



MATHEMATICS TEACHERS' KNOWLEDGE AND SKILLS FOR ICT INTEGRATION IN INSTRUCTION IN SECONDARY SCHOOLS IN BUNGOMA COUNTY, KENYA

Moses Mukenya¹ⁱ,

Wanjala Martin²,

Beatrice Shikuku²

¹Master of Education Student,

Department of Science and Mathematics Education,

Masinde Muliro University of Science and Technology,

Kenya

²Dr., Lecturers,

Department of Science and Mathematics Education,

Masinde Muliro University of Science and Technology,

Kenya

Abstract:

The main problem facing mathematics instruction generally is the need to improve performance of students through use of innovative approaches that involve technology. Despite the advancements in technology, the utilization of computers and other ICTs materials is not an integral part of the curriculum. The study reported in this paper investigated the teacher's knowledge and skills for use of Information Communication Technology in mathematics instruction. The study focused on determining the knowledge and skills needed for instructional use of ICTs in mathematics. The descriptive survey research design was adopted and involved secondary school mathematics teachers in the three Sub-Counties of Bungoma County: Kimilili, Bungoma North and Bungoma East. A sample of 218 teachers and heads of departments were selected using proportionate stratified and simple random sampling techniques. Data was collected using questionnaires and interview schedule. A pilot study was conducted and the data used to validate the instruments and compute the Cronbach's alpha reliability measure which was found as 0.704 for the instrument. Data analysis involved descriptive statistics that included frequencies and percentages, means and standard deviations while the inferential statistics included the independent samples t-test. The findings indicated a lack of the necessary knowledge and skills for use of ICTs among teachers. Therefore the ministry of education should formulate policies that aim at ensuring professional development of teachers in ICT pedagogy and a review of

ⁱ Correspondence: email msibweche@yahoo.com

curriculum to ensure teachers acquire relevant ICT knowledge and skills during initial training.

Keywords: information communication technology, knowledge, skills, instruction

1. Introduction

Mathematics subject is regarded as a very important subject and plays several roles in the society. Governments around the world recognize the importance of mathematics for national development and its usefulness has been noted in relation to science, technology, economics, education and even humanities (Tella, 2008). Numerical competency of learners in early years has been shown to affect their future academic achievement mastery of other subjects (Oketch et al., 2010). In Kenya, mathematics subject is required to join courses such as engineering medical and health sciences courses, accounting, finance, human resource, banking etc (University of Nairobi, 2008). Mathematics forms an essential prerequisite for joining tertiary colleges and universities, useful for self-employment and in professions such as engineering and accounting and therefore it is important because of its social, utilitarian and communication roles in the society (Ishenyi, 2015; Hughes, 2005; Macau, 2000). Research findings are represented both in numerical and graphical forms then analyzed and decisions made based on the findings. Mathematics has aesthetic role in the society as reflected in the beauties generated from architectural and engineering designs, for instance the beautiful houses, cars and other models. Mathematics has a social role too as reflected in the teaching of intervals, sequences and series which are applied in social life, for instance, rhythms in the music world and in a variety of entertainments. Concepts such as diagonals, course and tracks are well applied in games such as soccer, basketball, hockey and swimming among many other games. Besides the roles of Mathematics in society, the world view depicts instructional weaknesses in the subject in learning institutions (European Mathematical Society, 2012).

As noted by Yusuf (2005), ICTs have affected the education field especially in classroom instruction and research. The quality of education has been noted to improve as the use of ICTs especially computers have proven potentials in innovations, accelerating, enriching and deepening skills motivation and engagement of students, school experiences related to work practices, developing economic viability for future work related skills and strengthening teaching and learning activities in schools (Al-Ansari, 2006; Jhurree, 2005; Yusuf, 2005). The 21st century has witnessed remarkable changes as a result of growth in ICTs that have constituted demands in the modern society. The importance of ICTs has been noted in the education system and our daily lives especially in knowledge and skills dissemination and which has had positive impacts on the economy in society (Andoh, 2012; Kipsoi, Chang'ach & Sang, 2012). This has resulted in numerous efforts to enhance the teachers' competencies and self confidence in the use of ICTs in instruction by initiatives to ensure acquisition of the

necessary infrastructure and resources for preparation of teachers. Guided by the Kenya's Vision 2030, the government has put in place the National ICT Policy and E-Government with aims to produce an ICT literate workforce with the necessary ICT knowledge and skills that will enhance a knowledge base for a dynamic and sustainable economic growth.

The emergence of new technologies such as computers in addition to other technologies such as radio and telephone has improved the practice of education (Farrell, 2007). The adoption and use of ICTs has been identified to proceed through emerging, applying, infusing and transforming stages of ICT development (Senapaty, H. K. 2004; UNESCO, 2005). The TPCK framework has been developed that explains how teacher's understanding of technology, pedagogy, and content knowledge can interact for specific subject areas instruction using technology (Koehler & Mishra, 2008; Mishra & Koehler, 2006). However as noted by Senapaty, the challenge is in implementing pedagogy-technology integration in mathematics instruction despite concerted efforts for use of ICTs in education worldwide (Senapaty, H. K. 2004). For improved learning, ICTs must be infused in pedagogy as they have the potential to enhance the quality of teaching and learning, research productivity and effectiveness in management of institutions (Kashorda et al., 2007). ICTs thus provide tools for learning, enhance accessibility to other areas of curriculum and administration and generally in teaching.

The roles of computer in classroom instruction in mathematics has been highlighted in many empirical studies (Mubichakani, 2012; Wanjala, 2005). The integration of ICTs in mathematics curriculum is emphasized because of the effectiveness of the technologies in instruction. However, its use in instruction has proved to be slow and difficult owing to the teacher's unpreparedness and attitudes. There have been efforts to enhance use of ICTs by teachers as findings reported by researchers have shown that there is increasing knowledge of and familiarity with technology among teachers and that there is infrastructural support to it though teachers are still not using these tools in instruction (Foley and Ojeda, 2007). According to Li (2007), teachers are not using these technologies because of fear of their replacement in the school system. The ineffective integration of technology is attributed to the lack of adequate knowledge and skills that is attributed to a lack of sufficient training (Jamieson-Proctor & Finger, 2008). There exists the lack of professional development in use of ICTs in instruction by mathematics teachers and several authors have suggested remedies to this. There has been emphasis on on-going professional development (Wells, 2007 and Sprague, 2007); courses in formal training in technology (Swan and Dixon, 2006); software packages training (Toumasis, 2006); instructional strategies and training in software use (Sorkin et al., 2004); and mathematics lesson planning in integrating technology (Hardy, 2004).

Other studies have been conducted worldwide particularly in developed nations on integration of ICT in Mathematics instruction with more emphasis on teacher related factors such as teacher training and attitude (Hennessy et al., 2010; Wanjala et al., 2012). In Kenya, the initial teacher training has been identified as one that does not offer student-teachers the experiences they need to become competent in integrating information and

communication technology in their teaching. The Government of Kenya has attempted to invest heavily to improve the quality of instruction through ICTs but there has been minimal improvement. The uptake of ICT tools has been slow and difficult probably owing to some bottlenecks related to classroom instruction. The study reported in this paper sought to investigate teachers' preparedness in knowledge and skills for ICT integration in mathematics instruction in secondary schools.

2. Purpose and Objectives of the Study

To investigate the teacher preparedness in use of ICTs in Mathematics instruction. Specifically, the study purported to :

- To determine the type of knowledge and skills needed by teachers to enable them use the ICTs in mathematics instruction.
Answers were sought to the following question;
- What types of knowledge and ICTs skills are needed by mathematics teachers to enable them use ICTs in mathematics instruction?

3. Methodology

The descriptive survey research design was adopted in this study and involved collection of both quantitative and qualitative data to test hypothesis or to answer questions concerning the status of the subject of study (Ader, Van Marwik, Deltaan, and Beekman, 2008). This study was carried out in the Western Region of the Republic of Kenya and involved teachers in the secondary schools in Kimilili, Bungoma North and Bungoma East sub-counties of Bungoma County. This county was chosen because of the need to improve mathematics instruction using ICTs in the various categories of secondary schools in the region. The study involved 218 Secondary School mathematics teachers in the 133 secondary schools in the three sub-counties selected using proportionate stratified sampling based on various characteristics such as level of experience, level of education, gender, age, and even type/nature of school they taught. Mathematics Teachers' Questionnaire (MTQ), Principals' Questionnaire (PQ), Interview and Observation schedules were used in data collection. Piloting of the instruments was done in selected schools from the same region and the instruments were validated using expert's help from the department of Science and Mathematics Education.

The Cronbach's Alpha was computed for the test of reliability of the questionnaire and the findings indicated a computed value of 0.704 which was deemed a good indication that the research instrument was reliable. Data collection involved distribution of research instruments to the teachers in the selected schools for the research. The researcher conducted face to face interviews with the teachers and heads of departments for in depth information and understanding of the issues surrounding the use of ICTs in mathematics instruction as dictated by teacher preparedness in knowledge and skills. Observations were done to collect the necessary data for understanding ICTs availability

and the utilization of these tools in the actual mathematics teaching and learning process. Data analysis involved both descriptive and inferential statistics including computation of frequencies, percentages, means and standard deviations while the inferential statistics included the independent samples t-test which were used to make interpretations and recommendations from the descriptions and relationship between the variables teacher's knowledge and skills and ICTs uptake and integration into mathematics teaching and learning process.

4. Findings

The descriptive characteristics' results for the distribution of respondents based on gender, age bracket, education level and work experience are presented in frequencies and percentages as in Table 1.

Table 1: Teachers Demographic Characteristics

Teachers Data		f	%
Gender	Males	136	62%
	Females	82	38%
Age Bracket	Below 25 years	13	6%
	25-35 years	34	16%
	36-45 years	131	60%
	Above 45 years	40	18%
Level of Education	College	21	10%
	Dip. Ed/ SI	27	12%
	Graduate	150	69%
	Post Graduate (MED/ MSc. PhD)	20	9%
Position/Responsibility	Classroom Teacher	135	62%
	Head of Department	61	28%
	Deputy Head Teacher	15	7%
	head Teacher	7	3%
Work Experience in years	Less than 2	25	11.5%
	2-3	25	11.5%
	4-5	114	52%
	Above 5 years	54	25%

As indicated Table 1, it is observed that out of the 218 mathematics teachers, 136 (62%) and 82 (38%) were males and females respectively. This was an indication that there were many male teachers as opposed to females of the same cadre. It is also noted that 13 (6%) of the teachers were aged below 25 years, 34 (16%) were aged between 25-35 years, 131(60%) were aged between 36-45 years, and 40 (18%) of the teachers were aged above 45 years. From the results, it is evident that most of the teachers of mathematics in the schools that participated in the study were aged above 36 years. There was need to establish their highest academic qualification and as indicated, 21 (10%) had acquired college certificate qualification, 27 (12%) had acquired Diploma in Education/S1 qualifications, 150 (69%) most teachers were graduates, while 20 (9%) had postgraduate

qualifications. The results show that in the schools that participated in the study, most of the mathematics teachers were graduates or had post graduate qualifications and thus deemed well prepared as teachers of mathematics at this level of education. It was necessary to ascertain the responsibilities that the teachers had in their schools and as indicated, 135 (62%) of the teachers were just classroom teachers, 61(28%) were heads of departments, 15 (7%) were Deputy Head teachers while 7 (3%) were Head teachers respectively. The results show that most of the teachers who took part in this study were just classroom teachers and had the crucial role of ensuring effective teaching and learning of mathematics. There was also need to ascertain the teaching experience of the mathematics teachers who participated in the study and as indicated, 25 (11.5%) had an experience of less than 2 years and 2-3 years respectively, 114 (52%) of the teachers indicated to have an experience of between 4-5 years as 54 (25%) indicated to have an experience of more than 5 years. The results show that of the teachers who participated in the study, a majority had an experience of 4 years and above and thus were deemed appropriate for the reported study.

4.1 Findings According to the Objectives of the Study

The purpose of this study was to establish teacher preparedness in knowledge and skills and its influence on the integration of ICTs in mathematics instruction. The objective of this study was as follows:

- To determine the type of knowledge and skills required for teacher use of ICTs in teaching and learning of mathematics.
The research sought to answer the following question:
- What is the type of knowledge and skills required for teacher use of ICTs in teaching and learning of mathematics?

4.1.1 Type of Knowledge and Skills for Integration of ICTS in Mathematics

To ascertain the type of knowledge and skills required by teachers for effective utilization of ICTs in mathematics instruction answers were sought from the teachers and findings are as indicated in the following sections.

4.1.1.1 Type of ICT Knowledge and Skills

The teachers' rating of their basic ICTs knowledge and skills operations which involve use of computers and other ICT materials in instruction are as indicated in Table 2.

Table 2: Type of ICT knowledge and Skills

		Highly Adequate	Adequate	Inadequate	Highly Inadequate	Not Available
1	Start and shut a computer	52 (24%)	26 (12%)	68 (31%)	0	72 (33%)
2	Use internet	54 (18%)	18 (15%)	68 (31%)	6 (3%)	72 (33%)
3	Use word processor	0	0	26 (12%)	52 (24%)	139 (64%)
4	Use spread sheets	0	0	26 (12%)	40 (18%)	152 (70%)
5	Use database applications	0	6 (3%)	26 (12%)	(25%)	152 (70%)
6	Use presentations applications	0	0	33 (15%)	33 (15%)	152 (70%)
7	Teach basic computing algorithms	0	0	25 (11%)	30 (14%)	163 (75%)
8	Use mathematics software	0	0	33 (15%)	22 (10%)	163 (75%)
9	Prepare ICT content materials	0	0	44 (25%),	33 (15%)	152 (70%)
10	Use ICT devises	0	0	33 (15%)	44 (25%)	141 (65%)

The responses on the mathematics teacher's knowledge and skills of use of ICTs in instruction were based on the knowledge of how to put a computer on and off, internet use, use of Microsoft processor in word, spreadsheets, data base application, presentations applications and ICT content material. The results show that on how to start and shut a computer, highly adequate was noted by 52 (24%), adequate by 26 (12%), inadequate by 68 (31%), highly inadequate by none as a majority 72 (33%) of the respondents noted the unavailability of computer tools. On knowledge of how to use the internet highly adequate was noted by 54 (18%), adequate by 33 (15%), inadequate by 68 (31%), highly inadequate by 6 (3%) as a majority 72 (33%) of the teachers indicated that the computers are not available. The use of word processor was not rated highly adequate or adequate but inadequate by 26 (12%), highly inadequate by 52 (24%) as a majority 139 (64%) of the teachers indicated not available. The use of spreadsheets was not rated highly adequate or adequate but inadequate by 26 (12%), highly inadequate by 54 (18%) as a majority 152 (70%) of the teachers of mathematics noted that computers were not available. The use of data base application was not rated highly adequate but adequate by 6 (3%), inadequate by 26 (12%), highly inadequate by 33 (15%) as a majority 152 (70%) of the teachers indicated that the computers are not available. The use of presentations applications was not rated highly adequate or adequate but inadequate and highly inadequate by 33 (15%) as a majority 152 (70%) of the teachers indicated that the computers are not available.

The teachers ability to teach basic computing algorithms was rated inadequate and highly inadequate by 25 (11%) and 30 (14 %) respectively as a majority of the teachers 163 (75%) noted not available. Asked about the knowledge and skills about use of instructional programmes in mathematics such as Geogebra, sketchpad of Geometer, Graphmatica, SPSS, STATA among others, inadequate and highly inadequate were noted by 33 (15%) and 22 (10%) respectively as unavailability of these software in their schools was noted by 163 (75%) most of the teachers. The knowledge of preparation and use of ICT content material was not rated adequate but inadequate by 33 (15%), highly inadequate by 44 (25%) as (70%) most of the teachers indicated that the computers are not available. Asked about the use of the ICT devices in instructional activities, highly inadequate and inadequate were noted by 44 (25%) and 22 (10%) of the teachers respectively as unavailability was noted by 141 (65%) most of the teachers. The results reveal that most of the teachers in the schools indicated that computers, projectors, instructional software and other ICT materials and equipments are not available and in the schools with these ICT facilities and materials, the use was inadequate or highly inadequate.

The teachers' opinions on the rating of their ability in knowledge of preparation and use of the ICT resources in instruction is as indicated in Table 3.

Table 3: Knowledge and Skills Level for Use of ICT Resources

How do you rate	Highly Adequate		Adequate		Inadequate		Highly Inadequate		Not Available	
	F	%	F	%	F	%	F	%	F	%
	Levels of personal ICT skills	0		13 (6%)		91 (42%)		114 (52%)		0
Quality of training in ICT use	0		0		21 (10%)		77 (35%)		120 (55%)	
Levels of technical support	0		10 (5%)		21 (10%)		65 (30%)		120 (55%)	
Preparation and use of ICT content material	0		0		55 (25%)		65 (30%)		98 (45%)	
Maintenance of ICT equipment	10 (5%)		22 (10%)		55 (25%)		76 (35%)		55 (25%)	

Answers were sought on the teachers' rating of their levels of skills in ICTs for personal use, support in terms of technical expertise, the quality of ICTs use training, preparation of ICT content material and maintenance of ICT equipment. The results show that the level of teacher's personal skills was rated adequate by only 13 (6%) and inadequate and highly inadequate by 91 (42%) and 114 (52%) respectively most of the respondents in the schools. Quality of training for teacher use of ICTs was rated inadequate by 21 (10%) and highly inadequate by 77 (35%) as 120 (55%) most of the teachers indicated that it is not available. The level of technical support was rated adequate by only 10 (5%), inadequate by 21 (10%), highly inadequate by 65 (30%) and 120 (55%) most of the teachers indicated not available. The preparation and use of ICT content material was rated inadequate by

55 (25%), highly inadequate by 65 (30%) and not available by 120 (45%) most of the respondents. As shown in the results, ICT equipments maintenance was rated highly adequate and adequate by 10 (5%) and 22 (10%) of the teachers respectively, inadequate by 55 (25%) and highly inadequate by 76 (35%) most of the teachers as 55 (25%) of the teachers indicated not available.

5. Discussion of Findings

As noted in the findings of this study, those teachers who indicated to have undergone training in Information Communication and Technology acknowledged that the knowledge and skills acquired assisted them in the integration of ICTs in instruction. Most of the teachers indicated awareness of need for ICT knowledge and skills though they indicated to have not had ICT training and for those who have trained they indicated to only have basic computer application skills at the certificate level that could not help them to competently use these technologies in instruction. In most of the schools, it was only the use of internet that was noted high by the teachers and this could be attributed to the personal use of internet for communication and search of new material and information and not instruction. The results show that in most of the schools, it was only the use of internet and ICT content material preparation applications that were noted high but with very few teachers and this could be attributed to the personal use of internet for communication and search of new material and information and not instruction.

The results show that the use of ICTs in preparation of schemes of work, instructional materials, student's progress records, instruction in class and in preparation of student's records was noted to a large extent by some of the teachers but in all the applications most of the respondents indicated none. Results generally show limited integration of ICTs materials in the teaching and learning of mathematics. The levels of skills in personal ICT use, support in technical expertise, training quality in ICTs use, preparation and use of ICT content material and maintenance of ICT equipment were rated inadequate and not available by most of the teachers in the schools that took part in this study. The implication of this is that the mathematics teachers in most of these schools don't use the ICT materials in instruction which is pointed at lack of initial training in college and university that leaves them without the required knowledge and skills. From the findings, teachers require to be trained in pedagogical skills, more so in selecting the relevant software and how to integrate the same in instruction. The findings are in agreement with other researchers who also point out that teachers require assistance in how ICTs can be well applied and utilized to realize the educational objectives and how to organize learner friendly classroom environment (Mwelese, Wanjala, Simiyu & Amadalo, 2016).

Based on the results presented, most of the teachers acknowledged the fact that teacher of mathematics needed to possess the knowledge and skills in ICT that would help them prepare to teach effectively and improve performance. Notably, skills that enable them use the internet for research in order to enhance and share knowledge, they

needed to have basic computing skills, skills for use of various ICT devices, skills for repairing and maintenance devices and skills to integrate ICT technology in instruction.

6. Conclusion

The study reported in this paper explored the influence of teacher preparedness in knowledge and skills for use of Information Communication Technologies in mathematics instruction. The Information Communication Technology (ICTs) full potential can only be realized if the role of ICTs in education is defined, all education stakeholders at all levels are involved in identifying the challenges facing them and the need for adequate teacher preparedness and planning for effective utilization of these tools classroom instruction. With the teacher realization of the benefits of ICTs in mathematics instruction, the many factors militating against ICTs use will not be a hindrance to their putting in practice the use of ICTs tools in the classroom. The bottlenecks to the teacher use of ICTs in instruction are many and their impact is both on personal and professional level. Therefore for actualization of ICTs use in instruction, there is need for development of teacher's in terms of technological, pedagogical and content knowledge and skills in ICTs.

The study findings bring to the need for continuous professional development with focus on helping teachers to acquire the necessary knowledge and skills for integration of ICTs in the mathematics instruction. The focus of the in-service training should be on teacher acquisition of the necessary knowledge and skills for preparation of instruction content specific software and actual utilization of these technologies and not just computer application skills. For better use of ICTs in instruction, there is need to focus on the teachers understanding of the effectiveness of ICTs in pedagogy and enhanced accomplishment of the objectives of education. As established in the study reported in this paper, the adoption and use of any new innovation such as information communication technology in instruction is pegged on the acquisition of the necessary knowledge and skills and through opportunities for continuous professional development. It is thus envisaged that the current study has enhanced realization of the need for continuous development of teachers professionally for the acquisition of the necessary knowledge and skills for adoption and use of ICTs generally and in mathematics instruction.

7. Recommendations

There is need for provision of continuous professional learning opportunities to teachers enhance their capability for full utilization of the opportunities availed by the information communication technologies in instruction, especially how to exploit the ICTs in supporting instructional practices. Teachers need to be equipped with the necessary technological, pedagogical and content knowledge and skills for the adoption and use of the ICTs during their pre-service courses in the institutions of training and higher

learning. There is need for formulation of appropriate government policies through the Ministry of Education for initiatives that ensure mathematics teachers who complete their studies undertake and complete in-service training such as SMASSE in-service training to enhance their ability to use ICTs in instruction. The teacher training curriculum should be reviewed in such a way that teacher trainees undertake a comprehensive and hands-on training where they gain knowledge and experience pedagogical uses of ICTs in instructional practices.

There is also need for sufficient time for development of relevant skills for teacher's to be able to exploit available opportunities for effective instruction in the current mathematics curriculum and do more preparation for lessons planning and execution using the ICTs tools. There is therefore need for concerted efforts by teachers to be innovative in improvising and designing relevant instructional software materials for classroom use.

The uptake of ICTs generally in curriculum areas and instructional practices in particular requires support from the stakeholders including managers of schools and the community at large. Prioritization of teachers' accessibility to training in ICTs knowledge and skills through professional development, quality digital content development in mathematics and computer infrastructure should be ensured by the Government of Kenya.

References

- Afshari, M. (2009). Factors Affecting Teachers' Use of ICT. *International Journal Instruction*, 2, *Universiti Putra: Malaysia*.
- Al-Ansari, H. (2006). Internet use by the faculty members of Kuwait University. *The Electronic Library Vol.24, No. 6, pp; 791-803*.
- Andoh A. C. (2017). Factors Influencing teachers' adoption and integration of ICT: A Review of Literature. *International Journal of Education and Development using ICT (IJEDICT)*,8, 136 -155.
- Borg, W. and Gall, J. (2007). *Educational Research: An Introduction*. Retrieved January, 13 2012, from <http://www.amazon.com/EducationalResearch-Introduction-M-all/dp/0205488498>.
- Cohen P. (2014). *Research Methods in Education*. (3rd ed.) London: Croom.
- Erb, W. (2008). *ICT in the Early Years*. Tuku Tuku Koreno, New Zealand Land Education Gazette.
- Farrell Glen (2007). *Survey of Information and Communication Technology and Education in Africa: Kenya County Report*.
- Foley, J. and Ojeda, C. (2007). How do teacher beliefs influence technology use in the classroom? *A paper presented at the Society for Information Technology and Teacher Education International Annual Conference, March 26-30, 2007, San Antonio, Texas, USA*.

- Ikeo, A. (2014). *A History of Economic Science in Japan: The Internationalization of Economics in the Twentieth Century*. New York: Routledge Publishers
- Kipsoi, E. J. et al. (2012). Challenges facing adoption of information communication technology (ICT) in educational management in schools in Kenya. *Journal of Sociological Research*.
- KNEC (2012). Syllabus and Regulations. Kenya National Examination Council, Nairobi.
- Koehler, M. J. & Mishra, P. (2009). What is Technological Pedagogical Content Knowledge? *Contemporary Issues in Technology and Teacher Education Journal*, 9(1), 60-70.
- Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy and technology. *Computers & Education*, 49(3), 740-762. doi: 10.1016/j.compedu.2005.11.012
- Kothari, C. R. (2009). *Research Methodology: Methods and Techniques*. New Delhi. Vishwa.
- Li, Q. (2007). Student and Teacher Views about Technology: A Tale of Two Cities? *Journal of Research on Technology in Education*, Eugene: Summer 2007. Vol. 39, Iss. 4: pg. 337-398.
- Mbugua S. N. (2014). *The influence of integration of information communication technology in teaching on students' academic performance in secondary schools in Nakuru County, Kenya*. Unpublished PhD thesis, Maasai Mara University, Narok, Kenya.
- Mishra, P., & Koehler, M. (2007). *Technological pedagogical content knowledge (TPCK): Confronting the wicked problems of teaching with technology*. In C. Crawford et al. (Eds.), *Proceedings of Society for Information Technology and Teacher Education International Conference 2007* (pp. 2214-2226). Chesapeake, VA: Association for the Advancement of Computing in Education.
- Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, 108 (6), 1017-1054.
- Mubichakani, J. M., (2012). *Effect of Computer Based Learning in Mathematics on Learners Motivation and Achievement Level in Relation to Gender in Bungoma North District, Kenya*. Unpublished M. Phil Thesis, Moi University.
- Olakulehin, F. K. (2007). Information and communication technologies in teacher training and professional development in Nigeria. *Turkish Online Journal of Distance Education*, vol. 8, no. 1, pp. 133-142.
- Orodho, A. J. and Kombo, D. K. (2002). *Research Methods*. Nairobi: Kenyatta University, Institute of Open Learning.
- Polit D. F. & Beck C. T. (2010). *Essentials of Nursing Research: Appraising Evidence for Nursing Practice*, 7th edn. Wolters Kluwer Health / Lippincott Williams & Wilkins, Philadelphia.
- Republic of Kenya (2005). *Sessional Paper No. 1 of 2005, A Policy Framework for Education, Training and Research*, Nairobi Government Printing Press.

- Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press. *Journal of Information Technology in Teacher Education*, 5, 3, 253–270.
- Senapaty, H. K. (2004). Integrating Digital Technology into Constructivist Learning Environment. Paper presented in the International Conference held at Saurashtra University, Rajkot, Gujarat, India.
- Senapaty, H. K. (2005). *Teachers Education in a new Paradigm of ICT Integrated Constructivists Learning*. Regional Institute of Education. NCERT. Shyamla Hills, Bhopal.
- UNESCO (2002). *UNESCO Report: Information and Communication Technologies in Teacher Education, A Planning Guide*, Division of Higher Education, UNESCO.
- UNESCO (2009). *ICT Competency Standards for Teachers: Policy Framework*.
- Venkatesh, V. (2000), Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, Vol. 11, pp. 342-65.
- Wanjala M. (2016). Information Communication Technology Pedagogical Integration in Mathematics Instruction among Teachers in Secondary Schools in Kenya. *Journal of Education and Practice* Vol.7, No.2, 2016, pp 66-73
- Wanjala, M. M. S., Khaemba, E. N., & Mukwa, C. (2011). Significant factors in professional staff development for the implementation of ICT education in secondary schools: A case of schools in Bungoma District. *International Journal of Curriculum and Instruction*, 1(1), 30 – 42.
- Yilmaz, N. P. (2011). Evaluation of the technology integration process in the Turkish education System. *Cotemporary Educational Technology*, 2, 37-54.
- Yusuf, M. O. (2005). Information and communication education: Analyzing the Nigerian national policy for information technology. *International Education Journal* Vol. 6 No. (3), pp 316-321.

Creative Commons licensing terms

Author(s) will retain the copyright of their published articles agreeing that a Creative Commons Attribution 4.0 International License (CC BY 4.0) terms will be applied to their work. Under the terms of this license, no permission is required from the author(s) or publisher for members of the community to copy, distribute, transmit or adapt the article content, providing a proper, prominent and unambiguous attribution to the authors in a manner that makes clear that the materials are being reused under permission of a Creative Commons License. Views, opinions and conclusions expressed in this research article are views, opinions and conclusions of the author(s). Open Access Publishing Group and European Journal of Education Studies shall not be responsible or answerable for any loss, damage or liability caused in relation to/arising out of conflicts of interest, copyright violations and inappropriate or inaccurate use of any kind content related or integrated into the research work. All the published works are meeting the Open Access Publishing requirements and can be freely accessed, shared, modified, distributed and used in educational, commercial and non-commercial purposes under a [Creative Commons Attribution 4.0 International License \(CC BY 4.0\)](https://creativecommons.org/licenses/by/4.0/).