views on diverse exposure of CAT learners to problem solving using acquired competences from CAT across subject areas.

Efforts were made to ensure validity and reliability of responses from participating learners; these include having a transparent and systematic approach to data collection from the learners. The questions were set in simple and clear language to ensure correct understanding by the learners. A test-retest method of reliability was carried out to identify any administrative problems prior to completing the questionnaires. The researcher administered the instrument to a sample of randomly selected ten learners on two occasions and thereafter compared the scores. The validity and reliability of the instrument was within a statistically acceptable level; with a cronbach alpha of 0.68.

As the study involved humans, ethical considerations were taken into account to ensure that basic human rights of the participants were not violated. Initial consent was sought from the respondents and their anonymity and confidentiality were guaranteed.

RESULTS AND DISCUSSION

The results show that about 95 percent of the learners were of the opinion that CAT was an interesting and exciting subject for them. In terms of the mode of instruction for CAT, 64 percent of the learners reported that the language of instruction was familiar; strangely 16 percent reported "don't know" to the language question. This could be an indication of proportion of learners that are struggling with language and communication barriers in the CAT classroom at the school. When students study in a different

language than their mother tongue, they are faced with the problem of content literacy. This is a situation in which students are unable to effectively use reading and writing to learn subject matter in a given discipline. Van der Poll and Van der Poll (2007) in their study observed that language literacy could be regarded as one of the main challenges to computer education in South Africa.

On the perception of learners with regard to application of skills from CAT in other learning areas Table 1a shows that 85.7 percent of learners were positive that CAT could help in other subject areas.

This implied that a majority of the learners may have the required psychological disposition in terms of integration of acquired competencies in CAT with other learning areas as envisaged by the national curriculum statement (DOE 2003). Subsequently, the researcher explored whether educator practices support learners in this regard.

In Table 1b about 59 percent of CAT learners agreed that the teachers required them to do tasks using CAT skills, but only about 14 percent strongly agreed to the same fact. About 23 percent were not positive that teachers urged them to use CAT skills in doing tasks and assignments. There could be a feeling among the respondent learners that the research exercise was meant to evaluate their teachers, therefore in their response on this question regarding teachers' attitudes they tended to be protective of their teachers which was also observed by Galanouli et al. (2004). This assertion could be supported with the response of the CAT teacher when the same question was posed to her; she responded "*I am not aware of what other teachers do*". From the personal observation of the researcher, there was no evidence that shows that learners are encouraged by teachers in other learning areas to apply their skills from CAT in doing tasks and assignments in other sub-

jects. Such tasks as for instance, requiring learners to type-set their essays or poems using word processing software like MS-Word or requiring learners to do calculation-based tasks in subjects such as mathematics, commerce, accounting and physics using spread sheet software like MS-Excel. Particularly, mathematics as a subject that is mainly about developing learners' cognitive abilities of problem identification and solving is supposed to be well integrated with CAT skills for optimal development of learners in order to achieve the intended outcomes of CAT.

On the perception of learners about factors that hinder smooth integration of CAT skills at school, 88 percent believed that the school was not well resourced in terms of having enough computers and logistics for smooth delivery of the subject. This notion of the learners was equally observed by the researcher. Three to four learners were found to practice on one computer in class as shown in Figure 1, this makes it difficult for some learners to be actually hands-on in class.

Observation by the researcher indicated that many of the computers were also found having faults with no immediate plan of fixing them.

When asked whether there are enough computers in the school, about 90 percent of the learners believed that the school is under-resourced in terms of computer facilities.

Another constraint for learners was very restricted access to computers. For the majority of learners the only time for them to practice on the computers is only during their formal teaching period. This was confirmed by 60 percent who reported not having adequate time and access to computer. Learners that do not have computers at home are especially affected as most of the learners that reported lack of adequate access also reported not having access to computers at home.

Table 1a: CAT could help in other subjects

Response	Frequency	%
Strongly disagree	2	4.8
Disagree	0	0
Don't know	4	9.5
Agree	31	73.8
Strongly agree	5	11.9
Total	42	100.0

Table 1b: Teachers require us to do tasks using CAT

Response	Frequency	%
Strongly disagree	2	4.8
Disagree	8	19.0
Don't know	1	2.4
Agree	25	59.5
Strongly agree	6	14.3
Total	42	100



Fig. 1. Learners in a CAT Class

In the opinion of learners with regard to what they perceive as an urgent solution to the barriers to smooth delivery of CAT in their school, the majority (69%) of the learners believe that purchasing of more computers would improve the teaching and learning of CAT in their school. Twelve percent of the learners were of the opinion that adding more computers as well as increasing access time will help improve the utilisation of CAT. Two percent of the learners reported that access to the internet would help to improve CAT in their school, while 7 percent reported that a combination of several interventions is needed to improve CAT in their school. Their suggestions included: getting more or changing current CAT teachers, allowing longer time for access to computers and getting more computers. The central message about the various responses from learners is that learners believe that more resources would help to improve the teaching and learning of CAT at the school.

Despite the above limitations at the school which are similar to most systems in the developing world (Cawthera 2001), 88 percent of learners responded positively that they can now use computers.

However further examination reflects that the confidence in the use of computers could be associated with gender and whether a learners has access to computers at home or not.

The Chi-square test for independence indicated a significant association between gender and confidence in use of computers: $\chi^2(1, n = 42) = 4.26, p = 0.04$. Boys were found to be more confident in the use of computers than girls. This supports similar findings by Gupta and Houtz (2000). The test also indicated a significant association between access to computers at home and confidence in the use of computers: $\chi^2(1, n = 42) = 3.63, p = 0.03$. Learners who had access to computers at home were found to be more confident in the use of computers than those learners who did not have access to computers at home.

CONCLUSION

Globally, integration of computer technology and acquired learning competencies of CAT with other learning areas have met challenges of varying nature, both in industrialised and developing countries. Notwithstanding, computer application technology was introduced as a learning area in the South African School system in view of the central role computers play in most aspects of human existence in this information age. The achievement of the aim of introducing CAT demands integration of acquired competencies from this learning area into other learning areas and real life problem solving out-

side school. In this research, the researcher has explored learners' perceptions of the subject and factors hindering the integration of acquired competencies from CAT at the school. Hypothetically, the researcher postulated that the problem could be mainly due to existing practices in the school that influence learners' perception of CAT especially the integration of CAT across learning areas and real life problem solving. Such practices such as lack of involvement of educators of other learning areas in making learners use their CAT skills in their various subject areas. Perhaps non availability of computers to learners outside school could also contribute towards shaping learners perception that CAT is just a mere school subject in which learning activities begin and end in the CAT classrooms with no authentic use.

The above hypothetical stands were investigated by the research through first hand observation, administration of questionnaires to learners and oral interviews of teachers.

The results reflected that learners' at this school are aware that skills from CAT could be applied in other learning areas and for solving real life problem against the hypothetical stand of the researcher which suggested otherwise. However, researcher observation and interview also manifest that the practices of educators in the school do not really encourage learners to practice the transfer of skills to other learning areas.

Learners were of the opinion that the school is not well resourced in terms of computers resources, some of the learners also felt that they needed more time on the computers as well as more CAT teachers. The majority of the learners were confident that they could now use computers, but these differed along gender lines where boys were found to be statistically more confident than girls. Besides, the learners who had access to computers at home were statistically more confident than those that do not use computers at home.

RECOMMENDATIONS

In light of the above results, it is recommended that a series of awareness workshops be organized by provincial school management for all educators in all learning areas. Many non-technology exposed educators often have a constricted view of what it means to integrate technology into their specific subject curriculum. The

workshops should be targeted on getting educators to realize the importance of encouraging learning to integrate CAT skills into various learning areas. It is also recommended that female learners and those learners without access to computers at home be allowed to spend more practice time with the computers in order to grow their confidence in the use of computers. Most educators in CAT offering schools and other schools in the system may have not had any formal education on computer use and the application of acquired competencies. In-service training for these educators is required to re-orientate them on the importance of allowing their learners to integrate CAT skills to their learning areas. This is very critical for the learning outcomes of CAT to be achieved.

The current scope of this study is relatively narrow, wider follow-up study that would sample more schools and teachers is recommended for more detailed generalisation across schools in the system.

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