Critical Factors in the Integration of Information and Communication Technologies in Early Childhood Education in Kenya : A Case of Nairobi County

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Abstract

In Kenya during the last one decade, public and private sectors have invested a lot of resources in computer based Information and Communication Technologies (ICT) to improve the quality of education in schools. The main objective has been to integrate ICT in the delivery of curriculum in order to improve the quality of teaching-learning and to produce ICT literate workforce. The computer based technologies are used in management, pedagogy, and communication. This paper presents results from a study that was conducted in Nairobi County in Kenya to determine the key factors in the integration of computer based ICT in teaching-learning in pre-primary and lower primary schools. Results had revealed that the use of computer based ICT in teaching-learning by both pre-primary and lower primary schools was influenced by accessibility of resources, capacity to use the technology, availability of time, and provision of technical support.

Keywords : Information and Communication Technologies, Integration, Teaching-learning, Early Childhood Education

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1. Introduction

Technology is vital in our country's social and economic development. The aim of Kenya's Vision 2030 is to transform Kenya into industrialized, middle-income country by the year 2030. The dream cannot be achieved without effective integration of Information and Communication Technologies (ICT) in early childhood education. This is because the foundation of effective and efficient use of technology is laid in early childhood education.

The importance of ICT in our society cannot be overemphasized because the technologies have impacted every aspect of our society ranging from education, communication, business, and entertainment. In Education, ICT has been integrated to school curriculum in order to improve the quality of teaching-learning and to produce ICT literate workforce [Ministry of Education, 2006].

2. Information and Communication Technologies

Information technology refers to the hardwares and software that are used to store information. Information and Communication Technologies stands for "anything which allows one to get information, to communicate with each other, or to have an effect on the environment using electronic or digital equipment" [Siraj-Blatchford and Siraj-Blatchford, 2003]. The technologies include; desktop computers, laptops, digital cameras, DVDs, CDs, tape recorders, internet, telephones, and mobile phones. The other technologies include; computer software programmes for teaching-learning, and for play.

2.1 National ICT Policy and Strategy

In Kenya policies have been put in place which supports the integration of ICT in different sectors of our society. The National ICT policy was launched in January 2006 and its vision is "a prosperous ICT - driven Kenyan society", while its mission is "to improve the livelihoods of Kenyans by ensuring availability of accessible, efficient, reliable, and affordable ICT services" [Republic of Kenya, 2006].

National ICT strategy for Education and Training was developed to facilitate the integration of ICT into education and training systems and was launched in June 2006 to address the issue of ICT in education sector. The vision of the strategy is "ICT as a universal tool in education and training", while its mission is to "integrate ICT in education and training for improved access, learning and administration". The strategy provides guidelines for the transformation of Kenyan society into a digital society. In the policy Government of Kenya recognizes that ICT literate workforce is the foundation on which Kenya could become a knowledge based economy. The integration of ICT in education sector would also accelerate the achievement of Vision 2030 [Ministry of Education, 2006].

In the strategy, the Government resolved to adopt and support the New Partnership for African Development (NEPAD) recommendations for the development of ICT platforms. The Partnership

was initiated to address the challenges facing African countries and ICT is one of its priority areas of action. In 2003, NEPAD prioritized efforts towards bridging of the digital divide between Africa and the developed world. One of its priority areas is NEPAD e-Schools programme with an objective of integrating ICT in the delivery of primary and secondary schools curricula by the end of ten years which is yet to be fully achieved.

To promote the use of ICT in educational institutions, the Ministry of Education was: To facilitate the establishment of National ICT support centre, through which technical support was to be provided to educational institutions; and set up ICT support centres equipped with necessary tools for addressing maintenance and related capacity building at educational institutions. The Ministry was also to establish model institutions that were to be used to demonstrate integration of ICT in teaching-learning; train teachers on integration techniques and sensitize education managers on ICT integration [Ministry of Education, 2006]. However, most of these targets are yet to be fully achieved.

2.2 Integration of ICT in Early Childhood Education

In Kenya the integration of ICT in Early Childhood Education (ECE) is recent, small scale, and is in experimental stage. The technologies have been integrated into; curriculum, management, and used in communication between teachers and parents. To lay a strong foundation in ICT and to produce competent ICT work force for social and economic development for our country, integration of ICT in education should start at pre-primary school level and then continued at primary school level in order to give children a good start or head start in ICT. This is because attitudes towards technology are formed in early years. Studies have shown that while computer based technologies were beneficial to students in general, the degree of impact decreases from elementary to secondary to post secondary levels [Becker, 1991; Kulik, 1985]. This means that pre-primary school children benefit more from computers than the other learners. The current policies in Kenya focus on integration of ICT in secondary schools and universities which cannot yield maximum benefits from the investment compared to when the integration starts in ECE.

The government of Kenya intends to provide laptops for primary school children. This is important because: We are living in a digital world; technology is part of our culture; and there is need to bridge the digital divide. However, for the children to effectively use the technologies, their teachers must be technology literate or competent. Teachers should also be conversant with the technologies and understand the value of the technologies in teaching-learning. This implies that teachers should have access to adequate resources, capacity to use technologies, and be provided adequate time support, and technical support to help them while using the technologies [Bowes, 2003].

In the National ICT strategy the Ministry of Education reports that there is inadequate technical support in schools to facilitate effective use of ICT. The ministry also reveals that most

schools use less than 40% of the available ICT infrastructure. In addition, the ministry discloses that very few schools are using ICT in delivering school curriculum [Ministry of Education, 2006]. Albion [2001] remarks that as society expectations for integration of information technology into the daily practices of teaching-learning grow, it is important that all teachers are adequately prepared for this dimension of their professional practice and have adequate resources. Thus, to ensure optimum use of ICT in schools, there was need to establish the key factors which influence effective use of ICT in ECE in order to exploit the potential of the technologies.

3. Methodology

The study was intended to establish key factors in the integration of computer based ICT in teaching-learning in pre-primary and lower primary schools in Nairobi County, Kenya. The study had employed an "ex-post-facto" research design. The dependent variable was instructional computer use, while the independent variables were; attitude towards computers; computer knowledge; computer training; computer self-efficiency; time support; and technical support. Stratified random sampling technique was used to select 396 pre-primary and lower primary school teachers from 66 primary schools with attached pre-primary schools. A questionnaire was used to obtain information from teachers on how they were using computers in teaching-learning and the factors influencing the use. Interview and observation schedules were used to collect data on the availability of resources, provision of time support, and the availability of technical support. Data was analyzed using descriptive and inferential statistics and results presented using tables.

4. Results and Discussions

The National Association for the Education of Young Children [NAEYC] [1996] states that computers should be integrated into the learning environment of children to support children's social and cognitive abilities. Clements [1999] adds that technology can change the way children think and what they learn. Clements and Sarama [2003] also affirm that technology should be used as a tool for improving children's learning, through exploration and creativity.

Consequently, how pre-primary and lower primary schools were using computer technology in teaching-learning was a subject of investigation in the study. To understand the level of pre-primary and lower primary school teachers' instructional computer use, overall mean scores in instructional computer use were calculated and the results have been presented in <Table 1> below.

〈Table 1〉 Overall Mean Scores in Instructional Computer Use by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-primary school	198	1	5	1.83
Lower Primary	198	1	5	1.86

<Table 1> above shows that the overall mean score for pre-primary school teachers' instruc-

tional computer use was 1.83, while that of lower primary school teachers' was 1.86. The results indicate that the difference between pre-primary school and lower primary school teachers' instructional computer use was minimal which imply that computer technology was rarely used in teaching-learning and was at the beginning stage.

The results from observation and interviews conducted by the researcher had revealed that computers were being used by teachers to: Deliver school curriculum; develop computer skills; and teach other activities (reinforcing skills taught, re-mediating deficiencies, and challenging bright children). The uses reported by pre-primary and lower primary teachers in this study have also been reported in different studies [Becker, 1994; Becker, 1991; Evans-Andris, 1995]. Lynch and Warner [2004] had found that pre-primary school teachers in USA were using computers to extend concepts taught in classrooms, allowing children to explore and play with technology, teaching basic skills needed in school and life, providing appropriate use of free time, increasing enrollment for pre-schools, and rewarding children for good behaviour. The researchers had also established that computers were also used to: Extend concepts taught in the classroom; allow children to use computers to explore and play with technology; and teaching basic skills needed in school and life.

To determine whether the difference in instructional computer use between pre-primary school and lower primary school teachers was significant; the following null hypothesis was formulated and tested:

$H_0$1: There is no significant difference at .05 level of significance in instructional computer use scores between pre-primary and lower primary school teachers.

The t-test for independent samples was used to determine whether the difference in instructional computer use between pre-primary school and lower primary school teachers' instructional use was significant. <Table 2> presents the results.

〈Table 2〉 Independent Samples t-test for Equality of Means

Instructional computer use	t-test for Equality of Means			
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	-.308	.758	-.032	.102

<Table 2> shows that the difference between the two mean scores for pre-primary school and lower primary teachers' instructional computer use was -.032 with .758 level of significance. The result implies that the difference between the two means was not significant at .05. The null hypothesis was therefore accepted. This means that pre-primary and lower primary school teachers were using computer technology the same way.

The same use of computer technology could be because of several reasons like: The majority of pre-primary and lower primary school teachers did not have appropriate computer software for teaching-learning; and the teachers were using the same computer software for teaching both pre-primary and lower primary school children. The other reasons for same use in-

clude: Computer was not taught in increasing levels of difficulty; teachers taught the same content to pre-primary and lower primary school children; and some schools were mainly using computers to market their schools or to attract many children.

4.1 Computer Software for Children

Pre-primary school and lower primary school teachers were asked to write the computer software they were using to teach; language, math, science, art, social studies, music, computer skills and other activities. There were varieties of computer software available for different uses. Some of the computer software the teachers were using include: Fun School; Jump-start; Print Artists; Junior Doctor; What Will My Child Learn; My First Toddler; Reader Rabbits; Fisher-Price; Learn to Read; Learning Ladder (six series) for ages 1~10 years; Nursery School ages 2~4 (Europress); Animated Storybook (Winnie Pooh 4~8), Music Skills (7~11 years); and Become a World Explorer (6~10 years).

The researcher was also interested to establish the factors which influenced use of computer technology in teaching-learning. The factors investigated were: Attitudes towards computers; computer knowledge; computer training; computer self-efficacy; availability of time support and provision of technical support.

4.2 Teachers' Attitudes towards Computers

Cox, Rhodes, and Hall [1999] remark that teachers were unlikely to use new technologies in their teaching if they felt no need to change their professional practice and could resist change due to lack of the necessary education. To determine the nature of pre-primary and lower primary school teachers' attitudes towards computers, overall mean scores were computed. The results have been presented in <Table 3>.

〈Table 3〉 Teachers' Overall Mean Scores in Attitudes towards Computers by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-primary school	198	1	5	3.21
Lower Primary	198	1	5	3.28

<Table 3> shows that the overall mean scores for both pre-primary and lower primary school teachers' in attitudes towards computers were above 2.5. The results imply that the teachers' attitudes towards computers were similar and positive. Similar results were reported by Guha [2000] who had found that elementary school teachers believed that computers could enhance children's learning and all wanted to be competent computer users.

The descriptive results were further subjected to regression analysis to determine the contribution of teachers' attitudes towards computers to their computer technology usage in teaching-learning. The results are presented in <Table 4>.

<Table 4> shows that the regression coefficient (B coefficient) for pre-primary school teachers' attitudes towards computers was .063 with .035 p-value, while that of lower primary

school teachers was .052 with .122 p-value. The results signify that the contribution of pre-primary school teachers' attitudes towards computer technology usage in teaching-learning was significant, while that of lower primary school teachers' was not significant.

〈Table 4〉 Regression Coefficients for Attitudes Toward Computers by School Level

School Level	Beta Coefficients	t	Sig.
Pre-primary school	.063	2.13	.035
Lower primary	.052	1.55	.122

Independent Variable: Attitudes toward computers.
Dependent Variable: Instructional computer use.

Similar results were reported by Honey and Moeller [1990] who had found that teachers with student-centred pedagogical beliefs were successful at integrating technology. In Australia, studies on computer use during teaching practice had revealed that despite possessing positive dispositions towards computer use, pre-service teachers lacked confidence in their capacity to teach successfully with computers [Albion, 1996; Downess, 1993].

4.3 Teachers' Computer Knowledge

Office of Technology Assessment [1995] observes that strategies like appropriate and timely training, expertise to support and help teachers, and time for teachers to learn, mess around with the technology, and work with colleagues increases teachers' computer knowledge and encourage computer technology use. The level of pre-primary and lower primary school teachers' computer knowledge was thus established and <Table 5> below presents the results.

〈Table 5〉 Teachers Overall Mean Scores in Computer Knowledge by School Level

School Level	No of Teachers	Min	Max	Mean
Pre-school	198	0	1	0.37
Lower Primary	198	0	1	0.37

<Table 5> shows that the overall mean scores in computer knowledge for both pre-primary and lower primary school teachers was similar and below average. The results disclose that teachers' computer knowledge was inadequate. The results from this study were similar to that reported by Newhouse [2002] who had established that many teachers lacked knowledge and skills to use computers.

The descriptive results on pre-primary and lower primary school teachers' computer knowledge were further subjected to regression analysis to determine the contributions of computer knowledge to instructional computer use. The inferential results are presented in <Table 6>.

〈Table 6〉 Regression Coefficients for Computer Knowledge by School Level

School Level	Beta Coefficients	t	Sig.
Pre-primary	-.059	-.32	.750
Lower primary	.559	3.66	.000

Independent Variable: Computer knowledge.
Dependent Variable: Instructional computer use.

<Table 6> shows that the regression coefficient (B coefficient) for pre-primary school teachers' computer knowledge was .059 with .750 p-value, while that of lower primary school teachers' was .559 with .000 p-value. The results denote that the contribution of pre-primary school teachers' computer knowledge to instructional computer use was not significant, while that of lower primary school teachers was highly significant at 0.05.

In USA, Larner and Timberlake [1995] surveyed 78 US elementary school teachers with an objective of identifying the most important variables in determining computer use in instruction. The variables investigated were: Knowledge, anxiety, personal attitudes, and professional attitudes. The results had revealed that computer knowledge had negative correlations with computer use. This is similar to the findings of this study where pre-primary school teachers' computer knowledge had a negative relationship with instructional computer use.

4.4 Teachers' Computer training

Armstrong [1996] reports that training influences teachers to adopt technology. Torkzadeh and Koufterous [1994] support the position by saying that proper computer training increases computer use. Office of Technology Assessment [1995] supports the observation by saying that teachers who receive proper computer training are inclined to use it in classroom instruction. The researcher was therefore interested to ascertain the level of pre-primary and lower primary school teachers' computer training and <Table 7> presents the results.

〈Table 7〉 Overall Mean Scores in Computer Training by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-school	198	1	5	2.42
Lower Primary	198	1	5	2.54

<Table 7> shows that the overall mean scores in computer training for pre-primary school teachers was below average, while that of lower primary school teachers was average. The results indicate that both teachers' computer training was inadequate. Some of the reasons why the teachers' computer training was inadequate were: Lack of training opportunities, lack of access to computers, lack of pedagogical training, and computer training was not part of their initial teacher training. The results agree with Farrel [2007] who reported in a study on ICT education in Kenya that many teachers still choose not to use ICT in teaching because they lacked ICT skills.

To understand the influence of the teachers' computer training on computer technology usage in teaching, regression analysis was done and results are presented in <Table 8>.

〈Table 8〉 Regression Coefficients for Computer Training by school level

School Level	Beta Coefficients	t	Sig.
Pre-primary	-.162	-.79	.425
Lower primary	.097	.47	.641

Independent Variable: Computer training.
Dependent Variable: Instructional computer use.

<Table 8> shows that the regression coefficient (B coefficient) for pre-primary school teachers' computer training was -.162 with .425 p-value, while that of lower primary school teachers was .097 with .641 p-value. The results disclose that the contributions of both pre-primary and lower primary school teachers' computer training to instructional computer use were not significant at 0.05 [2007].

The findings are in agreement with Olivier [1993] who discloses that many teacher education courses were graduating teachers with general computer skills which do not translate into integration of computers in teaching and teachers who had general computer training were not different in their computer use from those without formal computer training. Results from the present study confirm Olivier's findings that we are graduating teachers with general computer skills which do not promote computer technology usage in teaching-learning. Experts in technology recommend that instructional computer skills related to different subjects in different levels of education should be emphasized and developed during teachers' initial training [Office of Technology Assessment, 1995].

4.5 Teachers' Computer Self-efficacy

Torkzadeh and Koufterous [1994] assert that proper computer training increase computer self-efficacy. To establish pre-primary and lower primary school teachers' computer self-efficacy, the teachers' were asked to rate their computer self-efficacy for eight different content areas and <Table 9> presents overall means scores.

〈Table 9〉 Overall Mean Scores in Computer Self-efficacy by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-primary school	198	1	5	2.40
Lower Primary	198	1	5	2.49

<Table 9> shows that the overall mean scores in computer self-efficacy for pre-primary school teachers was 2.40, while that of lower primary school teachers was 2.49. The results point out that both pre-primary and lower primary school teachers' computer-efficacy were very low. The results also reveal that majority of the teachers believed that they were not capable of using computer technology in teaching-learning because they were not trained on how to use computers in instruction. Close examination of the results also revealed that teachers with high computer self-efficacy were using computers in teaching while those with low computer self-efficacy were not using computers in instruction.

The mean scores were further subjected to regression analysis to find out the contributions of computer self-efficacy to computer technology usage in teaching-learning. The results have been presented in <Table 10>.

<Table 10> shows that the regression coefficient of pre-primary school teachers' computer self-efficacy was .974 with .000 p-value, while that of lower primary teachers was -.170 with .306 p-value. The results reveal that the contribution of pre-primary school teachers'

computer self-efficacy was highly significant, while that of lower primary school teachers' was not significant at 0.05.

〈Table 10〉 Regression Coefficients for Computer Self-efficacy by School Level

School Level	Beta Coefficients	t	Sig.
Pre-primary	.974	5.05	.000
Lower Primary	-.170	-1.03	.306

Independent Variable: Compute Self-efficacy.
Dependent Variable: Instructional computer use.

The findings are in agreement with those that were reported by Harrison, Rainer, Hochwarter, and Thompson [1997] who revealed that increased performance with computers was related to high levels of computer self-efficacy. That is, teachers with high levels of computer self-efficacy were using computers in teaching while those with low levels of computer self-efficacy were not using computers in teaching. This is also supported by Albion [1996] who identified lack of confidence for teaching with computers as a factor which was hindering the use of computers in teaching. A study by Honey and Moeller [1990] further reveals that the teachers who believed that they were able to successfully use computers in teaching were successful in using computers in teaching. Another study by Ellen [1987] had established that teachers with high levels of self-efficacy were willing to adopt new technology in their classroom instruction.

4.6 Time Support

Teachers require enough time to learn to use and plan to use technology in teaching-learning. Office of Technology Assessment [1995] observes that with teachers who already have too many things to accomplish in a school day, time may limit the use of computer technology. Nantz and Lundgren [1998] report that it takes time for teachers to learn to use computer technology. Sammons [1994] supports the observation by saying that lack of time to learn about computers, plan for computer instruction and use computers in instruction is a major deterrent to the adoption of computers.

The researcher was as a result interested to find out whether pre-primary and lower primary school teachers were provided adequate time to learn and use computer technology in teaching-learning and the results have been presented in <Table 11>.

〈Table 11〉 Overall Mean Scores in Time Support by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-school	198	1	4	1.58
Lower Primary	198	1	4	1.58

<Table 11> shows that the overall mean scores in time support received by both pre-primary and lower primary school teachers was the same and below average. The results indicate that time support provided to both the teachers were inadequate. Some of the reasons why time was not adequate were: Wide syllabus, and teachers were overloaded, that is, they were teaching too many lessons a week. To confirm the validity and reliability of the information pro-

vided by teachers, head teachers were interviewed and results also confirmed that time support was inadequate to promote the use of computer technology in teaching-learning.

The descriptive results were further subjected to regression analysis to establish the contributions of pre-primary and lower primary school teachers' time support to instructional computer use. <Table> 12 presents the results.

〈Table 12〉 Regression Coefficients for Time Support by School level

School Level	Beta Coefficients	t	Sig.
Pre-primary	-.332	-5.64	.000
Lower primary	.186	3.15	.002

Independent Variable: Time support.
Dependent Variable: Instructional computer use.

<Table 12> shows that the regression coefficients of pre-primary school teachers time support was -.332 with .000 p-value, while that of lower primary teachers was .186 with .002 p-value. The results show that in both pre-primary and lower primary schools, the contributions of time support to computer technology usage in teaching-learning was highly significant at 0.05 even though time support was inadequate.

The findings are consistent with those that were reported by Sammons [1994] who identified lack of time to teach with computers as a factor which was hindering the use of computers in teaching. Similarly, teachers who use computers in teaching are provided adequate time support [Hadley and Sheingold, 1993; Becker, 1994]. Instructional computer use was directly influenced by time support [Office of Technology Assessment, 1995; Sammons, 1994]. Therefore, school managers and head teachers should provide adequate time for teachers to plan and use computer technology in teaching-learning.

4.7 Technical Support

Not only do teachers require adequate time to use computer technology in teaching-learning, but they also require adequate technical support. Bialo [1980] reports that the availability of technical support contributes to effective computer use. Office of Technology Assessment [1995] adds that successful technology implementation includes providing not just the technology but also support in integrating technology into the curriculum and should include support in teaching with new teaching methods. Bialo and Sivin [1980] observes that a learning environment supporting exemplary computer using educators within the same school, applying computers to many different uses, support in the form of staff development, and a full time coordinator leads to effective computer use. The teachers, who receive technical support while using computers, teach with computers while those who do not receive technical support do not teach with computers. This is because fear of failure while using computers discourages teachers from using technology [Nantz and Lundgren, 1998].

To establish whether pre-primary and lower primary school teachers were provided adequate technical support, the teachers were asked to rate the technical support they were provided in their schools. <Table 13> presents the results.

〈Table 13〉 Overall Mean Scores in Technical Support by School Level

School Level	No. of Teachers	Min	Max	Mean
Pre-school	198	1	5	1.55
Lower Primary	198	1	5	1.52

<Table 13> above shows that the overall mean scores for pre-primary and lower primary school teachers' technical support were below average (2.5). The results reveals that technical support provided to both pre-primary and lower primary school teachers was inadequate. Head teachers were also asked whether they provided qualified personnel to help teachers when using computer technology in teaching-leaning and the majority of them had reported that they did not.

Further analysis was done using regression analysis to determine the contribution of pre-primary and lower primary school teachers' technical support to computer technology usage in teaching-learning. The results have been presented in <Table 14>.

〈Table 14〉 Regression Coefficients for Technical Support by School Level

School Level	Beta Coefficients	t	Sig.
Pre-primary	.481	9.83	.000
Lower primary	.300	6.21	.000

Independent Variable: Technical support.
Dependent Variable: Instructional computer use.

<Table 14> shows that the regression coefficients for pre-primary school teachers time support was -.481 with .000 p-value, while that of lower primary school teachers was .300 with 0.000 p-value. The results imply that in both schools, technical support was a highly significant variable in computer technology usage in teaching regardless of the fact that technical support was inadequate. Examination of the results had also revealed that teachers who were provided technical support were using computer technology in teaching-learning, compared to those who were not.

The findings are in agreement with those that were reported by Office of Technology Assessment [1995] which had indicated that teachers who were provided technical support were using computers in teaching while those not provided with technical support were not using computers in teaching. Institutional commitment in the form of financial support, infrastructure, and support personnel is essential for the use of instructional technology [Albright, 1996]. Results from a worldwide educational assessment on obstacles to integration of ICT in education had revealed that without technical support in the classroom, teachers cannot be expected to overcome barriers preventing them from using ICTs [Pelgrum, 2001]. Bingimlas [2009] also adds that technical faults discourage teachers from using ICT in instruction due to fear of equipment breaking down during a lesson.

4.8 Prediction of Instructional Computer Use with all the Independent Variables Combined

To determine whether the six independent variables together predicted pre-primary and lower primary school teachers' instructional

computer use, the data was subjected to regression analysis in order to respond to the hypothesis;

$H_0$2: The six independent variables (attitudes towards computers, computer knowledge, computer training, computer self-efficacy, time support, and technical support) together have no significant predictive value for determining pre-primary and lower primary school teachers' instructional computer use at .05 level of significance.

Before computing the combined influence, ANOVA was used to determine the significance of the variations among the independent variables and the ANOVA results have been presented in <Table 15>.

〈Table 15〉 Significance of the Variations Among the Independent Variables by School Level (ANOVA)

School Level	df	Mean Square	F	Sig.
Pre-primary school	6	22.37	230.25	.000
	154	.097		
	160			
Lower Primary	6	19.17	157.67	.000
	143	.12		
	149			

Predictors (independent variables): Technical support, Attitude towards computers, Time support, Computer self-efficacy, Computer knowledge, Computer training.

<Table 15> shows that in pre-primary school level, the F statistic was 230.25 with a p-value of 0.000, while in lower primary level; the F statistic was 157.67 with a p-value of .000. The results imply that there were significant variations among the independent variables in both pre-primary and lower primary schools. Multiple Regression analysis was then used to determine whether the variables together predicted the teachers' computer technology usage in teaching-learning and the results have been presented in <Table 16>.

〈Table 16〉 Prediction of Instructional Computer Use with all the Independent Variables Put Together by School Level

School Level	Change Statistics				
	R Square Change	F Change	df1	df2	Sig. F Change
Pre-school	.900	230.25	6	154	.000
Lower Primary	.869	157.67	6	143	.000

Predictors: Technical support, Attitude towards computers, Time support, Computer self efficacy, Computer knowledge, Computer training

<Table 16> shows that R squares for the equations were .900 for pre-primary school and .869 for lower primary schools, meaning that 90% and 87% of the variations in instructional computer use were accounted for by the variables. The model for pre-primary schools fits at 99% where F statistic is 230.25 with a p-value of 0.000, while the model for lower primary schools also fits at 99% where F statistic is 157.67 with a p value of 0.000. The results imply that the models were perfect and the independent variables combined predicted pre-primary and lower primary school teachers' instructional computer use. The null hypothesis which stated that: *The six independent varia-*

bles together have no significant predictive value for determining pre-primary and lower primary school teachers' instructional computer use at .05 level of significance was therefore rejected.

5. Findings of the Study

Computer technology usage in both pre-primary and lower primary schools was minimal. The difference between pre-primary school and lower primary school teachers' computer technology usage in teaching-learning was also not significant. The schools were using computer technology to: Deliver school curriculum; develop computer skills; and teach other activities (reinforcing skills taught, re-mediating deficiencies, and challenging bright children).

The majority of both pre-primary and lower primary school teachers had positive attitudes towards computer technology. The contribution of pre-primary school teachers' attitudes towards computer technology usage in teaching-learning was significant, while that of lower primary school teachers' was not significant.

Computer knowledge of both pre-primary and lower primary school teachers' was inadequate. The contribution of pre-primary school teachers' computer knowledge to computer technology usage was not significant, while that of lower primary school teachers was significant.

Computer training for both pre-primary and lower primary school teachers' was inadequate and its contribution to computer technology usage in teaching-learning was not significant. The contribution of pre-primary school teachers' computer self-efficacy to computer technology usage was significant, while that of lower primary school teachers' was not significant at 0.05.

Time support provided in both pre-primary and lower primary schools was inadequate. However, the contribution of time support to computer technology usage was highly significant in both school levels. Technical support provided in both pre-primary and lower primary schools was also inadequate but the contribution to computer technology usage was highly significant in both pre-primary and lower primary schools. Results had also revealed that the six independent variables combined predicted pre-primary and lower primary school teachers' instructional computer use meaning that they are significant factors in teachers' computer technology usage in teaching-learning.

6. Conclusion

The main objective of the study was to find out the critical factors in the integration of ICT in ECE in Kenya. Results have shown that the use of computer technology in teaching-learning by both pre-primary and lower primary schools was minimal because the key factors influencing the use ICT in teaching-learning were not catered for. The critical factors in the integration of ICT in ECE are: Accessibility to resources by teachers; capacity to use computer technology; availability of adequate time support for teachers to learn and to use computer technology in teaching-learning; and provision of adequate technical support to help teachers and children while using the technology.

7. Recommendations

Some of the recommendations for the key stakeholders are:

(ⅰ) The Ministry of Education, Science and Technology should: (1) Review teachers' work load. This is because time support cannot be addressed without reviewing teachers' work load. During the data collection stage, the researcher had noted that primary school teachers were having too many lessons a week and working for a minimum of eight hours a day. (2) The ministry should also facilitate the development of training programmes and provision of in-service training programmes to increase teachers' ICT pedagogical skills. The training programmes should emphasize on the development of pedagogical skills and not just to make teachers technology literate. (3) The ministry should also employ exemplary ICT teachers in pre-primary and primary schools to provide enactive experience. (4) The ministry should provide ICT resources to pre-primary and primary schools. (5) The Ministry should also establish computer assembling and repair centres to assemble new computers. The new computers will have long life span, low maintenance costs, and spare parts for the computers would be easily available in the market. Assembling of computers will also save our country from being a dumping ground for obsolete computers.

(ⅱ) KICD and DICECEs should provide in-service training programmes to increase teachers' ICT pedagogical skills. The institute should also improve the existing in-service teacher training programme to include ICT pedagogical skills.

(ⅲ) Universities should develop ICT training programmes and provide in-service training programmes to increase teachers' ICT pedagogical skills. They should also establish computer assembling centres to assemble new computers to meet the ever increasing demand of computers.

(ⅳ) School managers should: Provide access to ICT so that teachers can learn and practice with ICT; provide time support for teachers to learn how to use the technologies; provide technical support to help teachers and children while using ICT; sponsor teachers to attend in-service training programmes to learn how to use ICT to deliver school curriculum; appreciate and cater for the factors that influence the use of computer technology in teaching-learning.

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