Influence of Teachers' Gender, Academic Qualification, Computer experience and Purpose for Computer Use towards integration of computers in mathematics instruction in Kenyan Secondary Schools

Metrine Wambani Sulungai

Masinde Muliro University of Science and Technology

Department of Science and Mathematics Education

+254791424358 P.O. BOX 190-50100, KAKAMEGA, KENYA

Corresponding author:metrine.sulungai@gmail.com ,metrinesulungai@yahoo.com

ABSTRACT

The Kenya Certificate of Secondary Examination (KCSE) results shows that Students' performance in mathematics are consistently poor (KNEC, 2007). Among reasons cited for poor performance is the abstract nature of mathematics. Computer technology is premised for constructivist approach to learning. However, use of computer technology in mathematics instruction has not been effective in Kenya. Studying teacher factors that influence computer integration in mathematics instruction may assist educators to overcome these barriers and become successful technology adopters in the future. These paper reports findings of influence of gender, academic qualification,computer experience, purpose for computer use towards integration of computers in mathematics. 147 mathematics teachers in 25 public secondary schools of Kakamega South were selected using purposive, stratified and simple random procedures. Questionnaire and interview schedule were used and their reliability was determined by split –half. The findings indicated that teacher factors influence integration of computers in mathematics instruction.

Key words: Integration, Gender, Computer experience

1.0 INTRODUCTION

The formidable problem currently facing mathematics education in Kenya is the need to improve the students' performance in mathematics (KNEC report, 2008). Mathematics in Kenya is a core subject and a critical filter for career choices. However, student performance in the Kenya Certificate of Secondary Education examination (K.C.S.E) has been dismal over the years. From the KNEC analysis report indicated the following: in 2002 and 2003 KCSE mathematics mean score was 39.39% and 38.62% respectively. In 2004 and 2005, a mean of 37.2% and 31.91% was registered. The following year, a mean of 38.08% was realized while 39.46% was realized.

According to Strengthening of Mathematics and Science (SMASE) Report of 2008, the poor results have been attributed to various causes ranging from poor teaching methods to psychological factors like poor attitude. The Ministry of Education and other stakeholders have embarked on various large scale capacity building seminars and workshops that are aimed at strengthening the teaching of mathematics and the sciences in Kenyan secondary schools. In 1998, Strengthening of Mathematics and Science in Secondary Education (SMASSE) was implemented nationwide with the hope of solving pedagogical issues that have contributed to poor performance in mathematics

and science subjects over the years. The Ministry of Education also introduced the use of scientific calculators for instruction and examination of candidates at KCSE aimed at enhancing performance in the subject (Ministry of Education, 2005). All these initiatives are expected to yield outstanding results in the subject in terms of solving perennial problems inherent in the subject. However, the problem of poor performance continues to persist as clearly indicated by the Kenya National Examination Council report (KNEC report, 2008). The trend is adding another impediment in Kenya's efforts to realise Vision 2030. Hence need to look at other alternatives.

In recent years, the impact of the "information age" has shifted from occurring primarily within the arena of governments and multinational corporations into school curricula. Accompanying this expansion is a growing belief that computers are essential components of the educational and instructional systems. According to many researchers including Polonoli (2001) and Goddard (2002), such public perception is warranted because the computer represents both an excellent curricula tool and revolutionary classroom approach that can help students to realize important gains in learning and understanding of mathematical concepts.

School systems in developing nations are also increasingly viewing the computer as a powerful and realistic tool for the classroom (Pelgrum, 2001; Kozma and Anderson, 2002). According to Makau (1990) computers have the potential of making teachers' work easier and efficient. Furthermore, they help the student become less dependent on the teacher as a source of expertise.

African nations have begun designing new policies and investing large sums of capital aimed at integrating computers into the classrooms. The Kenyan Ministry of Education in an endeavor to provide learners with access to ICT came up with vision and mission statements. The vision states: "ICT to be a universal tool in education and training." The mission states: "To integrate ICT in education and training to improve access, learning and administration" (Sessional Paper No. 1 of 2005). To achieve these, every educational institution, teacher, learner and respective community should be equipped with appropriate ICT infrastructure and skills needed to benefit from ICT knowledge- based economy. Teaching and learning should be transformed to incorporate new pedagogies that embrace ICT and that are appropriate for the 21st century.

In addition, a unit has been established at the Kenya Institute of Education (K.I.E) to provide overall leadership in digital content, development and delivery. Resources are being mobilised to address digitalisation of the entire curriculum (Ministry of Education, 2006). However, e-content is now available and curriculum innovation centre was launched at K.I.E in March, 2010 for purposes of enhancing curriculum delivery (www.icwe.co.ke/elearn2010). All these reflect the seriousness with which the government treats inclusion of ICT in classroom instruction. While acknowledging the availability of e-content and recent launching of curriculum innovation centre at K.I.E, this shifts the challenge from e-content availability to training teachers to integrate computers in teaching.

According to Kenya ICT 4E situational analysis (2009) the following achievements have also been realised: M.O.E again disbursed Ksh. 1.5 million to 213 schools evenly distributed across the country to be used to acquire 25 new computers per school, 1 printer per school, educational software and sensitize ICT teacher on technical maintenance. Computers for Schools Kenya

(CFSK) reported to have installed 18,000 computers in over 600 schools with 20 computers per school. ICT Trust Fund has provided 200 schools with 20 computers each.

The NEPAD e-schools project provided 6 schools with 20 computers each. The Rural School Project has provided 4500 computers to a number of unidentified schools. Overall, the analysis indicated that 15,450 computers have been disbursed to 1300 secondary schools out of over 4000 schools. There is also evidence that some secondary schools with digital content are using computers in teaching specific subjects. In the most recent budget (2009-2010) the M.O.E has allocated funds for purchase of digital laboratory books for each district to be achieved through Economic Stimulus Program. In addition, there is also a scheme to provide affordable laptops to teachers. The private sector will be involved in provision of laptops with ICT integration team providing specifications and ensuring quality of laptops with the wider ICT integration agenda.

Despite the aforementioned efforts and the fact that ICT increases access to instructional material and several advantages to teaching, computers in many school are underused and as such the potential of computer technology is not being realised (Abrami,2001; Muir-Herzig,2004; Sutherland et al., 2004). Work conducted in the United Kingdom, Thailand, Greece, and Australia reveal the same (Pelgram, 2001; Demetriadis et al., 2003; Wilson, et al., 2003). There was therefore need to ascertain whether a similar situation holds for Kakamega South District schools. The current study aimed at investigating whether mathematics teachers' gender, academic qualification, teaching experience, purpose for computer use and computer technical skills influenced their use of computers in mathematics instruction.

While developed countries have reported up to 41% of integration of computers in instruction, the proportion remains substantially low in Africa (National ICT strategy for Education, Training and research, 2006). Muriithi (2005) argues that in Kenya like most developing countries computer usage is still limited to computer literacy training. He contends that present computer curriculum deals with teaching about computers and not how computers can be used to transform teaching and learning in schools. He further argues that even in situations where teachers have been trained in the use of ICT, the integration of computers in the teaching of subjects has been weak because of lack of integration into the existing curriculum and textbooks, lack of computer-based materials that are interactive for teachers to use, the absence of systematic management support and teacher overload as well as lack of incentives and motivation.

Although, more and more secondary schools are acquiring computers, there needs to be more than just transferring resources to schools if educational change is to be attained. The ability to use computer as a cognitive tool is a major milestone in the process of integrating computer in the teaching of mathematics. This depends on several factors, among them computer technical skills towards computer use in teaching. In addition, variables such as gender, computer experience, academic qualification, and purpose of computer use and their impact on teachers' attitudes towards computer use in mathematics instruction needed to be understood. It is against this backdrop of the use of computers and preparedness of teachers that the present study strived to investigate teacher factors influencing integration of computers in mathematics instruction in secondary schools in the Kakamega South District.

1.1 Statement Of The Problem

Computers are perceived to have overwhelming potential in the teaching and learning of mathematics since they support constructivist pedagogies and help students discover or construct ideas (International Society for Technology in Education, 2002). Morever, use of computers for teaching of topics such as algebra, statistics, geometry, calculus and trigonometry has had fundamental changes in the teaching and learning (Henderson and Landersman, 1992; Guttenberger, 1992; Munirah, 1996, Larborde, 2001; Healy and Hoyles, 2001; Abrahamson and Wilensky, 2007; Cobo et al, 2007).

Poor performance in national K.C.S.E mathematics examinations has persisted over the years as indicated by the KNEC report, 2008. A similar trend is experienced in Kakamega South District. This is despite the efforts made by the government of Kenya to improve the situation. An effort has also been made to introduce computers in secondary school curricula including mathematics instruction in some schools (Kenya ICT 4E situational analysis, 2009). However, there is limited knowledge about influence of teacher characteristics on use of computers in their mathematics classrooms in the district. It therefore became imperative to find out, individual factors related to teacher's characteristics such as academic qualification, gender, academic qualification, computer experience, purpose for computer use and computer technical skills towards integration of computers in mathematics instruction in Kakamega South District.

1.2 Purpose

The purpose of the study was to establish the influence of teachers' gender, academic qualification, teaching experience, purpose of computer use and level of computer training towards integration of computers in mathematics instruction in secondary schools in Kakamega South District, Kenya. The main purpose was to find out if mathematics teachers in Kakamega South District are using computers and if not could their gender, academic qualification, teaching experience, purpose of computer use and level of computer training interplay.

2. Methods and materials

The study was conducted in the Kakamega South District in Kenya. The study adopted descriptive survey design. This design was deemed appropriate as it enabled the researcher to reach as many respondents as possible within a short time. The target population was 77 public secondary schools with a total of 228 mathematics teachers. The sampling frame was 25 schools with computers with a total of 147 mathematics teachers (43 female and 104 male) representing 32.5% of the total public secondary schools in the district. Purposive sampling was used in selecting schools with computers. Stratified sampling was then used to avoid gender disparity. Simple random sampling was then used to pick 30% (n=74) the mathematics teachers in each stratum to be interviewed. This was to ensure each respondent got equal opportunity to participate in the study. Data was collected using questionnaire and interview schedule. Split half method was used to test reliability of research instruments. Spearman Brown Formula coefficient of 0.858 was realized which was above recommended 0.8. The reliability of 0.858 was regarded as a reasonable reliability index for the research instrument. Data collected were analyzed using descriptive statistics such as frequencies, percentages and means. The results were presented using tables.

3. Results and discussions

3.1 Gender Of The Mathematics Teachers
Gender of the mathematics teachers was an important factor to consider in this study since it influenced the use of computers in mathematics instruction. Based on this information, it was important for the study to establish whether teachers' use of computers in mathematics instruction in Kakamega South District was determined by their gender. Table 2 gives a breakdown of the respondents by gender.

Table 2: Gender Of Mathematics Teachers

Gender of teachers	Number of teachers	Percentage (%)
Male	104	70.7
Female	43	29.3
Total	147	100.0

From the findings in Table 2, it can be seen that majority of the mathematics teachers were males (70.7%) while females were fewer (29.3%) respectively. This clearly implies that there is a gender disparity in the mathematics teachers in the selected schools. The results are consistent with similar studies which indicate that female mathematics teachers are more likely to display negative attitudes to teaching mathematics when computers are involved (Torkzadeh et al., 1999; Norton et al., 2000; Burtler, 2000).

Some differences were also noted in the views of male and female teachers on issues associated with computer use especially in the few schools integrating computers in teaching. While all believed that using computer to teach mathematics will enhance their mathematics teaching and changed how they taught, the female teachers(67%) felt more strongly than the male teachers (33%) that their students were able to solve non-routine problems that would otherwise be inaccessible using traditional methods of talk and chalk, and that students were able to engage with challenging problems; they believed less strongly that students accepted answers given by the computers and rarely checked for reasonableness. The females also believed more strongly than the males that the introduction of technology was a positive development.

3.2 Academic Qualification Of Mathematics Teachers
There was need for the researcher to know the academic qualifications of the mathematics teachers in Kakamega South District since training helps the teacher to understand the curriculum relevant to a given level like high school. She or he understands how to interpret the objectives and use the right learning experiences and resources for the students. Training makes it possible for teachers to evaluate their learners and themselves. In this study mathematics teacher academic qualification appears in Table 3.

Table 3: Academic Qualifications Of Mathematics Teachers

Professional qualification	Number of teachers	Percentage (%)
Diploma in Education	28	19.0
BA/BSC +PGDE	19	12.9
Bachelor of Education (B.E.D)	89	60.5
Others(Specify)	11	7..5
Total	147	100.0

From Table 3 it can be seen that the majority of teachers had B.ED (60.5%), followed by diploma (19.0%), BA/BSC +PGDE (12.9%) and others (7.5%). Those in the category of others included those who held masters 0.7%, PHD (1.4%) and Approved Teacher (0.7%) and students on teaching practice (4.7%). From the above findings, it is clear that in the selected schools, 95.4% of the respondents were professionally qualified. Therefore these teachers are expected to be competent in handling the mathematics curriculum. The results are consistent with Norton et al (2000) and Harris and Kington (2002) who argue that academic qualification correlated with computer use in instruction. Other similar studies indicate that academic qualification is a critical determinant of the teacher's competency in use of computers in instruction (Cole and Conlon, 1994). From the findings of this research, one would expect that students' achievement in KCSE mathematics be reasonable. Yet the results were still on a declining trend. This is an indication that for an enhanced achievement in mathematics and effective integration of computers in mathematics classrooms, teachers need more than just academic qualification. It is for such a reason that the study sought to establish if mathematics teachers were also trained in pre-service in use of computer technology in their classrooms. It was noted that from the face to face interviews, it was clear that majority (98.1%) of the mathematics teachers agreed that their pre-service training did not include a component on use of computers to teach secondary school mathematics. A paltry (1.9%) did. Their training was generally on teaching secondary school mathematics curriculum. This information enabled the researcher correlate the mathematics teachers' academic qualifications with their attitudes towards use of computers in mathematics education. There is therefore need to train teachers' on how to integrate computers in teaching mathematics to enable them have a positive attitude towards the same.

3.3 Years Of Teacher's Computer Experience
The researcher sought to find out whether years of computer experience have influence on the use of computers by mathematics teacher in Kakamega South District. In this study, the teachers' experience in the use of computers is summarized in Table 4.

Table 4: Years Of Mathematics Teachers' Computer Experience

Years of computer experience	Number of teachers	Percentages (%)
Below 3 years	40	27.2
Above 3 years	33	22.4
Not at all	74	50.3
Total	147	100.0

The results in Table 4 shows that majority (50.3%) of mathematics teachers in the selected schools do not have any computer skills, 22.4% had experience of above 3 years while 27.2% had below 3 years of computer experience. This showed that majority of the teachers were not computer literate and hence are not capable of using computers in mathematics instruction. Inevitably, they would not be expected to be competent to handle computer integrated mathematics curriculum unless trained. Studies done in this area indicate that teachers with little experience may have a positive attitude towards use of computers than those without any computer skills (OECD, 2005). Kadevijech (2002) argues that, due to lack of training and experience, even when computers are available, mathematics teachers rarely used computers in their educational practice. Limited computer experience is a factor that influences teachers' use of computer technology. Lack of training and experience is also believed to be, in part, the reason why many teachers have not been well-disposed to computers and consequently deprived of their usefulness in the classroom.

It was therefore necessary to find out teachers perception on their competence to integrate computers in mathematics instruction on a 4 point scale ranging from high competence to incompetence. Table 5 gives the highlights of the results.

Table 5: Summary of Mathematics Teachers' Perceived Competence in Integration of Computers in Instruction

STATEMENT	Frequency	Percentages (%)
High Competence	10	6.8
Average competence	15	10.2
Low Competence	48	32.7
Incompetence	74	50.3
Total	**147**	**100**

From the results in Table 5,10 (6.8%) of the mathematics teachers who took part in the survey indicated high competence in integration of computers in mathematics instruction, 15(10.2%) indicated average competence,48 (32.7%) indicated low competence and 74 (50.3%) indicated they were incompetent to use computers in mathematics instruction. These findings indicate that majority of the mathematics teachers in the secondary schools do not have the required competence in the integration of computer technology in their classrooms unless trained. This corroborates the report of Milner (1980), Keating and Evans (2001), Kadevijech (2002), Staub and Stern (2002),Hughes (2005) and Mueller et al (2007) who argue that the vast majority of teachers do not know how to use the computers to promote student achievement, and they are not adequately trained to use modern computer technology. It also confirms the assersion that teachers have not developed competence in the use of computers in their classrooms, thus they cannot model good use of technology (Polonoli, 2001).

On respondents rating of level of competency in computer technical skills in the teaching of mathematics, the results were summarized in Table 6.

Table 6: Mathematics Teachers Rating Of Level of Competency in Computer Technical Skills

Statement	Number of teachers	Percentage (%)
Excellent	4	5.4
Good	12	16.2
Poor	33	44.6
Very poor	25	33.8
Total	74	100.0

The findings in Table 6 indicate that only a paltry proportion (21.6%) thought had the necessary computer technical skills. A majority (78.4%) considered themselves either poorly or very poorly equipped with the necessary computer technical skills. A finding worth noting was the fact that mathematics teachers who had adequate skills (that is excellent/good computer technical skills), very few of them (3.4%) used computers in mathematics instruction. This could be partly explained due to teacher's attitudes, lack of integrated mathematics curriculum and inadequate computers in their schools. These results are consistent with Newhouse (1998) who surveyed 60 Australian teachers and found that even, when they had the technical skills, teachers were reluctant to implement technology in the classroom. He further argued that mathematics teachers were not convinced about the benefit of computers in mathematics instruction. Reasons for such resistance were preference for traditional methods of instruction. Respondents with inadequate computer technical skills had basic skills in computers that would not be appropriate for teaching mathematics. In addition, the remaining teachers lacked computer skills. This again attest to the fact that there is need to train teachers in use of computers in instruction before they can use computers in their mathematics classrooms.

3.4 Purpose For Computer Use

The respondents were asked to say what they used computers for, the mathematics teachers gave responses summarized as in Table 6.

Table 6: Purpose Of Computer Use By Mathematics Teachers

Purpose	Number Of Teachers	Percentage
Internet	52	40.6
Email	46	35.9
Word processing	81	63.3
Spreadsheet	81	63.3

Programming	19	14.8
Others	12	9.4

The results in Table 6 showed that most mathematics teachers (63.3%) use computers for word processing and spreadsheet much more than other computer applications. This may be partly because of typing student examinations and analysis of students' examination results. This also showed how useful computers were helping the teachers' improve in efficiency and effectiveness of their work. Some teachers 40.6% of the respondents used computers for internet surfing, 35.9% email communication 14.8% programming and 9.4% other computer applications. Other computer applications included: research in postgraduate programs (5.5%), teaching (2.3%), e-learning (0.8%), and power point presentations (1.6%). The results support those of Sutherland et al (2004) in the literature who argued that computers are being underused in many schools and that the potential of computer technology was not being realised. Kirschner and Davis (2003) have shown that in order for teachers to implement computers in classroom instruction, they will need to become proficient in basic computer operations, basic applications of software like word processing, databases, spreadsheets, graphic software and the integration of computers in teaching. This lack of computer use in teaching mathematics may be due to teachers' lack of appropriate computer skills to aid in pedagogy or due to negative attitudes towards computer technology. These reasons are investigated in the next sections.

4. Conclusions

4.1: **Gender Of Mathematics Teachers**
The findings established that gender influence teachers attitude towards use of computers in teaching and learning mathematics in the district
4.2: Academic Qualification Of Mathematics Teachers

The findings established that academic qualification influence teacher's attitude towards use of computers in teaching and learning mathematics in the district

4.3: **Years Of Teacher's Computer Experience**
The findings established that years of teacher's computer experience influence teacher's attitude towards use of computers in teaching and learning mathematics in the district

4.4: Purpose For Computer Use

The findings established that purpose of computer use influence teacher's attitude towards use of computers in teaching and learning mathematics in the district

5.1 Recommendations

From the findings outlined, the following recommendations are reached:

   a) Mathematics teachers that have the relevant professional skills on how to use computers in mathematics instruction should play a central role in developing the integrated K.C.S.E curriculum in collaboration with curriculum developer (K.I.E).

b) The government should organize seminars and workshops for mathematics teachers for example by use of SMASE INSETS to provide relevant professional training in use of computers in mathematics teaching and learning.

c) Seminars and workshops can be organized at school level by mathematics teachers who have the knowledge and skills to sensitize other mathematics teachers on the potential of computers in their mathematics classrooms.

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