ISSN 2278-8808
An International Peer Reviewed
SCHOLARLY RESEARCH JOURNAL
FOR INTERDISCIPLINARY STUDIES

ICT AND INNOVATIVE CLASSROOM PRACTICE: FACTORS UNDERLYING MATHEMATICS TEACHERS' ATTITUDES TOWARDS THE INTEGRATION OF COMPUTER IN TEACHING

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Received: 18 June 2012
Reviewed: 24 Sept 2012
Accepted: 21 November 2012

Abstract

The purpose of the study was to identify factors underlying the Mathematics teachers' attitudes towards the integration of computers in teaching mathematics. Specifically the study attempted to achieve these objectives: (1) determine the attitudes of selected mathematics teachers towards the integration of computers in teaching, (2) identify factors underlying mathematics teachers' attitudes towards the integration of computers in teaching mathematics, and (3) determine the amount of variance in the teachers' attitudes towards the integration of computers that can be explained by the identified factors. The analysis was based on 110 respondents comprising of teachers teaching mathematics in the selected secondary schools. The median teaching experience was 4 years. Teachers have positive attitudes towards the integration of computer technology in teaching. Teacher's attitudes were further classified into four factors using a factor analysis procedure. The four factors were confidence, educational value, apprehension, and liking towards computer. Teachers do not have the confidence, the study shows that teachers are not that apprehensive in the integration of computer in teaching and they like the idea of integrating computers in teaching.

Key Words: *ICT, Innovative Classroom Practice, Teachers Attitude.*

Introduction

Despite growing support for computers as tools for learning and discovery, why is there a general unwillingness among teachers and schools to promote the use of computers across the curriculum? According to Collis (1988), the advocates of integration have failed to account for the reality of school life. The lack of teacher role models for those teachers implementing and managing computers in their classrooms is a fundamental cause of the problem. Complicating the situation is that those role models, who do exist, are generally computer studies teachers using computers in laboratory situations. Wellington (1990) believes that the physical obstacle of computer rooms and the more subtle obstacle of computing being the domain of computer studies boffins inhibit the spread of computers across the mathematics curriculum.

The emphasis on computer based-teaching and learning of mathematics in Kenyan secondary schools becomes more urgent considering the teacher-dominated approach to schooling and teaching in the country. Learning is largely passive and the products of the schools are rated low in creativity, critical thinking and problem solving, apparently, because the schools have failed to develop such skills in them through the integration of digital technologies into the curriculum implementation process. Because of the potency of educational technology to improve education and ameliorate most of the ineffectiveness in the schooling process in Kenya, it becomes necessary to assess the integration of computer technology by mathematics teachers in secondary schools.

Technology in general has advanced greatly in the last decade. More computers and curricular materials related to the use of technology are being planted in schools. However, these technological tools are not an integral part of the curriculum. Regardless of many research articles reporting the effectiveness of integrating instructional technologies with mathematics curriculum, teachers are still not consistently using the technologies. Regardless of the investments in instructional technologies, students are still learning mathematics without these tools (computers).

Integration is based on the assumption that computers should be an integral part of the learning process at all levels (Lockard, Abrams & Many, 1994), that is, the tool should service curriculum needs first and then be an object for study. However the integration of computers into every day classroom activity has proved to be more slow and difficult than many may have expected it to

be (Collis,1988), giving rise to the notion that there are incentives and barriers at work enhancing the adoption of technology in some schools while effectively blocking wide acceptance in others. The study sought to find out the factors underlying teachers' attitudes towards the integration of computers as instructional tools in mathematics in secondary schools.

Purpose and Objectives of the Study

The study sought to investigate the factors underlying teachers' attitudes towards the integration of computers as instructional tools in mathematics curriculum. Specifically it sought to:

(1) Determine the attitudes of selected mathematics teachers towards the integration of computers in teaching.

(2) Identify factors underlying mathematics teachers' attitudes towards the integration of computers in teaching mathematics.

(3) Determine the amount of variance in the teachers' attitudes towards the integration of computers that can be explained by the identified factors.

Hypotheses

The following null hypotheses were tested at an 0.05 alpha level of significance.

i. There is no statistically significant relationship between teachers' attitudes and integration of computers in mathematics instruction in secondary schools?
ii. There is no statistically significant difference in teacher's attitudes towards integration of computers in mathematics instruction.

Theoretical Considerations

This study was based on the Technology Acceptance Model (TAM), introduced by Davis, which is an adaptation of Theory of Reasoned Action (TRA). This model provides an explanation about user acceptance of a technology. TAM suggests that specific behavioral beliefs, perceived ease of use (EOU) and perceived usefulness (U), determine an individual's attitude toward using. Perceived usefulness is the degree to which a person believes that using a technology will increase his or her performance, while perceived ease of use is the degree to which a person believes that using a technology will be free of effort, and perceived usefulness is influenced by perceived ease of use.

As postulated in the TAM, usage of technology will be positively influenced by attitude toward using as well as perceived usefulness and computer self-efficacy has a significant effect on perceived ease of use (Venkatesh and Davis's (1996). This provided a basis for the current study.

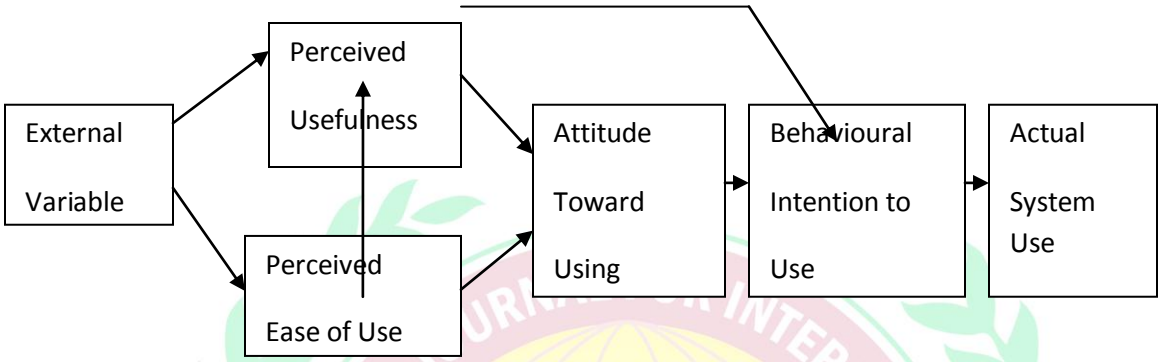

Figure 1. Technology Acceptance Model (TAM)

(Source: Davis et al., 1989)

The TAM model of Information Systems success relies on Fishbein and Ajzen's (1980) Theory of Reasoned Action to assert that two factors are primary determinants of system use:

- **Perceived Usefulness (PU).** PU is defined as the user's subjective probability that using a specific technology will increase his or her job performance within an organizational setting (Davis et al., 1989); and
- **Perceived Ease of Use (PEOU).** PEOU is the user's assessment that the system will be easy to use and require little effort.

Straub, Keil and Brenner (1997) suggest that Perceived Usefulness of computers has a positive effect on the adoption of IT (Information Technology). Nelson, and Todd (1992) and Davis (1989) report that Perceived Usefulness affects both attitudes and actual computer use. While Hu et al. (1999) suggest Perceived Usefulness to be a significant determinant of attitudes and intention. This provides a theoretical basis for this study.

The Study Area

The study was conducted in secondary schools in Bungoma Districts, which are located in western province of the Republic of Kenya. Secondary schools in the area are typical of most schools in the country. The Teachers Service Commission using the same criteria as for the other parts posts teachers from among applicants from all teacher training colleges and universities in

Kenya. This meant that the teachers in the districts would be representative of the quality of teacher's entry behavior in Kenya.

Sample and Sampling Procedures

The target groups were secondary school mathematics teachers. Stratified random sampling technique was used to select samples that were drawn independently and randomly from the stratum of secondary schools in Bungoma District. Proportionate stratified random sampling technique was used to select 200 respondents from forty secondary schools from all the one hundred and fifteen secondary schools in the entire Bungoma District.

Research Design and Methodology

In this study the descriptive research design was adopted. This involved collection of quantitative and qualitative data in an attempt to answer the research questions. The survey method was used in this study.

Instruments

Researchers prefer using methods that provide high accuracy, generalizability and explanatory power, with low cost, rapid speed and maximum management demands and administrative convenience (Warwick and Lininger 1975-8). Basing on this fact, a combination of the following research instruments were used in this study for complementary purposes: questionnaires, interview schedule and observation checklist.

Data Collection and Analysis

Data was collected using questionnaires, interview schedule and observation checklist. Data collection involved distribution of research instruments to the teachers in the selected schools for the research. Interviews were conducted by the researcher to get in depth information and understanding of the issues surrounding the implementation of computers in mathematics instruction. Observations were done to collect the necessary data for understanding the factors that hinder or promote the integration of computers in mathematics instruction as perceived by the teachers in the schools. The observation checklist was used to obtain data on the availability and computer use. Data analysis involved both descriptive and inferential statistics. Descriptive statistics consisted of frequencies and percentages. The inferential statistics used included analysis of variances (ANOVA), which was employed to determine the statistical significance of the relationships between the variables. In addition, the quantitative analysis was supplemented

by qualitative descriptions to provide a fuller picture of the findings particularly in those areas that are not easily amenable to quantification. The findings are as presented in tables 1,2,3 and 4.

Table 1: Alpha scores of variables affecting teachers' intentions to use computers

Variable	No. of items	Score
Computer Anxiety	15	.8527
Self Confidence	10	.7554
Perceived Relevance/ Usefulness	11	.6861
Pedagogical Practice	15	.7175
Professional Staff Development	10	.8167
Access to Resources	10	.8384
Policy Formulation	10	.8062

Table 2: ANOVA: Teachers' Attitude and Integration of computers in mathematics instruction

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	584.111	4	146.028	3.033	.0019
Within Groups	9389.969	195	48.154		
Total	9974.080	199			

Significant at 0.05 level, critical value 3.033>.0019

An examination of the F-ratio in the table 2 indicates that the F-ratio is statistically significant because the F-value (3.033) and the small associated significance levels (.0019, $p < .05$) indicate that there is a significant relationship between the variables. There is therefore need to reject the hypothesis in question. This is a clear indication that the teacher's attitude affects the integration of computers in mathematics instruction. The results show that teachers' attitude has a significantly positive effect on computer use. Namely, the more the teacher feels at ease, liking and confident, the easier he or she feels the need to use computer as an instructional tool.

Table:3

ANOVA: Differences in Teacher's Attitudes towards Integration of Computers in Mathematics Instruction.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1043.516	4	260.879	6.201	.0012
Within Groups	8204.359	195	42.074		
Total	9247.875	199			

Significant at 0.05 level, critical value 6.201>.000

The large F static values (6.201) and its small significance level (.0012, P< .05 indicates that it is very unlikely that these variables are independent of each other. Therefore the hypothesis is rejected. Thus it can be concluded that there is a statistically significant difference in teacher's attitudes towards the integration of computers in mathematics instruction.

Table 4: Factors underlying mathematics teachers' attitudes towards the integration of computers in teaching mathematics

Variable	**D F**	**F Ratio**	**p< or =**
Computer Anxiety	4	36.2318	0.0001
Self Confidence	4	27.7290	0.0001
Perceived Relevance/ Usefulness	4	7.2703	0.0001
Pedagogical Practice	4	10.7703	0.0001
Professional Staff Development	4	8.4712.	0.0001
Access to Resources	4	2.1971	0.0072
Policy Formulation	4	6.2015	0.0065

Discussion of findings of the study

The finding reported in this study has provided information on secondary mathematics teachers' use of computers. The research has found that mathematics teachers' attitude towards use of computer technology is related to several factors such as, self confidence, Knowledge and skills, educational value, perceived relevance/usefulness, pedagogical knowledge, beliefs, and experience, access to technology, policy formulation issues and professional development

opportunities. The factors are perceived as barriers to the integration of computers by the teachers.

Self Confidence

The analysis showed that confidence in using computers was related to exposure to these technologies, as measured by access, professional development, and computer technology-specific teaching experience. Access was also important in relation to how often teachers use computers with their classes; in fact, this was the only factor linked to frequency of use of the technology.

Knowledge and Skills

The study found out that apprehension was a determining factor in teachers' attitude towards use of computers in instruction. Apprehension is related to the teacher's complete understanding of computer technology and its use in instruction. Teachers lack Knowledge and Skills. To implement the use of any type of educational technology effectively, teachers must feel confident in its operation and their own ability to integrate it into daily classroom practice. The need for training has emerged in the study as an issue of major proportions.

Educational Value of computers

Dissatisfaction with the status quo suggests that there must be a reason for members of the system to want to implement technology. The study reported that teachers, like other professionals, will use technology once they understand how it can make them more productive and help them do their jobs more professionally. The educational value of computers was found to be a key factor in teacher's intention to use computers in instruction.

Perceived Usefulness on Intention to Computer Technology Use

The results of this study found that teachers' perceived usefulness was significant and strong in determining intention to computer technology use. This can be explained by the fact that teachers find computer technology useful in improving their instructional performance, and motivating their intention to use computer technology in the future.

Inadequate Resources

It is obvious that sufficient hardware and software resources must be available for successful computer incorporation. Teachers often require technical assistance as well as pedagogical support such as advice on choosing relevant software and integrating it into instruction. It is

reported that technology support personnel for assisting teachers is limited in most schools. It was discovered that even schools that had technology support person did not provide teachers with adequate computer assistance.

Rewards and incentives

It was noted in the study that Extra pay could stimulate computer use where none has previously existed, or might deter computer-using teachers from leaving the teaching profession. It has been noted that teachers are motivated by formal recognition of their technology endeavors and in technology-related staff development, "release time, remuneration, and recognition" as the "three R's" of staff development. Improvement in student learning serves as the greatest motivator.

Attitudes of administrators

The study indicates the growing importance of administrators in the success of technology innovations. It is the lack of realization that school administrators control policy making, financial allocation, and program implementation within schools. The actions, interests, and priorities of the building principal have made a significant difference between effective and ineffective implementation of program change.

Participation

In the survey, teachers clearly indicated a call for a voice in the decision-making process. Teachers must not be cut out of the decision-making loop; they should be centrally involved in decisions regarding software and the integration of computers into the mathematics curriculum.

Time factor

The time factor surrounding the implementation process is viewed by teachers as being a major barrier in their using of computers. It was found that teachers who begin using computers in their teaching believe, initially, that technologies create more work for them. As reported in this study, accomplished technology-using teachers rated the lack of time as one of the most problematic barriers to technology utilization in schools. It is important to recognize that mastering technology requires time.

Availability of Hardware and Software Issues

The responses to the survey indicated that issues surrounding computer hardware were the most serious barriers affecting implementation. Regarding hardware, teachers reported "serious" to "very serious" concern with "too few computers" and "too few printers." The study identified

software issues that act as barriers to successful implementation of computers in mathematics instruction. These include: matching courseware to curriculum, evaluation, quality control acquisition, setting priorities security, placement and appropriate use

Teacher Attitudes

Results indicated that while teachers did not feel that their own jobs were threatened by the computer, they still saw them as dehumanizing, isolating, prone to error and possibly as a violation of the right to privacy.

Professional development

Inappropriate or inadequate professional development is frequently cited as a barrier to the integration of computers in the teaching and learning of mathematics. Inadequate pre-service teacher training courses and inappropriate in-service workshops do not prepare teachers to integrate computers into their teaching.

Pedagogical and Policy formulation Issues

The way computer is used in lessons is influenced by teacher knowledge about their subjects, and how computers can be utilized and related to it. The study has established that outcomes of computer use at the classroom level are shaped by the theoretical framework and beliefs of individual teachers; the range of their pedagogical repertoire; and their sensitivity and responsiveness to the structure, potential and limitations of computer instructional software programs.

Conclusion

The potential of computer technology can only be realized if educators at all levels understand the issues facing them, define the role of computer technology in mathematics education, and plan for its appropriate use by classroom teachers. Teachers realize the tremendous potential computer technology can bring to teaching and learning. Teachers will continue to use computers in their classrooms despite the many factors affecting implementation. The challenges facing teachers in their initiative are vast and complicated and affect them on a personal and professional level. Teachers are expected to develop their technological skills and knowledge and use computers in their classrooms. Pedagogical issues challenge teachers' approaches to teaching and learning and impacts traditional classroom practices.

From the findings of the study, it can be concluded that the teacher, not the technology, is of central importance to the implementation of computers in schools. Staff development must have a curricular focus and help teachers integrate technology into the curriculum. This implies changes to current professional development strategies. In-servicing that focuses on specific computer applications outside of the curriculum does little more than teach computer skills. If authentic integration of computer technology is to occur, professional development strategies must focus on giving teachers an understanding how educational objectives can be supported by technology and how computer technology will impact on their pedagogy.

Microcomputers offer exciting possibilities to advance and change teaching. It is essential that mathematics educators define the computer's role and application if the true potential of this technology is to be realized.

This study has been directed towards emphasizing the importance of professional development to any program concerned with the integration of the information communication technology more generally, into teaching and learning. The findings, the discussions and the implications of this study were definitely important to the study and implementation of computer technology in an educational context. Thus it is hoped that this study has stimulated thinking about the importance and methodology of professional development in any meaningful integration of the information communication technology more generally into teaching and learning.

Recommendations

From the research findings and the conclusions made, the following recommendations were made:

- There is need for providing teachers with professional learning opportunities to enhance their capacity to fully utilize the opportunities presented by the use of computers and to embed the use of computer in teaching and learning, including the ways in which computer can support assessment practices in schools. University teacher training courses should equip new teachers with required computer knowledge and skills.
- Adequate time must be allowed for teachers to develop new skills, explore their integration into their existing teaching practices and curriculum, and undertake necessary additional lesson planning, if computers are to be used effectively in instruction.

- Support of school administrators and, in some cases, the surrounding community, for teacher use of computers is seen as critical if computers are to be used at all, let alone effectively.
- Providing policies and protocols that facilitate the uptake and use of computers in schools. There is need for the Government to give priority to providing teachers with access to computer resources through professional development, quality digital content and computer infrastructure.

These challenges need to be confronted so that Kenyan students are able to reap the educational benefits available through the effective use of computer technology. It is important that concurrent actions continue to be undertaken in the three priority areas: connectivity, people and content.

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