Science Teachers' Technological Competence Among Late Generation Z Students: Are They Equipped For Students' Optimum Performance?

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***Abstract*—The study seeks to investigate science teachers' technological competence among late generation Z students. 160 science teachers (Biology [40], Chemistry [40], Mathematics [40] and Physics [40]) were selected from public and private schools in Rivers Sate using the purposive sampling technique. Three research questions and two hypotheses were formulated for the study. A 29-item statement questionnaire titled "Questionnaire on Science Teachers' Technological Knowledge" (QSTTK) with a reliability coefficient index of 0.81 was used for data collection. Data collected was analyzed using the frequency count, mean, bar chart and Analysis of Variance (ANOVA) at 0.05 level of significance. The findings of the study revealed that science teachers were not technologically competent in utilizing software and social media platform for teaching science subjects in secondary schools and there is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing software [$F_{(3,156)} = 2.455$, $P = .014$] and social media [$F_{(3,156)} = 2.925$, $P = .032$] applications for teaching of science in secondary schools. The study also indicated that science teachers' attendance of in-service training was very low. Recommendations were posited for the study such as refurbishing of the science curriculum aimed at using technological software and tools for science teaching with a call for support from Government and Public sectors in organizing annual in-service training for science teachers basically on technology integration.**

***Keywords*— Teachers, Science Teachers, Technology, Competence, Generation Z**

I. INTRODUCTION

There is no doubt that technology has been progressively enshrined into our daily activities and certainly, we are in the digital era where knowledge is at everyone's disposal. With the present nature and availability of technology for the process of teaching and learning, it is obvious that several challenges of its implementations by some generational users are evident. Every generation has experienced transformation in the process of knowledge acquisition with the emergence of technology which has impacted and defined the reality of that era. The consequential ascension of global connectivity has also played an important role in causing a generational shift. Firstly was the traditionalist generation also known as the "Silent Generation" which were born between 1924 and 1946 [1]. Members of this generation lag behind other generations in the use of computer technology due to lack of knowledge and confidence. The second generation is the baby boomers born between 1947 and 1964 and are currently the biggest consumers of traditional media like newspapers, radio, magazines and television. The baby boomer has begun to adopt more technology and the rate of adoption has been growing rapidly such that 5 out of 10 boomers are more likely to own a smartphone. The generation X are the next set of generation

born between 1965 and 1979. They are digital savvy, though still listen to radio, read newspapers and magazines and watch TV. [2] commented that Generation X members were adults by the time smartphones came into play, though they still find time to adopt to the use of tech devices. The fourth generation is the generation Y also known as the Millennials or Net Generation and are born between 1980 and 1994. This generation is extremely comfortable with tech devices, they use the internet often having various social media account.

Today's generation of students in our science classroom in secondary schools are not the same as the previous generations. These minds are born into an era that is saturated with all types of sophisticated technological devices which makes information readily accessible and easily distributed from one end of the globe to another, they are called the GENERATION Z [3]. Gen Z is the newest generation to be named and were born between 1995 and 2015. They are currently between 5-25 years old and they are prevalent in our secondary and higher institutions. Most students currently in secondary schools in Nigeria would have been born between 2000 and 2008 and are considered 'late Generation Z'. Most of them grew up operating their parents' phones, tablets, laptops or Personal computers. Having grown up in a hyper-connected world, this set have no memory of the world without surfing the World Wide Web. [4] further categorized the Generation Z into the Generation Z1 born between 1995 and 2000 and the Generation Z2 born after 2005. They also have the Google kids or Generation α which are those born after 2010.

The children born in this generation are those that decline the use of toys rather opt for computers and digital gadgets and instinctively learn how to use them. [5] referred to them as Internet-surfing, iPoding, texting, Googling, Whatsapp, Instagram, Facebooking, IMing, Snapchart, Twitter and extremely tech-savvy generation. An important trait of generation Z is their ability to multitask. They have the extraordinary ability to handle several tasks at once, ability to process information and disseminate information within seconds. They are viewed as the new social media class molded by the generation Y but have surpass them due to the extent of there been social and globally connected [3]. Despite the omnipresence of technology in the lives of the generation Z, [6] reiterated that there has been decrease in their attention span, which also affects their cognitive processing of information.

[7] also commented that students' of the generation Z are easily distracted by social media, smartphones, e-mail and associated usage of new technologies. [1] noted that generation Z learners do not effectively assimilate when taught with the traditional or lecture method devoid of blended instructional strategies. These generational shifts in attitude, behavior and communication are becoming pervasive in our schools, reaching all the way into the classroom. The education system should also align to this paradigm shift by deliberately readjusting to the technological developments in order to prepare quality citizens for the technological age. [8] stated that;

> *"The generational divide between teachers and students, combined with the need to develop core competencies like digital competence and the use of technologies to address the new learning needs of a changing generation raise questions about the preparation of current teachers for leading the teaching-learning processes that Generation Z students will use."(p. 12).*

One major challenge in science teaching in secondary schools recently is how to provide scientific lesson through a digital platform having all components that will enhance the performance of generation z students. A study carried out by Federation of Trade Unions in Education (FSLI) in Romania in 2011 cited by [7] revealed that apart from teachers complain of payment, it was more baffling that teachers want to leave the profession due to the difficulty of "cohabitation" with the present generation of learners who are little understood by the teachers. Over the past two decades which typified the age range of the generation z, supporting technological integration in science teaching in secondary schools has turned out to be the crucial agenda of discuss in science education [9]. Critically, the proliferation of modern technology in all aspects of our everyday life has consequently increased the need

for teachers to use these technological devices for science teaching. Technological integration in science teaching enables demystification of the abstract nature of science and enhances visualizations and simplicity of various scientific concepts and principles that are inherent in nature thereby creating a technological rich learning environment [10]. Technology integration in science teaching and learning process offer the opportunity for science teachers to surmount difficult concepts and experiment that might be time consuming, very expensive or even dangerous to conduct.

Technological knowledge is the understanding of how technology tools, resources and devices fit into the process of teaching and learning. It is also seen as the ability and capacity of a teacher in using technological components (hardware and software) for instructional purpose. Technological knowledge is the mastery of technology in which educators can confidently plan and use a particular technology in and out of the classroom for instructional purpose. [11] presented three levels of technology competencies for teachers.

- Level 1 (Technology Literacy): Understanding the technologies and integrating technological competencies in the curriculum.
- Level 2 (Knowledge Deepening): Use of these competencies in order to add value to society and the economy, and applying this know-ledge to solve complex and real problems.
- Level 3 (Knowledge creation): Production and subsequent leverage of new knowledge.

[12] National Educational Technology Standards and Performance Indicators (United State of America and Canada) for Teachers in 2008 stated that teachers should incorporate modern technology tools and resources to develop students' knowledge, attitude and skills. It was highlighted that teachers should;

i. design or adapt relevant learning experiences that incorporate digital tools and resources to promote student learning and creativity.
ii. develop technology-enriched learning environments that enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress.
iii. customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources.
iv. provide students with multiple and varied formative and summative assessments aligned with content and technology standards and use resulting data to inform learning and teaching

It is imperative that science teachers know how to integrate technology into science classrooms in other to promote meaningful learning of science. [13] asserted that there are two important broad areas of knowledge required of science teachers for technology integration. The first is that science teachers need to identify and develop technologies into tools essential for meaningful science learning. Secondly, acquiring technological knowledge that are curriculum based with dual purpose – for teachers and students. Integration of technology into the curriculum can provide both teachers and learners access to up-to-date primary source material, ways to collaborate with students, teachers and other experts around the world, opportunities for expressing understanding via multimedia and learning that is relevant and assessment that is authentic. Using technology effectively in the classroom may be best accomplished by science teachers who tend to be proactive and move one step ahead of the generation z learners by adopting emerging technology in their day-to-day activities and adjusting to the demands of the Generation Z. The study therefore focused on science teachers' technological competence among the late Generation Z students.

Aim and objective of the study

The aim of the study was to investigate science teachers' technological competence among the late Generation Z students. Specifically, the objectives of the study are to;

1. investigate the extent of science teachers' software competence for teaching science in secondary schools.

2. determine the extent of science teachers competence in utilizing social media for teaching of science in secondary schools.

3. investigate in-service training programmes attended by science teachers in enhancing technological knowledge for the past five years.

Research questions

1. To what extent are science teachers competent in utilizing software applications for teaching of science in secondary schools?

2. To what extent are science teachers competent in utilizing social media for teaching of science in secondary schools?

3. What are the in-service training programmes attended by science teachers in enhancing technological knowledge for the past five years?

Hypothesis

Ho_1: There is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing software applications for teaching of science in secondary schools.

Ho_2: There is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing social media for teaching of science in secondary schools.

Methodology

The descriptive survey research design was adopted for the study. The population of the study consisted of all science teachers in public and private secondary schools in Rivers State. A total of two hundred and sixty (160) science teachers (Biology = 40, Chemistry = 40, Mathematics = 40 and Physics = 40) were selected using the purposive sampling technique. The criteria used for the selection were;

i. The teacher must have taught for more than 5 years.
ii. The teacher must be a graduate of one of the science subject.

The instrument used for data collection developed by the researchers was titled "Questionnaire on Science Teachers' Technological Knowledge" (QSTTK). The questionnaire consisted of two sections A and B. Section A is basically concerned with demography information of the respondents while section B consisted of 29 item statements that were sub-divided into three categories namely, software knowledge, social media utilization, frequency of in-service training. The software knowledge and social media utilization were built on a 4-point modified Likert scale of Very Competent (VC) – 4 points, Competent (C) – 3 points, Fairly Competent (FC) – 2 points and Not Competent (NC) – 1 point. The frequency of in-service training was based on percentage. The instrument was face and content validated by experts in educational technology and science education in University of Port Harcourt, Rivers State, Nigeria. The research instrument was further subjected to a pilot study and was given to 40 secondary school science teachers that were not used for the main study. A test-retest method was employed to administer the instrument at an interval of one week for the purpose of establishing the reliability of the instrument. Both responses from the respondents were correlated using the Person Product Moment Correlation Statistics and a reliability index of 0.81 was obtained making the instrument 81% reliable. Data that was obtained for the study were analyzed using the frequency count, percentage, mean, bar charts and Analysis of Variance at 0.05 level of significance

Result

Research Question 1: To what extent are science teachers' competent in utilizing software applications for teaching of science in secondary schools?

Table 1: Analysis of science teachers' competence in utilizing software.

s/n	Items	Biology N = 40 mean	Chemistry N = 40 mean	Mathematics N = 40 Mean	Physics N = 40 mean
1	Word processing	2.35	2.59	2.73	2.36
2	Power point	2.05	2.11	2.14	2.57
3	Simulations	1.03	1.06	1.37	1.65
4	Spread sheet	2.05	2.10	2.12	2.32
5	Multimedia development	1.08	1.11	1.86	1.06
6	C-mapping tools	1.20	1.00	1.09	1.77
7	Creating graphics	1.93	1.47	1.64	1.64
8	Webcam	2.21	2.34	2.42	2.65
9	Web browsers	2.67	2.55	2.67	2.31
10	Moodle	1.01	0.94	1.30	0.82
11	PSB learning media	1.22	1,05	1.09	0.97
12	Web page development	0.78	0.62	0.85	1.03
	Aggregate mean decision	**1.63 NC**	**1.63 NC**	**1.77 NC**	**1.76 NC**

Source: Researchers' Fieldwork, 2019. *
NC = Not Competent

Result presented in Table 1 reveal science teachers' competence in utilizing technological software for the purpose of teaching science in their schools with respect to their teaching subjects. Based on the criterion mean of 2.50, it was shown that Biology, Chemistry and Mathematics teachers are competent using the Web browser, chemistry and Mathematics teachers are competent using the word processing while only Physics teachers shows competence using power point. However, the study indicated that the calculated aggregate mean for Biology teachers is [x = 1.63 (NC)], Chemistry teachers [x = 1.63 (NC)], Mathematics teachers [x = 1.77 (NC)] and Physics teachers [x = 1.76 (NC)]. The findings of the study therefore showed that science teachers are not technologically competent in utilizing software for teaching science subjects in secondary schools.

Hypothesis one: There is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing software applications for teaching of science in secondary schools.

Table 2: One-way ANOVA analysis of science teachers' response on competence of software application in teaching science.

Source of variation	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	24.969	3	8.323	2.455	.014
Within Groups	2852.975	156	18.288		
Total	2877.944	159			

Source: Researchers' field work, 2019.

The analyzed data of the One-way ANOVA of Table 2 indicated that $F_{(3,156)}$ degree of freedom at 0.05 level of significance is [$F_{(3,156)}$ = 2.455, P = .014]. Since the calculated P_{value} is less than P =.005, the null hypothesis is retained. This implies that there is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing software applications for teaching of science in secondary schools.

Research Question 2: To what extent are science teachers competent in utilizing social media for teaching of science in secondary schools?

Table 3: Analysis of science teachers' competence in utilizing social media.

s/n	Items	Biology N = 40 mean	Chemistry N = 40 mean	Mathematics N = 40 Mean	Physics N = 40 mean
1	Whatsapp	2.72	2.53	2.50	2.51
2	Zoom	2.32	2.01	2.11	1.96
3	Edmodo	1.71	0.82	1.02	1.11
4	Instagram	1.01	1.93	0.85	0.82
5	Xanga	1.00	0.83	0.94	0.94
6	Facebook	2.14	2.33	2.40	2.33
7	Skype	1.76	1.27	1.37	1.53
8	Myspace	0.82	0.72	0.86	0.65
9	Eskimi chat	0.70	0.77	0.88	0.82
10	Twitter	1.20	2.01	0.69	1.73
	Aggregate mean decision	1.54 NC	1.52 NC	1.36 NC	1.44 NC

Source: Researchers' Fieldwork, 2019. *
NC = Not Competent

Table 3 indicated the analysis of science teachers' response based on their subject areas on the utilization of social media for teaching of

science in secondary schools. The calculated aggregate mean and standard deviation for Biology teachers was given as [x = 1.54 (NC)], Chemistry teachers [x = 1.52 (NC)], Mathematics teachers [x = 1.36 (NC)] and Physics teachers [x = 1.44 (NC)]. The findings of the study revealed that science teachers do not utilize social media platform for science teaching in their secondary schools except the use of Whatsapp with mean values > 2.50 for all teacher groups

Hypothesis two: There is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing social media for teaching of science in secondary schools.

Table 4: One-way ANOVA analysis of science teachers' response on competence of software application in teaching science.

Source of variation	Sum of Squares	Df	Mean Square	F
Between Groups	52.669	3	17.556	2.925
Within Groups	2852.9775	156	54.197	
Total	1707.444	159		

Source: Researchers' field work, 2019.

One-way ANOVA of Table 4 indicates that $F_{(3,156)}$ degree of freedom at 0.05 level of significance is [$F_{(3,156)}$ = 2.925, p = .032]. Since the calculated p_{value} is less than p =.05, the null hypothesis is retained. The null hypothesis is retained and implies that there is no significant difference among science teachers (Biology, Chemistry, Mathematics and Physics) on their competence in utilizing social media for teaching of science in secondary schools.

Research Question 3: What are the in-service training programmes attended by science teachers in enhancing technological knowledge for the past five years?

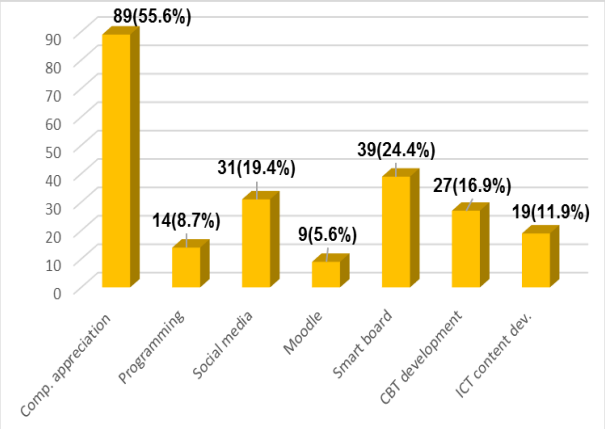

Figure 1: Analysis of science teachers' response on in-service training attended for the past 5 years

Figure 1 showed the type of in-service training attended by science teachers for the past 5 years. The result indicated that 89 (55.6%) attended in-service training on computer appreciation, 14 (8.7%) for programming, 31 (19.4%) on social media, 9 (5.6%) on moodle, 39 (24.4%) on smartboard, 27 (16.9%) on Computer Based Test Development while 19 (11.9%) attended for ICT content development. The finding of the study revealed that science teachers' attendance of in-service training is very low except in computer appreciation.

Discussion of findings

The rate at which modern technology infiltrate the educational world and the exceeding mode of adoption has caused a state at which science teachers are faced with the challenge of teaching a generation that are "Hypertech" or "Wireless". It is therefore imperative that science teachers should be in tune with the modern realities. The study was concerned with investigating science teachers' technological competence among late generation z. The findings of the study showed that science teachers are not technologically competent in utilizing software for teaching science subjects in secondary schools. The findings are in line with the outcome reported by [14] that most science teachers lack the knowledge and skills of using technological software for classroom curriculum delivery in Anambra State, Nigeria. [15] also mentioned that most teachers in Ogun State secondary schools do not have the required competence and ability to use simple soft wares.

The findings of this study revealed that science teachers do not utilize social media platform for science teaching in their secondary schools. [16] explained that social media are internet based channels that provide users the real time interaction with both broad and narrow audience. The importance of social media to the generation Z has adversely conditioned teachers to explore this platform in promoting meaningful learning. [17] noted that lack of knowledge and experience make teachers not to employ the use of social media platform for teaching while [18] posited that teachers did not know how to integrate social media in existing online learning environments. [19] opined that social media use should be encouraged and blended with appropriate instructional strategies to make learning more meaningful to the students. Knowledge should be dynamic and flexible, therefore regular reinforcement is necessary for teachers to be abreast with recent happenings. Findings from the present study also revealed that science teachers' attendance of in-service training for the past five years have been very low. [10] noted that lack of professional training on technology integration is a major constraint in the application of technology for science teaching. [20] asserted that if teachers participate in a long-term in-service training on technology use, it will make them more competent and confident in using the technological tools. Similarly, [21] stressed that teachers participation in technology training and seminars is a function of quality education.

Conclusion

Students' performance in science is very crucial and understanding the unique characteristics of the generation z can help science teachers re-align their methods of teaching. Technology application in education is the order of the day, therefore, science teachers' needs to be conscious of their students learning needs by implementing innovative strategies involving the use of new technologies in science classrooms.

Recommendations

1. There is an exigent need for the secondary schools science curriculum to be refurbished so as to deliberately accommodate new educational technologies, software and tools as channels for content delivery.

2. Government at the Federal, State and Local levels including the private sectors should regularly support in-service science teachers training on the use of technology in order to gain sufficient technological knowledge and competence.

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