

Influence of Teachers' Gender on Integration of ICT in Biology Teaching in Public Secondary Schools in Kiambu County, Kenya

By

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Abstract

Information Communication Technology (ICT) is now a common phenomenon in our lives today. Use of digital devices characterizes our life. The development of this study was influenced by concern on influence of gender on the integration of ICT in biology teaching in Kiambu County, Kenya. Therefore, the purpose of this study was to investigate the influence of teachers' gender on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya. The objectives of the study were, to: determine teachers of biology gender distribution in public secondary schools in Kiambu County, Kenya; determine the influence of teacher's gender on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya. This study was anchored on Technology Pedagogy Content Knowledge (TPACK) model which provided the theoretical base for the current study. The study was guided by both qualitative and quantitative paradigms. *Ex-post facto* research design was adopted to guide the study. The target population of the study was 521 teachers of biology in Kiambu County public secondary schools. The sample size was 167 teachers of biology. The sample selected using stratified random sampling and purposive sampling methods. The researcher also used simple random sampling technique to select three teachers in schools with more than three teachers of biology. The sample size was determined by use of Krejcie and Morgan table. The data was collected by use of teachers questionnaire. Reliability was determined using the test-retest method and coefficient of 0.792 was obtained. The data obtained from the study was analysed by use of both descriptive and inferential statistics. T-test was used to test the hypotheses at significance level of .05. Statistical package for social sciences (SPSS) version 26 was utilized to analyse data. The study established that gender in public secondary schools had no statistically significant influence on integration of ICT. The study recommends that Public Secondary Schools should be empowered to deal with the challenges of managing and maintaining ICTs such as providing affordable and durable ICT spare parts, maintenance and update services. Teachers training courses should include ICT integration aspects, the teachers service commission (TSC) should employ ICT technicians at Sub-County level.

Key Words: Gender, Integration, Information Communication Technology, Teachers, Biology, Kiambu, Kenya

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Introduction

Information Communication Technology (ICT) is a general term that includes computer hardware, software and audio - visual systems which enable users to create, access, store, transmit and manipulate information (Prasad & Chakravarty, 2020). Amutha (2020) defined ICT as an umbrella that includes any communication device or application, cellular phones, computer and network hardware, software, satellite system and video conferencing facilities. Arthur-Baidoo et al. (2022) on the other hand defined ICT as tools used to transmit, store and retrieve information by users. Shengru (2018), observed that ICT are items used in day-to-day communication in order to relay messages, store and help to retrieve effectively and efficiently. Such items include computers, printers, phone, television, radio, projector and any accompanying hardware and software Shengru (2018). Therefore, ICT can be said to be a term that refers to tools used for communication to receive, store, process and retrieve information. Such tools include computers, mobile phones, internet, television, hardware and software that accompany them.

ICT use has seen tremendous growth in the recent past because of its significant impact in all areas of human endeavor including education (Arthur-Baidoo et al. 2022). According to Shengru (2018) schools have invested a lot in ICT for use in administration, teaching and assessment purposes. Das (2019) observes that integration of ICT world over reveals that ICT is not fully integrated in the teaching process and this may be due to a number of factors. According to Shengru (2018) integration of ICT in secondary schools in Malaysia has been influenced by the following factors; insufficient or obsolete hardware and software, inadequate facilities and lack of support services to the teachers. The researcher further adds that, inadequate time, gender, age of the teacher, un-appropriate reward system, lack of information about good practice and underestimation of the difficulty in adopting new information technology could also influence integration of ICT in teaching. Das (2019) observes that although so much has been done to increase the technological infrastructure in schools, institutions are far short of providing a robust and reliable technology support structure for all students and teachers. The study concluded that integration of ICT is a complex process that is influenced by a myriad of factors.

This article aimed at investigating the influence of gender on integration of ICT in biology teaching in public secondary schools in Kiambu County Kenya. One of major foundation of nation development of is its education. Therefore, if the quality of education is right, the schools will give adequate knowledge, skills, and attitudes to the students that a country needs for its citizens in order to guarantee the role of education in development. Therefore, education is a major determinant of economic development in any nation. How something is done determines the results. Therefore, the methods used to deliver content in class has a major influence on performance and education in general. The integration of ICTs in teaching seems to be working well as young people have already identified themselves with ICT and perennial challenge of poor performance in sciences especially biology maybe solved by integration of ICT in teaching.

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The term integration is a comprehensive process of applying information communication technology to the educational system in order to improve teaching. In Kenya, the Ministry of Education (MoE) basic education Act, defines ICT integration as “seamless incorporation of information Communication Technology to support and enhance the attainment of curriculum objectives, to enhance the appropriate competencies including skills, knowledge and attitudes” (MoE, 2015). According to MoE (2021) integration of ICT in education is so important that the Africa Agenda, 2063 and the Continental Education Strategy for Africa (CESA), 2016- 2025 emphasizes the use of ICT as an important tool in the achievement of quality education in Africa. Infact the CESA strategic objective three emphasizes harnessing the capacity of ICT to improve access, quality and management of education and training systems.

Miima (2014) did a study on ICT integration in teaching Kiswahili subject in Kakamega County and emphasized that integration involves using ICT in all stages of teaching. This means a teacher can use ICT in lesson preparation, delivery of the content and assessment of learners. Wang and Woo (2019) postulated that depending on the scope of the content covered, ICT integration can happen in three (3) areas: curriculum (macro), topic (meso) and lesson (micro). They further elaborated that macro- integration entails use of multimedia resources and web-based courses. Meso involves smaller pockets of knowledge such as explaining the concept of Deoxyribonucleic acid (DNA) and cell division which are closely interrelated.

Statement of the Problem

Despite ICT having found its use in all sectors of our economy, its integration in teaching in secondary schools has remained an area of concern in Kenya with Kiambu County being no exception. Integration of ICT in teaching is influenced by several factors gender being one of them. The influence of gender on integration of ICT in biology teaching is unclear and hence there is a need for information in order to address the issue. This study therefore investigated the influence of gender on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya. How gender and the extent which it influences the integration of ICT in biology teaching in public secondary schools was the gap that the study filled.

Objectives

- i) To investigate the teachers of biology gender distribution in public secondary schools in Kiambu County.
- ii) To determine whether teacher's gender has any influence on integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Hypothesis

HO: Gender of the teacher has no statistically significant influence on integration of ICT in biology teaching in public schools in Kiambu County, Kenya.

Theoretical Framework (The Technology Pedagogy Content Knowledge (TPACK) Theory by Mishra (2019)

The proponent of this theory is Shulman (1986) who conceptualized the theory in form of a model which has Technology, Pedagogy and Content Knowledge (TPACK). This TPACK theory was further popularized by Rosenberge and Koehler (2015) who improved on it by showing the relationship between technology, pedagogy and content knowledge.

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According to Herring et al., (2016) the TPACK model describes the inter-relationship between content, pedagogy and technology, and emphasizes on integration of the three areas in developing effective teaching for learning. Knowledge of content (C) in the model is an understanding about subject matter. Teachers of biology must be knowledgeable in what they are teaching this include the facts, concepts, principles, theories, procedures and the structure of knowledge. Pedagogical knowledge (P) is knowledge about teaching and learning. Teachers of biology need to know how learning takes place; for example, how students construct knowledge and what a cognition process is, methods of teaching, student assessment, instructional design and classroom interactions. In the use of ICT in biology teaching in secondary: Technology and pedagogy management are also elements of pedagogical knowledge. Technology knowledge (T) involves the awareness of and skills in operating and applying technology such as computer software, the internet and liquid crystal display (LCD) projectors.

Pedagogical content knowledge exists in the intersection of content and pedagogy and it is the knowledge about teaching specific subject matter (Mishra, 2019). It is concerned with the arrangement of content, the representation and formulation of the subject, the analogies and demonstration of ideas in easily comprehensible ways for learners.

Technological content knowledge associates the application of technology in teaching subject matter of biology. An example of technological content knowledge is the understanding of statistical computer software (such as SPSS) and their applications into the subject matter statistics. Technological pedagogical knowledge, an overlapped area between the technology and pedagogy circles, refers to the ability of using technology in a way that supports the pedagogical approach. An understanding about existing technologies such as MS PowerPoint, digital cameras, animations and WebCT as well as the capabilities of utilizing them in teaching is illustrative of technological pedagogical knowledge (Rana et al., 2022). The Figure that follows shows the interrelationship between various knowledge as depicted by TPACK theory.

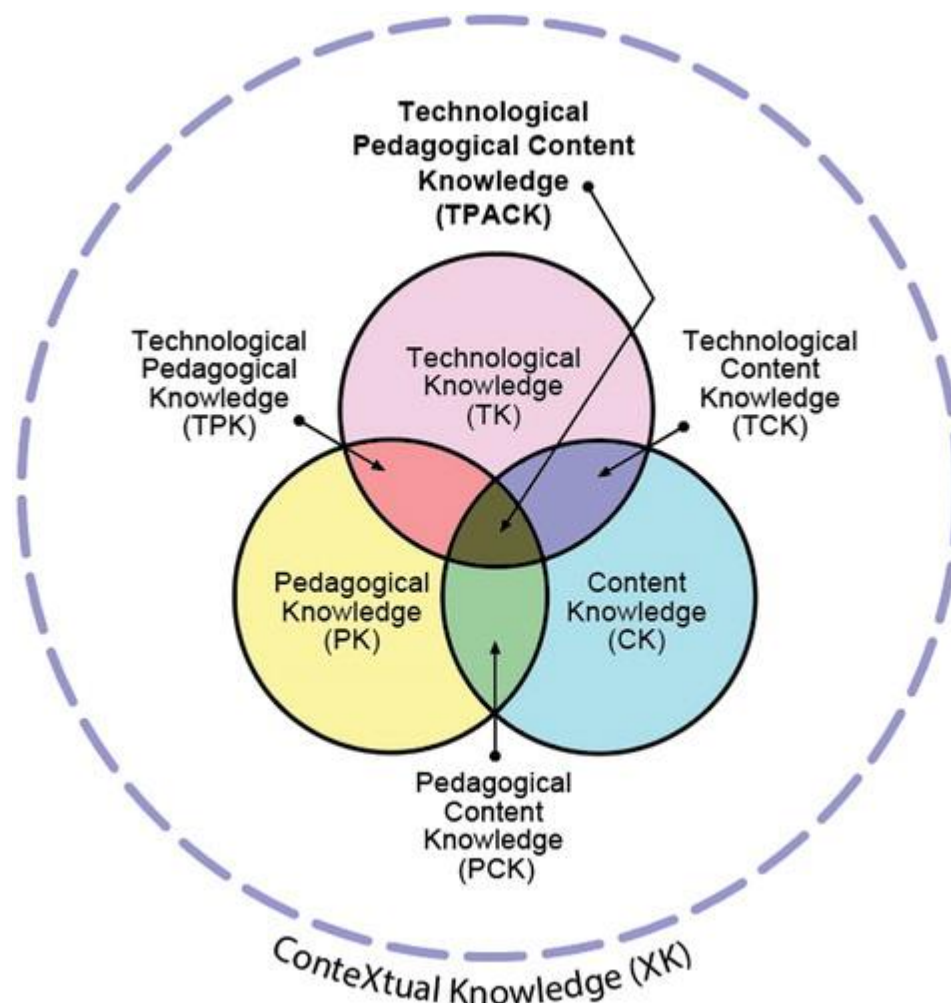


Figure 1: Revised version of the TPACK model.

Source: Adopted from Mishra (2019).

Figure is a Venn diagram. It's derived from mathematical concept of sets. As illustrated in the center of the model, technological pedagogical content knowledge, an emerged form of knowledge, is essential for successful application of ICT in teaching (Mishra, 2019) and is the focus of this study. It is the integration of teachers' understanding about the subject, knowledge about teaching and learning, and the ability of using technology. Thus, technological pedagogical content knowledge is the knowledge of how to teach the content of subject matter using technology in a way that facilitates learning. Each circle represents a type of knowledge.

According to Mishra (2019) The outer dotted circle "Contextual Knowledge" (i.e., the teacher's knowledge of the context) is everything from a teacher's awareness of available technologies, to the teacher's knowledge of the school, zone, sub-County, nation, or national policies of education they operate within.

The benefit to Contextual Knowledge is that it makes the outer circle another knowledge domain that teachers must possess to integrate technology in teaching. This, in turn, implies that contextual knowledge is something that teachers of biology can act on, change, and develop. Just as teachers of biology seek to develop teachers' knowledge types

and overall TPACK, it becomes clear that teachers ought to work toward increasing their contextual knowledge as well. Contextual knowledge therefore becomes of critical importance to teachers, and a lack of it limits the effectiveness and success of any TPACK development and teacher's attempts at technology integration. This outer dotted outer circle is named XK for "contexTtual Knowledge" in order to distinguish it from content knowledge (CK). Mishra (2019) notes that using X for contexTtual is very appropriate because X usually denotes a variable, and contextual knowledge often is highly variable.

The theory implies that the balance of technology, pedagogy and content knowledge are essential for success in effective teaching for learning biology using ICT. It's evident that the teacher should have acquired knowledge of the content, pedagogy and technology. These are confined in the teacher while availability of ICT is also essential for them to be used and these forms the selected factors. The outer dotted circle encloses a space but it is not designated as a form of knowledge. It is labelled "Context" or "Contexts." Since TPACK is a framework for teacher knowledge, maintaining semantic consistency requires that every enclosed space represent some aspect of teacher knowledge. That works for TK, PK, and CK (and the overlaps, TCK, PCK, TPK, and TPACK) and should for the outer dotted circle too. The TPACK theory has excellently explained interaction of the three spheres of knowledge and how they blend to enable a teacher of biology integrate ICT in teaching.

Conceptual Framework

Kombo (2006) affirmed a conceptual framework as a research tool intended to assist a researcher develop awareness and understanding of the situation under scrutiny and communicate it effectively. This shows that integration is a process that takes place over time rather than a particular time. It also indicates that integration of ICTs is at different levels depending with the teacher of biology.

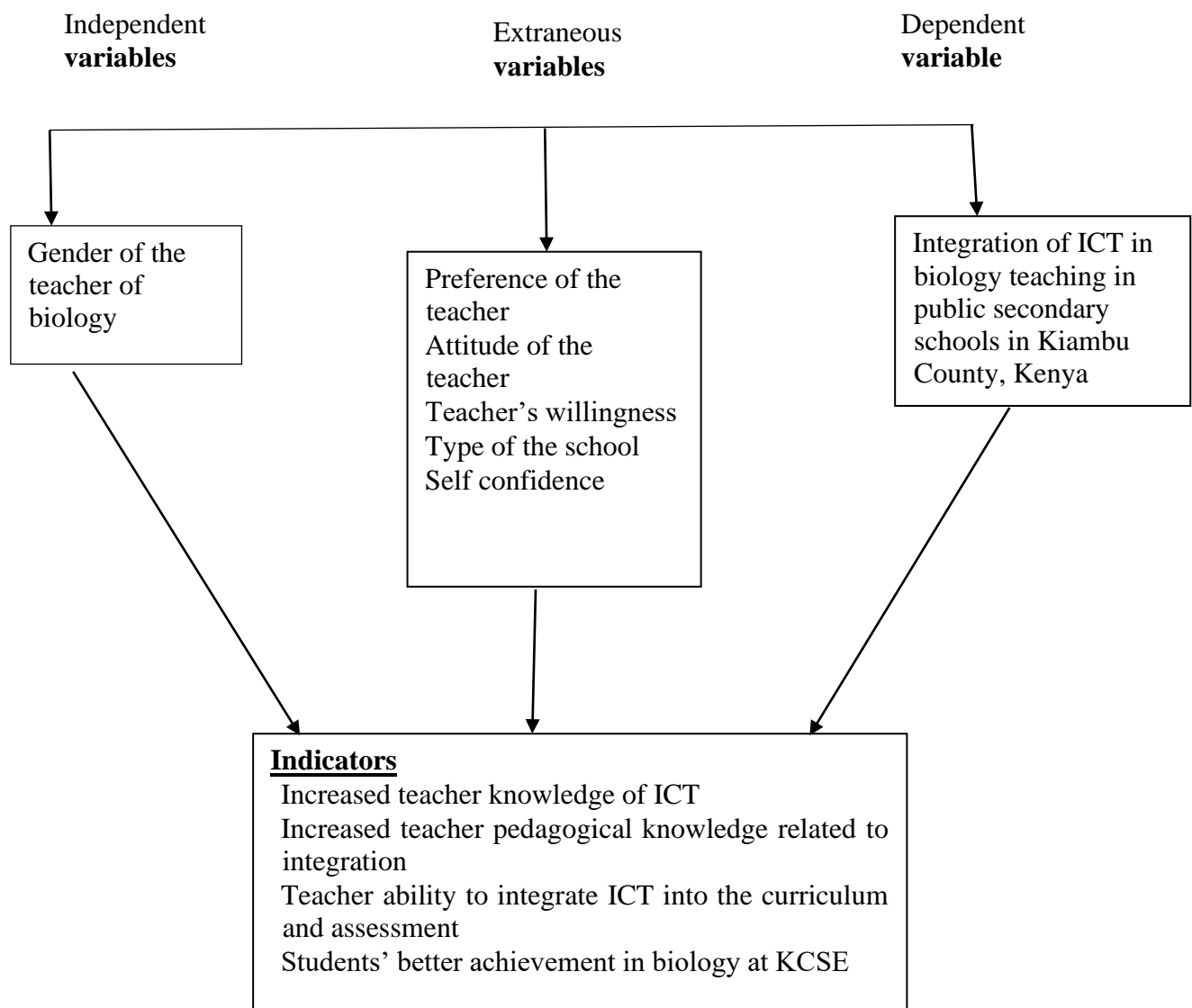


Figure 2: Conceptual Model
Source: Developed by Researchers

Review of related literature.

Gender of the Teacher and Integration of ICT in Biology Teaching

Gender differences and the use of ICT has been reported in several studies. However, studies concerning teachers' gender and ICT use have cited female teachers' low levels of computer use due to their limited technology access, skill, and interest (Hardaker, 2017). Several research studies revealed that male teachers used more ICT in their teaching and learning processes than their female counterparts (Seibert et al., 2019; Suraweera et al., 2017). Similarly, Khan and Markauskaite (2017), investigated gender differences in self-reported ICT experience and ICT literacy among first year graduate trainee teachers. The study revealed significant differences between males and females in technical ICT capabilities, situational and longitudinal sustainability where males' scores were higher. Danko et al (2020) observed that female instructors use ICT more often than their male colleagues whereas males showed higher self-reported ICT skills and confidence in instructional use. This agrees with the findings of Tena et al. (2016). Danko et al concludes that personal use of digital technology has become normalized for both genders.

Martin and Jamieson-Proctor (2022) conducted a study on teachers' integration of ICT in schools in Queensland State, Australia. Results from 929 teachers indicated that female teachers were integrating technology into their teaching less than the male teachers. But the situation was different in secondary schools in Meru where Koome (2017) reported that females' self-perceptions about technology competence was higher while males' self-perceptions about technological dominance was low. Koome was therefore in agreement with Chege (2014) that female teachers applied ICT more than the male teachers. The study by Koome (2017) also confirmed report by Ngo and Ngadiman (2021) that gender gap had reduced over the past years, presently, a greater number of females are using internet and web technology more than their male counterparts. However, some studies have revealed that gender variable is not a predictor of ICT integration into teaching (Chapidech and Sriwasdi., 2021). Research conducted by Seibet et al. (2019), revealed that male teachers had relatively higher levels of computer attitude and ability before computer implementation, but there was no difference between males and females regarding computer attitude and ability after the implementation of the technology. Seibet et al. claimed that quality preparation on technology can help lessen gender inequalities and no significant sex difference exists among tutors in relation to their perception on ICT integration in teaching in Volta region of Ghana.

To clarify those different findings, the current study sought to find out the relationship between gender and integration of ICT in biology teaching in public secondary schools of Kiambu County.

Methodology

The study was guided by both qualitative and quantitative paradigms. *Ex-post facto* research design was adopted to guide the study. An *ex-post facto* research design integrates different methods in collecting data required in a study (Plowright, 2011). According to Kothari, (2011) the design includes reporting what has happened or happening without interfering with given variables. Kothari asserts that, it is also concerned with describing, recording and reporting conditions as they exist. In *ex-post facto*, a researcher can generally discover causes even when he/she cannot control variables. This study explored the influence of teachers' gender on integration of ICT in biology teaching in public secondary schools in Kiambu County. This design was found to be appropriate for the current study in view of the

fact that integration is an activity that may have happened in some of the schools while in others it is ongoing.

The study was carried out in public secondary schools in Kiambu county which is located in the Nairobi metropolitan region of Kenya. The rationale of choosing the County was grounded on the fact that inspite of having many public secondary schools in all the categories (national, extra- county, County and Sub-County), being a County in metropolitan region and being richly endowed with many resources, no evidence of a study that has been conducted to determine influence of gender on the integration of ICT in biology teaching in public secondary schools. In addition, the County attracts a large number of personnel teachings there due to its proximity to the capital city. Lastly the County like others has not integrated the ICT as per ministry of education policy hence it's a rich place to collect data.

The target population of the study 521 teachers of biology in Kiambu County public secondary schools. The sample size was 167 teachers of biology. The sample selected using stratified random sampling and purposive sampling methods. The researcher also used simple random sampling technique to select three teachers in schools with more than three teachers of biology. The sample size was determined by use of Krejcie and Morgan table. The data was collected by use of teacher questionnaires. Reliability was determined using the test-retest method and coefficient of 0.792 was obtained. The data obtained from the study was analyzed by use of both descriptive and inferential statistics. T-test was used to test the hypotheses at significance level of .05. Statistical package for social sciences (SPSS) version 26 was utilized to analyze data.

Results and discussion

Gender of the Respondents

The gender of the respondents is categorised as male and female. The distribution of respondents according to gender is shown in Table 1.

Table 1: The Distribution of Gender of Teachers of Biology in Public Secondary Schools in Kiambu County, Kenya

		School category				
		Sub- county	County	Extra county	National	Sub-total (%)
Gender	Male	37	19	12	0	68(51)
	Female	37	11	12	5	65(49)
Sub-total		74	30	24	5	133(100)

Source: Field Data 2024

The results in Table 1 show the distribution of the gender of teachers of biology in public secondary schools in Kiambu County. From the analysis, it can be observed that 68 (51%) were male. The analysis also shows that 65 (49%) were female. This shows that there was a higher proportion of male than that of female teachers of biology. However, there was no much gender disparity in teachers of biology in Kiambu County as male to female representation was 51 per cent and 49 per cent respectively. This is well evident with the equal representation of male and female in both Sub-County and Extra-County schools. National public secondary schools in Kiambu County sampled had only female teacher of biology. The gender distribution shows that male teachers were more in number than their female counterparts. This indicates that the teaching profession in secondary school level

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especially in sciences is male dominated and calls for players in the education sector to address this disparity especially through teacher training affirmative action. Ezekiel and Ezekiel (2019) assert that male teachers in Nigeria had relatively higher levels of computer attitude and ability before computer implementation, but there is no difference between males and females regarding computer attitude and ability after the implementation of the technology. The study claims that quality preparation on technology can help lessen gender inequalities.

The Influence of Teacher’s Gender on Integration of ICT in Biology Teaching in Public Secondary Schools in Kiambu County, Kenya

The first objective sought to establish whether teacher’s gender has any significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya. To achieve the objective, the following null hypothesis was formulated:

H₀₁: There is no statistically significant influence of teacher’s gender on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

To ascertain the truth of the assumption in the null hypothesis, independent sample t-test was carried out and the results are presented in Table 2.

Table 2: The t-Test for Difference in Integration of ICT Among Genders of Teachers of Biology Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2- tailed)	Mean Differ ence	Std. Error Differ ence	Lower Upper
Ict integration in biology teaching	Equal variances assumed	.638	.426	-.416	131	.678	-.02285	.05498	-.13161 .0859
	Equal variances not assumed			-.417	129.50 3	.677	-.02285	.05479	-.13125 .0855

Source: Field Data 2024

The results in Table 2 indicate that the t-value was not significant ($t(131) = -0.416, P = .678$). Therefore, the null hypothesis was accepted. However, the female gender had a higher mean score of 3.8000 while that of male gender was 3.7771. This means that teacher’s gender has no statistically significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

The results have been supported by findings from other studies which indicates that gender of the teacher has no influence on integration of ICT in teaching. Kadiri (2015) did a study on factors influencing ICT integration in Vihiga county and concluded that teacher’s

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gender did not influence integration of ICT in teaching of English language. According to Chepkonga (2015) sought to find out whether there exists a relationship between the principal's gender and ICT integration in management of public secondary schools in Nairobi County, Kenya. The study concluded that there was no significant relationship between the secondary school principals' gender and ICT integration in management of public secondary schools in Kenya. Sabic et al. (2022) did a study in upper secondary schools in Croatia and found only minor gender differences in self-efficacy. According Gebhardt et al. (2019) there is no significant influence in ICT integration in teaching between female and male teachers in secondary school across Europe.

Arkorfu et al. (2021) did a study to examine the integration of Information and Communication Technology in teaching in Senior High Schools in Ghana and concluded that there was no significant difference in gender and acceptance of ICT integration in teaching. Ait Hammou and Elfatihi (2019) did a study among language teachers in Morocco and concluded that there was no significant difference in using ICT in language teaching between the male and female English language teachers. Mogeni (2020) observed that using ICT for teaching does not appear to differ greatly in terms of gender the study therefore concluded that there was no significant difference in computer usage levels based on gender. Similarly, Saripudin et al. (2020) investigated gender differences in self-reported ICT experience and ICT literacy among first year graduate trainee teachers and concluded that male teachers on average worked with computers significantly for more hours per week than female teachers but the difference wasn't statistically significant.

According to Norris (2019) gender variable is not a predictor of ICT integration into teaching. Ezekiel and Ezekiel (2019) assert that male teachers in Nigeria had relatively higher levels of computer attitude and ability before computer implementation, but there is no difference between males and females regarding computer attitude and ability after the implementation of the technology. The study claims that quality preparation on technology can help lessen gender inequalities. Papaioannou and Kyriacos (2021) undertook a study on the Cyprus primary school principals' attitudes towards Information and Communication Technology (ICT) as well as their perceptions about the factors that facilitate or inhibit ICT integration in primary schools in Cyprus. The findings of this study reveal there was no significant difference in integration of ICT between the gender.

The study found that gender of teacher of biology has no statistically significant influence on the integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Summary

The results generated by the analysis revealed that;

- (I) The mean score for male teachers of biology was 3.7771 with a standard deviation of .33965
- (II) The mean score for female teachers of biology was 3.8000 with a standard deviation of .29127
- (III) The t-test between the mean scores for male and female teachers was found not significant ($t(131) = -0.416$, P -value = .678). This means that there was no significant difference in the mean scores and therefore none of the gender integrates ICT more than the other significantly.

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- (IV) Null hypothesis (H_{01}) was accepted and conclusion made that neither the male nor female teachers of biology significantly integrate ICT more than the other in biology teaching in public secondary schools in Kiambu County, Kenya.

Conclusion

Based on the findings of the study it is concluded that gender has no significant influence in integration of ICT in biology teaching in public secondary schools in Kiambu County, Kenya.

Recommendations

The training of teachers should maintain balance in gender to have a relatively equal representation of male and females in teaching profession.

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