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Evaluating the Proficiency of Science Educators in Developing and Executing Online Instruction: A Case Study of Secondary Schools in Uganda

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ABSTRACT

This research delved into the assessment of the proficiency of science educators in formulating and executing online lessons within secondary schools in Uganda. Employing a quantitative methodology with a cross-sectional survey design, the study developed a questionnaire to evaluate the online teaching competencies of secondary school science teachers. The questionnaire was disseminated electronically, resulting in 50 respondents within a one-month timeframe. Data analysis encompassed the use of descriptive statistics and multivariate analysis of variance (MANOVA). The research findings disclosed that while science teachers exhibited competence in online teaching, course design, digital communication, and basic computer skills, they displayed some limitations in advanced computer skills and the utilization of Learning Management Systems. Furthermore, the study identified factors such as school location and the academic qualifications of teachers as overarching influences on the competency of science teachers in designing and implementing online lessons. In light of these findings, the study recommends the organization of professional development courses to enhance teachers' readiness for conducting online classes. Additionally, it underscores the importance of electrifying and equipping schools, especially those in rural areas, with the requisite infrastructure and resources.

Keywords: science, teachers, competency, designing, implementing, online lessons

INTRODUCTION

Since the break out of covid-19 at the end of 2019, online learning has become a common means of instruction to sustain the teaching learning process not only in Uganda but across the whole globe [1]. Online learning makes use of information technology (IT) devices such as virtual classes, whiteboards, net meetings among others [2]. Online learning has been found by previous researchers including [3] to build a comprehensive and interactive communication thinking pattern for students, teachers and all academicians and thus an appropriate alternative learning method that is quite effective and efficient in terms of implementation and evaluation of learning. Online environments help in solving the problem of lack of space as the small groups traditionally would need to interact face-to-face and of which these interactions are usually carried out at the same time [1]. In addition, this method of instruction is also convenient especially if the group members stay in different places and would probably find it challenging to travel to meet in the same place [2] as it makes possible for such students to access

content and instruction from whichever place they are in and at any time [2]. It also improves on both students' and teachers' experiences as they not only become more able to plan and pass on the content in a cost-effect way but are also able to handle big numbers of students effectively [4]. When online instruction is correctly carried out, it becomes more beneficial than if done in the traditional face-to-face classroom [2].

According to [2], online teaching/learning facilities if available can reliably support one-to-one, one-to-many, and many-to-many test, audio and audio-visual interactions. With inclusion of multimedia search engines and databases, online frameworks provide viable tools necessary to realize the goal and objectives of the present educational curriculum in Uganda which is active-learning-based in a more realistic way since the relatively small classroom groups do not impose a high demand on network speed allowing high quality synchronous online communication possible; and that online classes reduces the possible anxiety associated with face-to-face discussion in traditional ones [2]. Despite the vast advantages of online instruction, very few studies have documented details about teaching/learning in online environments among secondary schools, and basically the few have been in the medical or engineering section and in higher institution of learning. In addition, no studies have investigated how different factors affect competencies teachers possess in order to effectively conduct online lessons. Therefore, this study sought to fill this gap by investigating factors secondary school science teachers' competencies in planning and implementing online lessons.

Problem Statement

Previously, teacher-learning process has always be conducted in physical classrooms/face-to-face environments. However, due to the global invasion of covid-19 which led to closure of physical classrooms across the entire world, the education process was interfered with. The desire to have learners continue their studies amidst measures to combat the spread of the virus led to a paradigm shift from face-to-face to online learning. Despite this innovation, a number of teachers and students have not fully picked up as far as online instruction is concerned, and this may hinder students' academic progress during and after covid-19 era. Previous researchers mostly focused on: using internet to search for content [5], direct online teaching using PowerPoint [6], using ICT to enhance students' critical thinking, among others. However, little has been done on teachers' knowledge of management systems and how their competencies vary in relation to either gender, school type, school location, among others. Therefore, this study came out to fill such gaps by answering the following questions:

1. How competent are Ugandan Secondary School Science Teachers in Designing and implementing online lessons?
2. What factors influence Secondary School Science Teachers' Competencies in Designing and implementing online lessons?

Literature Review

Teachers' Competency in Designing and Implementing Online Lessons

Online learning initially was used as a way to enhance student participation and increase flexibility [1]. However, its employment became a perquisite during covid-19 outbreak era, bringing about accelerated changes in the education system. Thus, teachers' competencies in being able to design and deliver learning materials in this online environment has a great impact on the students' academic success [3]. [7] define 'competence' as a state of being well qualified to perform an activity, task or job function. Spector and la Teja further say that when a person has the competency to do something, he/she is said to have attained a state of competence that is recognizable and verifiable to a particular community of practitioners.

During planning and implementation of online lessons, a teacher is expected to possess the following competencies as given by [8]: pedagogical (using discussive resource in facilitating learning), social (rewarding the human relations among group members), managerial (being able to put in place measures about the discussion and development of activities), and technical skills (technological transparency for adequate relation between the system, the software and the selected interface).

Particular teachers' competencies specifically applicable to online environments include: being able to use technology; having skills in designing and implementing subject content; moderation, organization and archiving asynchronous discussions; establishment of ground rules, guiding and animating synchronous discussions; integration of different teaching and learning styles to the subject content; actively interacting with students and giving the timely feedback; making students aware of cultural differences among members of the group, internet ethics, among others [9]. To be able to achieve the pedagogical goals in a more effective, innovative and creative way when using online environments, the respective teachers should have the competency to transfer curricular content to the web which is adjusted to fit the media. In addition, these online teachers are advised to always be slow in speech while explaining in detail the different terminologies and also provide a short but detailed summary at the end of every lesson as this helps the students to better understand the content [1].

A teacher planning to work online needs to also deeply understand the nature and philosophy of distance education. In traditional teaching, the learning process is centered on the teacher who tries to transfer his/her own knowledge to the students. However, in online classes, the teaching is focused on the relationship between the teacher, the student, and the knowledge passed on. This therefore calls for the teacher to find educational practices that stimulate this type of online learning [9]. [1] point out that teachers ought to be well prepared before engaging in online instruction. Chao, Tsai and Lin recommended an online learning environment period-dependent specifically for implementing a digital problem-based learning curriculum (Table 1).

Table 1: Preparations recommended prior to, during, and after he implementation of digital PBL curricula

Period	Actions recommended
Before	1. Be sure to assign a moderator to streamline each course
	2. Be sure to allocate themes/questions to avoid speaker crowding
	3. Be sure to ask students to adapt their presentation style
	4. Be sure to introduce and train digital etiquette
	5. Be sure to arrange a preliminary check-up of software/hardware/location/connection
During	1. Try to encourage students' participation; for example, designate a dedicated questioner(s)
	2. Try to rotate speaker orders to encourage interactions
	3. Try to and encourage the provision of feedback, preferably instantaneously
	4. Try to turn off curricula-irrelevant applications, except adjunct communication modules
	5. Consider adopting role playing to encourage participation (optional)
	6. Consider adopting intermittent real-time polling (optional)
	7. Consider monitoring the speed of feedback of the entire group (Optional)
After	1. Be sure to provide content summarization after each digital PBL session
	2. Be sure to address any unfinished issues following each session

Source: [1]

An effective online lesson calls for initial serious planning of the proposed objectives of the subject content and careful studying of the profile, characteristics and needs of the students. As the teachers reflects upon these objectives, they can then be able to design and implement the target activities integrating appropriate ICT tools [9]. Therefore, in online environment, teacher takes up the role of a guider by helping students to form groups and accomplish given tasks, searching for, selecting and organizing the information, managing time and constructing knowledge in the online learning environment [10]. This study was based on the theory of cooperative learning where students work together in small groups to achieve the common goal. In this theory, each and every group member is required to learn the given material and make sure all others do the same [11]. Cooperative learning makes it possible to teach specific content, ensure active cognitive processing information during lessons, and provides a long-term support and assistance for students' academic progress [12]. This theory is very much applicable in this study since the goals and objectives to be achieved by each group in a joint manner are already spelt out and each group member has a role and contribution to make. As students discuss their points of view, it builds and increases in them the spirit of autonomy and collective interaction [13].

Factors that Influence Teachers' Competency in Designing and Implementing Online Lessons

As the education system is struggling to mingle online methodologies of instruction with face-to-face classes, previous studies identified factors that may hinder teachers and studies effectives in adopting to online teaching and learning. These factors include lack of proficiency in technology and cost of data [14], inability to use technological tools [15], lack of: technical support, ICT policies and infrastructure like computers [16]. These challenges render teachers unprepared to construct their lessons to online teaching. Additionally, individual characteristics were also found to influence teachers' competency in conducting online lessons. These characteristics include age, gender, personality, and values [17]. Attitude and beliefs influence one's decision to use or not to use ICT in the classroom [18]. Teachers may not be able to implement online approaches to teaching due to lack of self-confidence [19].

METHODOLOGY

Design

This study used a quantitative research approach with descriptive cross-sectional survey design.

Study participants and sample size

The participants of this study were 50 secondary school science teachers from Uganda who responded to the online survey within a period of one month. The characteristics of these participants are summarized in Table 2.

Table 2: Characteristics of participants

Characteristic		Percentage (frequency)
Gender	Male	66 (33)
	Female	34 (17)
School location	Urban	46 (23)
	Rural	54 (27)
Category of the school	Boarding only	30 (15)
	Both day and boarding	70 (35)
Type of the school	Single-boys	18 (9)
	Single girls	14 (7)
	Both boys and girls	68 (34)
Highest qualification	Postgraduate (masters or PhD)	34 (17)
	Bachelors	58 (29)
	Diploma	8 (4)

For a diploma, the minimum academic requirement is one principle pass obtained at an advanced level of secondary education. It takes 1-2 years, depending on the institution. For a bachelor's degree, the minimum academic requirement is two principles passes obtained at the end of advanced level (after grade 13) or successful completion of a diploma. It takes 3-5 years to complete, depending on the course. Since the participants were from different schools and had trained from different teacher-education institutions, the results from this study could be generalized to give an overview of factors that influence science teachers' competency in designing and implementing online lessons.

Study Instrument

In this study, an instrument was developed by modifying some items from [20] in their paper entitled Developing, Validating, and Implementing a Tool for Measuring the Readiness of Medical Teachers for Online Teaching Post-COVID-19: A Multicenter Study. The items developed spanned the range of skills in: learning and course design, digital communication, basic and advanced computer skills, and using learning management systems. It is a 30-item instrument and used a 5-point Likert scale (Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree). These items were first discussed with three other research experts from education to assess their validity in relation to the problem under investigation. This instrument was then pilot tested among eight members who were part of the final participants of this study. The reliability was obtained by computing Cronbach's Alpha Based on Standardized Items which yielded a value of 0.989, hence render the instrument fit for data collection.

Procedure for Data Collection

The instrument after being validated was then put into electronic form by use of Survey Monkey. A link was obtained which was shared with the intended participants (Secondary School Science Teachers) mainly through WhatsApp. At the start of the online survey, the participants were briefed about the aim of the study and those willing to continue participating in the study were considered to have consented. The instrument was open for data collection for a period of one month. After obtaining possible responses, they were exported in excel form before transferring them to the Statical Package for Social Scientists (SPSS).

Data analysis

Data was entered into the computer using Statical Package for Social Scientists (SPSS) for windows version 23.0. Data was then presented inform of frequency tables and analyzed using descriptive statistics and multivariant analysis of variance (MANOVA) to investigate the factors that influence science teachers' competency in designing and implementing online lessons. Statistically significant values were considered at a p-value less than 0.05.

Ethical Considerations

This study proposal was ethically approved by the Research and Ethics Committee of Kampala International University. The ability of participants to fill and submit their online responses to the survey indicated their consent to participate in this study.

RESULTS AND DISCUSSION

This section presents results from descriptive and inferential statistical analyses of science teachers' competencies in planning and implementing online lessons in terms of skills in technology, communication, basic and advanced computer, and data management systems.

Normality Testing

After data was collected, it was first checked if it was normally distributed using skewness and kurtosis in order to determine which test to use for analysis. All values of Skewness all items ranged between -1.5 and 0.1 while those of

Kurtosis ranged between -0.9 and 5. The data was thus considered normally distributed since these values of skewness and kurtosis were within the standard range of -2 to +2 and -7 to +7 respectively as given by [21, 22].

What are Science Teachers' Competency in designing and implement online lessons?

The participants' competency were divided into five parts according to the questionnaire:

a) Online Teaching and Course Designing - twelve items addressed the competencies in designing courses and educational materials for online teaching and learning, excelling in online teaching, and seeking development in such areas (Table 3).
b) Digital Communication Skills - this looked at the teachers' competence in communicating verbally and in writing and giving feedback to learners. It was addressed basing on six items indicated in Table 4.
c) Basic Computer Skills – This was addressed with four items in Table 5 which looked at the competencies of file management and document creation using the applications of Microsoft Office, sending and receiving emails, surfing the internet for educational materials, and being familiar with a learning management system.
d) Advanced Computer Skills- Four items in Table 6 addressed competencies of file encryption and recording audio and video clips.
e) Learning Management Systems - Four items in Table 7 addressed this part by looking at the comfort and confidence of science teachers in using learning management systems in course development and management.

Descriptive Statistics in form frequency Tables and Bar Charts were used for data analyze for science teachers' competency in designing and implementing online lessons.

Table 3: Science Teachers' Competencies in Online Teaching and Course Designing

	Item	Percentages				
		SA	A	NS	D	SD
1	During teaching, I incorporate online learning activities that are connected to real-world applications (including use of real day-to day cases, reflecting on applying knowledge in life uses)	24	68	8	0	0
2	I am oriented with online course planning.	18	66	8	2	6
3	I feel comfortable designing online interactive learning activities that provide students opportunities to interact with their peers, their instructor, and course content.	16	68	8	6	2
4	I feel comfortable writing measurable learning outcomes based on Blooms taxonomy.	18	72	10	0	0
5	I enjoy online teaching to my students for most of the class period.	16	68	10	2	4
6	I know how to check for plagiarism in student's written assignments.	8	28	46	8	10
7	I expect online teaching to take more time than face-to-face instruction, and I am prepared for it.	18	68	14	0	0
8	I am always keen to participate as a learner in online workshops, discussion forums, webinars... etc., to update my knowledge and skills in online teaching.	20	64	10	6	0
9	I am good at creating online teaching materials (including lessons, notes, manuals, assignments, among others).	18	68	8	4	2
10	I understand the copyright law and Fair Use guidelines when using copyrighted materials in education.	8	36	22	24	10
11	I feel comfortable conducting interactive learning activities (like small group case-based discussions, PBL, TBL, seminars...) where students can interact with their peers and teacher	20	68	10	2	0
12	I am able to create schedules for myself and stick to them	18	70	10	2	0

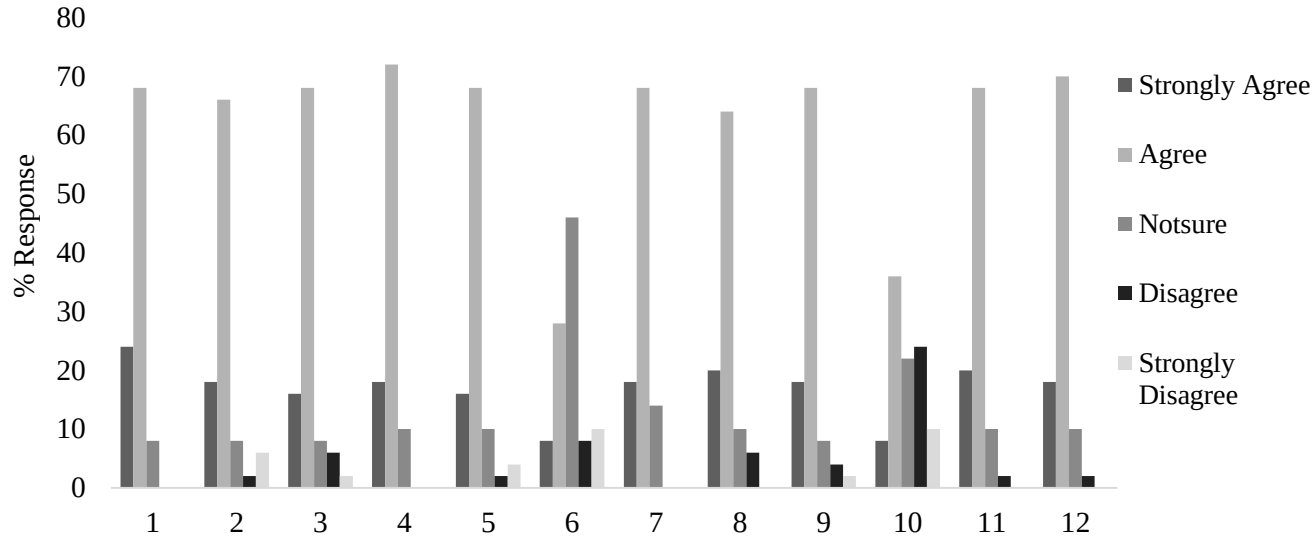

Figure 1: Science Teachers' Competency in teaching and course designing

Responses collected regarding science teachers' competencies in teaching and course designing presented in Table 3 indicated that, among the participants, 68% agreed and 24% strongly agreed that during teaching, they incorporate online learning activities that are connected to real-world applications; 66% agreed and 18% strongly agreed that they are oriented with online course planning; 68% agreed and 16% strongly agree that they feel comfortable designing online interactive learning activities that provide students opportunities to interact with their peers, their instructor, and course content; 72% agreed and 18% strongly agreed that they feel comfortable writing measurable learning outcomes based on Blooms taxonomy; 68% agree and 16% strongly agreed that they enjoy online teaching to their students for most of the class period; 68% agreed and 18% strongly agreed that they expect online teaching to take more time than face-to-face instruction, and that they are prepared for it; 64% agreed and 20% strongly agreed that they are always keen to participate as a learner in online workshops, discussion forums, webinars among others, to update their knowledge and skills in online teaching; 68% agreed and 18% strongly agreed that they are good at creating online teaching materials; 68% agreed and 20% strongly agreed that they feel comfortable conducting interactive learning activities where students can interact with their peers and teacher; and finally, 70% agree and 18% strongly agreed that they are able to create schedules for themselves and stick to them. Much as majority (more than 60%) of the participants showed that they strongly possessed skills in technology, only 28% agreed and 8% strongly agreed that they had knowledge of how to check for plagiarism in student's written assignments. In a similar way, 36% agreed and 8% strongly agreed that they understood the copyright law and Fair Use guidelines when using copyrighted materials in education. These finding are more illustrated in Figure 1. Thus, we can say that on average, science teachers are competent in online teaching and course design. In this regard, there need to make sure that the course materials are well aligned to learning outcomes as some teachers may find it challenging to prepare learner activities that allow learners to achieve the intended goals as pointed out by [23].

What are Science Teachers' Competencies in Digital Communication?

Table 4: Science Teachers' Competencies in Digital Communication

No.	Item	SA	Percentages A	NS	D	SD
13	I feel comfortable using social media tools to communicate with students and colleagues.	36	72	8	4	0
14	I feel comfortable communicating through speaking.	16	70	14	0	0
15	I feel comfortable communicating through writing.	18	66	16	0	0
16	I am ready to timely respond to communication requests from students and colleagues.	16	72	12	0	0
17	I am available to my students on a regular basis for questions and assistance.	16	74	10	0	0
18	I am willing to provide timely and constructive feedback to student performance.	16	74	10	0	0

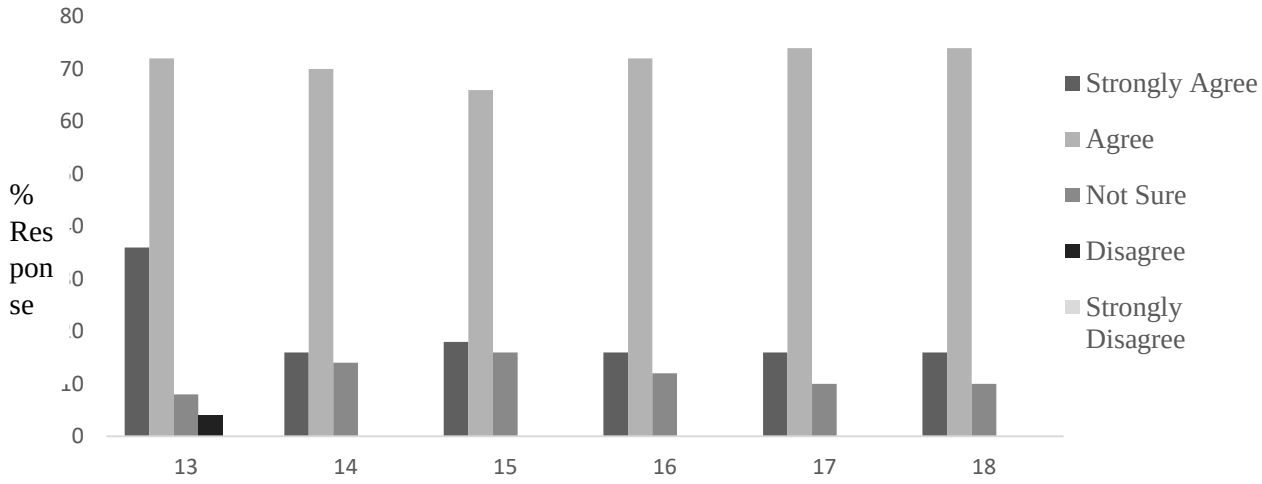

Figure 2: Science Teachers' Competencies in Digital Communication Skills

From Table 4, 72% agreed and 36% strongly agree that they feel comfortable using social media tools to communicate with students and colleagues; 70% agreed and 16% strongly agreed that they feel comfortable communicating through speaking; 66% agreed and 18% strongly agreed that they feel comfortable communicating through writing; 72% agreed and 16% strongly agreed that they are ready to timely respond to communication requests from students and colleagues; 74% agree and 16% strongly agreed that they are available to their students on a regular basis for questions and assistance; 74% agreed and 16% strongly agreed that they are willing to provide timely and constructive feedback to student performance. A few (about 12%) of the participants though were not sure of whether they had the required skills or not. In addition, Figure 2 clearly indicates that most of the science teachers agreed that they had the competency in digital communication.

What are Science Teachers' Basic Computer Competencies?

Table 4: Science Teachers' Competency in Basic Computer Skills

No.	Item	Percentages SA	A	NS	D	SD
19	I can send and receive emails, including opening and sending email attachments.	54	40	6	0	0
20	I can perform file management on my computer, such as copying, moving, renaming, and deleting files or folders	50	44	6	0	0
21	I can use Internet browsers, such as Google Chrome, Firefox, or Safari, to locate resources for teaching.	48	46	4	2	0
22	I can use Microsoft Office tools such as Word and PowerPoint to create documents and presentations.	48	44	6	2	0

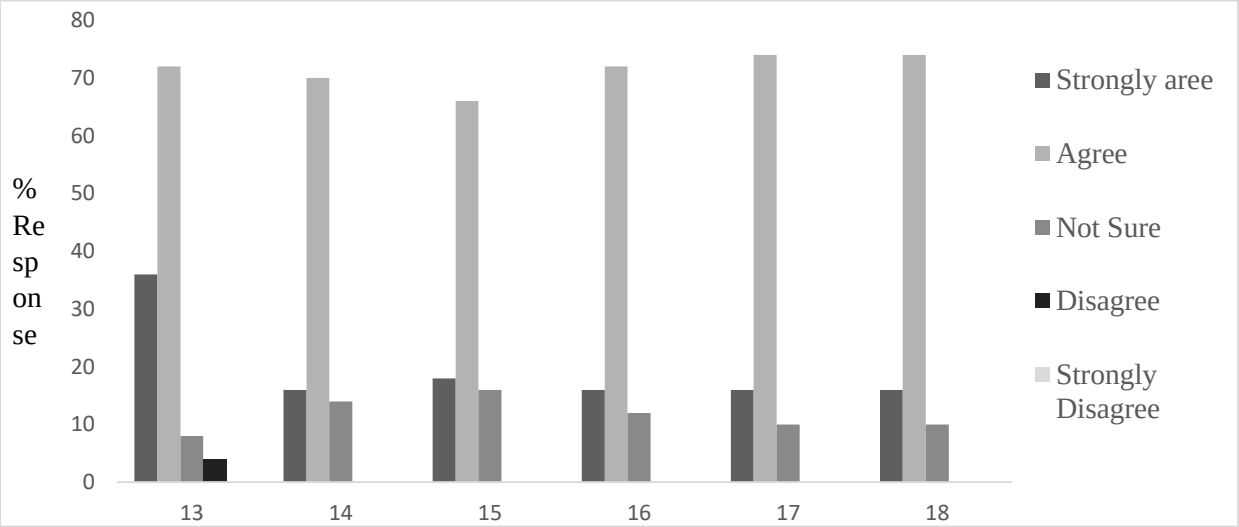

Figure 3: Science Teachers' Competency in Basic Computer Skills

The findings in Table 5 show that almost all the teachers (more than 90%) knew how to send and receive emails, including opening and sending email attachments; can perform file management on my computer, such as copying, moving, renaming, and deleting files or folders; can use Internet browsers, such as Google Chrome, Firefox, or Safari, to locate resources for teaching; and also can use Microsoft Office tools such as Word and PowerPoint to create documents and presentations.

Table 6: Science Teachers' Competency in Advanced Computer Skills

No.	**Item**	Percentages SA	A	NS	D	SD
23	I am familiar with at least one synchronous online teaching platform, like Zoom, Microsoft Teams, Canvas, among others.	26	64	8	2	0
24	I can add audio/video files to my presentations.	8	26	58	6	2
25	I can encrypt (lock with passwords) files on my personal computer to protect important data.	6	60	28	4	2
26	I can record audio/video using phone, tablet or computer.	64	34	0	2	0

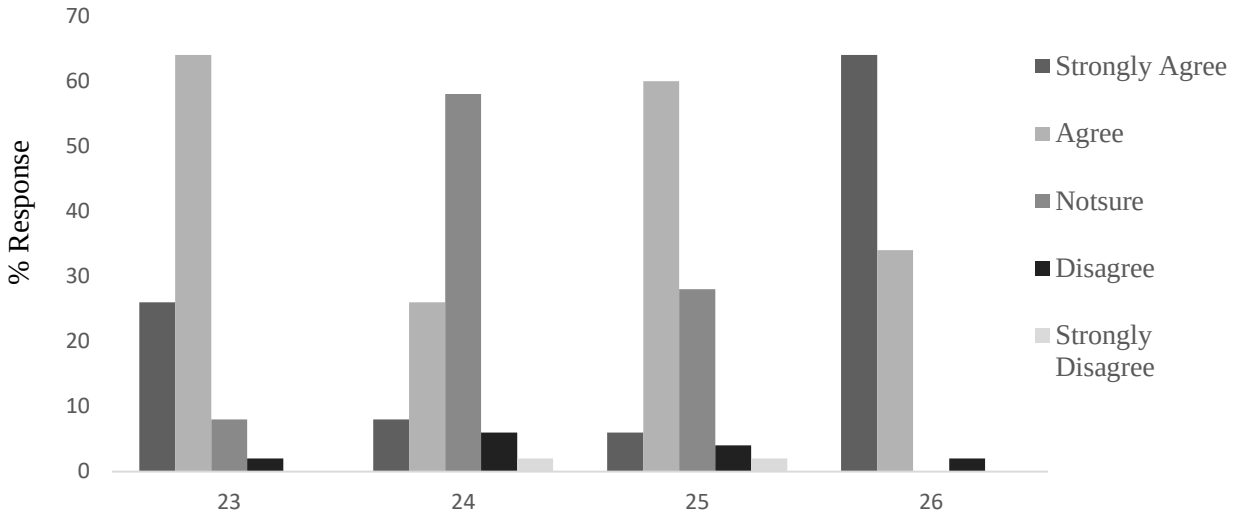

Figure 4: Science Teachers' Competency in Advanced Computer Skills

The findings in Table 6 indicated that much as 64% agreed and 26% strongly agreed that they are familiar with at least one synchronous online teaching platform, like Zoom, Microsoft Teams, and Canvas; 60% agreed and 6 % strongly agreed that they could encrypt files on their personal computer to protect important data; and 34% agreed and 64% strongly agreed that they could record audio/video using phone, tablet or computer. Only 26% agreed and 8% strongly agreed that they could add audio/video files to my presentations.

Table 7: Science Teachers'' Competencies in Using Learning Management Systems

		Percentages				
No.	Item	SA	A	NS	D	SD
27	I am comfortable using the learning management system or other online assessment tools (such as: quizzes, exams, assignments, rubrics... etc.) to evaluate student performance.	2	12	52	18	16
28	I am comfortable using tools in the learning management system (such as: uploading learning materials [reading materials, audio/video files...], synchronous and asynchronous communication, posting feedback, building forums...to facilitate student learning.	0	28	50	14	8
29	I am comfortable using the learning management system tools to develop an online course.	0	18	44	20	18
30	I am comfortable using the learning management system to record and report student grades.	0	58	30	2	10

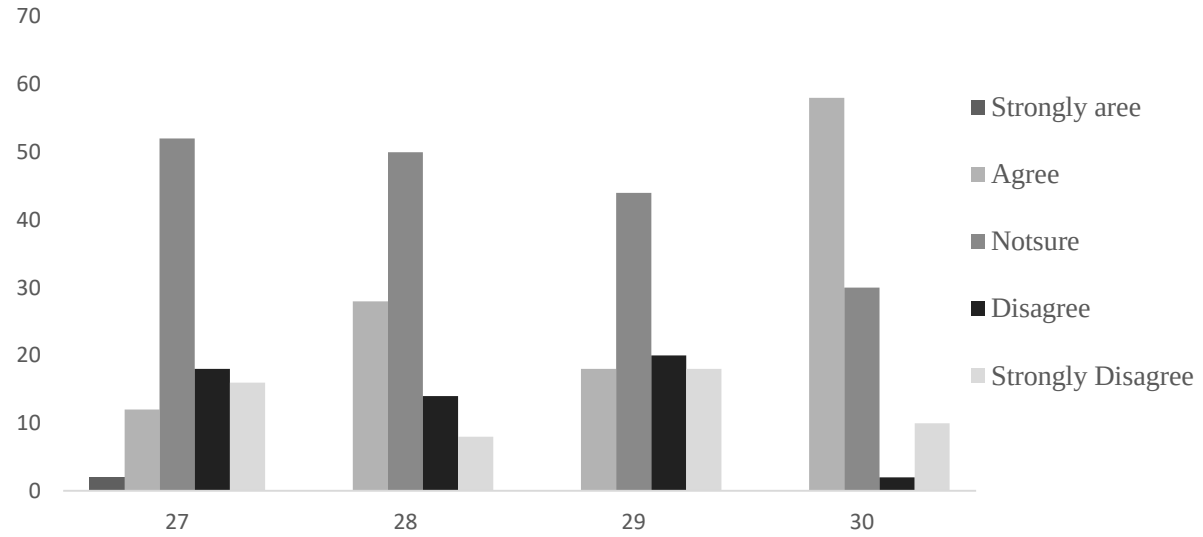

Figure 5: Science Teachers Competency in Learning Management System

Findings in Table 7 indicated that only 12% agreed and 2% strongly agreed that they are comfortable using the learning management system or other online assessment tools to evaluate student performance; 28% agreed that they are comfortable using tools in the learning management system such as uploading learning materials, synchronous and asynchronous communication, posting feedback, and building forums to facilitate student learn;18% agreed that they are comfortable using the learning management system tools to develop an online course. However, 58% agreed that they are comfortable using the learning management system to record and report student grades. It is very vital for teachers to possess the competency of using learning management system as most schools are the moment require teachers to upload their learning materials online to be assessed by students especially during holidays. These teachers are also required to use the same system to send their examinations/quizzes to learners after which the results are also stored and analyzed using computers. Findings in this study indicated that teachers possess basic competencies in designing and implementing online lessons. In relation to these findings, [23] found out that teachers to a great extent possessed skills required to use the learning management systems that enable them to design proper online courses with appropriate learning outcomes to support the learners. Several respondents in the study by [5] said they had used virtual learning environments (VLEs) such as Moodle (mentioned by six teachers), while two teachers had written software for these kinds of platforms.

What factors influence Science Teachers' Competencies in Designing and Implementing Online lessons?

This question was answered by investigating different factors such as gender, school location, school category, type of the school, and highest qualification of the participants; in relation to science teachers' competency in learning and designing materials, digital communication skills, basic computer skills, advanced computer skills, and learning management system. The data collected in this case was analyzed using Descriptive Statistics and MANOVA.

Factors that influence Science Teachers' Competency in online teaching and course design

The MANOVA test using Wilks' Lambda between gender and science teachers' competency in online teaching and course designing was found to be non-significant, Wilk's A = 0.692, F (12, 37) = 1.375, p = 0.221, η^2 =0.308. This implies that gender had no effect on science teachers' competency in online teaching and course design. On the hand, the MONOVA test using Wilks' Lambda between school

location and science teachers' competency in online teaching and course design was found to be significant with a moderate effect size, Wilks' A = 0.511, F(12, 37) = 2.949, p = 0.006 and η^2 = 0.489. This means that there is a significant in the competency of science teachers in online teaching and course design between those who teach in urban schools and those in rural schools. Because of this significance, univariate ANOVA results were examined at this stage see which pairs of means were different Table 8.

Table 8: Descriptive statistics and Tests of Between-Subjects Effects for School Location and Science Teachers' Competencies in Online Teaching and Course Designing

	Descriptive Statistics				Tests of Between-Subjects Effects					
	Urban based		Rural based							
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	P	η^2
1	4.43	0.507	3.93	0.474	3.216	1	3.216	13.418	0.001	0.218
2	4.22	0.671	3.59	1.047	4.848	1	4.848	6.056	0.018	0.112
3	4.17	0.650	3.67	0.877	3.196	1	3.196	5.234	0.027	0.098
4	4.30	0.470	3.89	0.506	2.144	1	2.144	8.920	0.004	0.157
5	4.26	0.541	3.59	0.931	5.547	1	5.547	9.196	0.004	0.161
6	3.65	0.775	2.74	1.059	10.317	1	10.317	11.679	0.001	0.196
7	4.26	0.449	3.85	0.602	2.078	1	2.078	7.205	0.010	0.131
8	4.35	0.487	3.67	0.784	5.763	1	5.763	13.037	0.001	0.214
9	4.17	0.650	3.78	0.847	1.949	1	1.949	3.345	0.074	0.065
10	3.74	0.964	2.52	1.014	18.504	1	18.504	18.828	0.000	0.282
11	4.35	0.487	3.81	0.622	3.529	1	3.529	11.076	0.002	0.187
12	4.30	0.470	3.81	0.622	2.976	1	2.976	9.560	0.003	0.166

Table 8 shows that for all other items other than item 9, science teachers' competencies in online teaching and course design were significant ($p < 0.05$). Additionally, MONOVA test using Wilks' Lambda between School Category and Science Teachers' Competencies in Online Teaching and Course Design was found to be non-significant, Wilks' A = 0.641, F(12, 37) = 1.730, p = 0.100 and η^2 = 0.359. Similarly, the MONOVA test using Wilks' Lambda between type of school and science teachers' competencies in online teaching and course design was also found to be non-significant Wilks' value = 0.485, F (24, 72) = 1.306, p = 0.193 and η^2 = 0.303. On the other hand, MONOVA test was significant between highest academic qualification and science teachers' competencies in online teaching and course designing and effect size was moderate, Wilks' value = 0.187, F(24, 72) = 3.938, p = 0.000, η^2= 0.568. With this significant test, a univariate ANOVA results were examined Table 9.

Table 12: Descriptive Statistics and Tests of Between-Subjects Effects for Highest Academic Qualification and Science Teachers' Competencies in Online Teaching and Course Designing

	Descriptive Statistics						Tests of Between-Subjects Effects					
	Postgraduate		Bachelors		Diploma							
Item	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
1	4.41	0.507	4.17	0.384	3.00	0.0	6.464	2	3.232	18.401	0.000	0.439
2	4.12	0.781	3.93	0.884	2.50	1.0	8.653	2	4.327	5.873	0.005	0.200
3	4.06	0.748	3.97	0.778	2.75	0.5	5.843	2	2.922	5.151	0.009	0.180
4	4.18	0.529	4.17	0.384	3.00	0.0	5.071	2	2.536	13.844	0.000	0.371
5	4.00	0.935	3.97	0.778	3.00	0.0	3.534	2	1.767	2.682	0.079	0.102
6	3.47	0.717	3.28	0.922	1.00	0.0	20.692	2	10.346	15.182	0.000	0.392
7	4.18	0.529	4.10	0.489	3.00	0.0	4.760	2	2.380	10.023	0.000	0.299
8	4.18	0.529	4.03	0.731	2.75	0.5	6.794	2	3.397	7.909	0.001	0.252
9	3.94	0.659	4.17	0.602	2.50	1.0	9.841	2	4.920	11.517	0.000	0.329
10	4.00	0.612	2.62	1.115	2.50	1.0	21.852	2	10.926	11.717	0.000	0.333
11	4.29	0.470	4.07	0.593	3.00	0.0	5.429	2	2.714	9.526	0.000	0.288
12	4.29	0.470	4.07	0.458	2.75	0.5	7.779	2	3.889	18.025	0.000	0.434

Factors that influence Science Teachers' Competencies in Digital Communication Skills

Descriptive Statistics and ANOVA values of factors influencing science teachers' competency in digital communication skills are presented in Tables 13, 14, 15, 16 and 17.

Table 13: Descriptive Statistics and ANOVA values for Gender and Science Teachers' Competencies in Digital Communication

	Male		Female		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
13	3.94	0.659	4.12	0.600	0.357	1	0.357	0.871	0.355	0.018
14	4.00	0.559	4.06	0.556	0.039	1	0.039	0.125	0.726	0.003
15	4.03	0.585	4.00	0.612	0.010	1	0.010	0.029	0.865	0.001
16	4.03	0.529	4.06	0.556	0.009	1	0.009	0.031	0.860	0.001
17	4.09	0.522	4.00	0.500	0.093	1	0.093	0.350	0.557	0.007
18	4.06	0.496	4.06	0.556	0.000	1	0.000	0.000	0.991	0.000

Wilks' Lambda value was 0.832 and it was found to be significant (F = 544.169, p = 0.22, η^2 = 0.168).

Table 14: Descriptive Statistics and ANOVA Values for School Location and Science Teachers' Competencies in Digital Communication

	Urban Based		Rural Based		Tests of Between-Subjects Effects)					
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
13	4.30	0.470	3.74	0.656	3.945	1	3.945	11.795	0.001	0.197
14	4.30	0.470	3.78	0.506	3.444	1	3.444	14.329	0.000	0.230
15	4.35	0.487	3.74	0.526	4.577	1	4.577	17.715	0.000	0.270
16	4.26	0.449	3.85	0.534	2.078	1	2.078	8.4220	0.006	0.149
17	4.30	0.470	3.85	0.456	2.543	1	2.543	11.878	0.001	0.198
18	4.30	0.470	3.85	0.456	2.543	1	2.543	11.878	0.001	0.198

Wilks' Lambda's value was 0.668 and it was non-significant (F = 3.557. p = 0.006, and η^2 = 0.332)

Table 15: Descriptive Statistics and ANOVA Values for Category of the School and Science Teachers' Competencies in Digital Communication

Item	Boarding only		Both day and boarding		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
13	4.40	0.507	3.83	0.618	3.429	1	3.429	9.931	0.003	0.171
14	4.47	0.516	3.83	0.453	4.275	1	4.275	19.170	0.000	0.285
15	4.47	0.516	3.83	0.514	4.275	1	4.275	16.152	0.000	0.252
16	4.40	0.507	3.89	0.471	2.777	1	2.777	11.963	0.001	0.200
17	4.33	0.488	3.94	0.482	1.601	1	1.601	6.850	0.012	0.125
18	4.40	0.507	3.91	0.445	2.477	1	2.477	11.496	0.001	0.193

Wilks' Lambda' value was 0.673 and was nonsignificant (F = 3.475, p = 0.007, η^2 = 0.327).

Table 16: Descriptive Statistics and ANOVA Values for Type of School and Science Teachers' Competencies in Digital Communication

Item	Single-boys		Single-girls		Both boys and girls		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
13	4.22	0.441	4.57	0.535	3.82	0.626	3.789	2	1.894	5.493	0.007	0.189
14	4.33	0.50	4.57	0.535	3.82	0.459	4.325	2	2.162	9.538	0.000	0.289
15	4.33	0.50	4.57	0.535	3.82	0.521	4.325	2	2.162	8.030	0.001	0.255
16	4.22	0.441	4.57	0.535	3.88	0.478	3.121	2	1.560	6.791	0.003	0.224
17	4.22	0.441	4.43	0.535	3.94	0.489	1.668	2	0.834	3.514	0.038	0.130
18	4.22	0.441	4.57	0.535	3.91	0.452	2.815	2	1.407	6.612	0.003	0.22

Wilks' Lambda' value was 0.598 and was nonsignificant (F = 2.048, p = 0.029, η^2 = 0.226)

Table 17: ANOVA results of Highest Academic Qualification and Science Teachers' Competencies in Digital Communication

Item	Postgraduate		Bachelors		Diploma		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
13	4.24	0.437	4.03	0.566	2.75	0.5	7.226	2	3.613	13.293	0.000	0.361
14	4.18	0.393	4.07	0.53	3.00	0.0	4.647	2	2.324	10.570	0.000	0.31
15	4.12	0.485	4.10	0.557	3.00	0.0	4.526	2	2.263	8.539	0.001	0.267
16	4.12	0.485	4.14	0.441	3.00	0.0	4.707	2	2.354	12.006	0.000	0.338
17	4.12	0.485	4.14	0.441	3.25	0.5	2.857	2	1.429	6.739	0.003	0.223
18	4.12	0.485	4.14	0.441	3.25	0.5	2.857	2	1.429	6.739	0.003	0.223

Wilks' Lambda' value was 0.514 and was significant (F = 2.760b, p = 0.003, η^2 = 0.283)

Factors that influence Science Teachers' Competency in Basic Computer Skills

Descriptive statistics and ANOVA values for factors that influence science teachers' competency in basic computer skills are presented in Tables 18, 19, 20, 21 and 22.

Table 18: Descriptive Statistics and ANOVA Values for Gender and Science Teachers' Basic Computer Competencies

	Male		Female		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
19	4.52	0.566	4.41	0.712	0.120	1	0.120	0.314	0.578	0.006
20	4.45	0.564	4.41	0.712	0.021	1	0.021	0.054	0.817	0.001
21	4.42	0.663	4.35	0.702	0.057	1	0.057	0.125	0.725	0.003
22	4.39	0.659	4.35	0.786	0.019	1	0.019	0.038	0.846	0.001

Wilks' Lambda value was 0.99 and was non-significant (F = 0.115, p = 0.977, η^2 = 0.01).

Table 19: Descriptive Statistics and ANOVA values for School Location and Science Teachers' Basic Computer Skills

	Urban based		Rural based		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
19	4.65	0.487	4.33	0.679	1.263	1	1.263	3.52	0.067	0.068
20	4.65	0.487	4.26	0.656	1.917	1	1.917	5.611	0.022	0.105
21	4.57	0.59	4.26	0.712	1.163	1	1.163	2.678	0.108	0.053
22	4.61	0.583	4.19	0.736	2.228	1	2.228	4.961	0.031	0.094

Wilks' Lambda value was 0.865 and non-significant (F = 1.759, p = 0.154, η^2 = 0.135).

Table 20: Descriptive Statistics and ANOVA results for Category of the School and Science Teachers' basic Computer Skills

	Boarding only		Both day and boarding		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
19	4.67	0.488	4.40	0.651	0.747	1	0.747	2.021	0.162	0.040
20	4.67	0.488	4.34	0.639	1.101	1	1.101	3.069	0.086	0.060
21	4.47	0.640	4.37	0.690	0.095	1	0.095	0.209	0.650	0.004
22	4.67	0.617	4.26	0.701	1.761	1	1.761	3.839	0.056	0.074

Wilks' Lambda value was 0.883 and was non-significant (F = 1.484, p = 0.223, η^2 = 0.117).

Table 21: Descriptive Statistics and ANOVA results for Type of the School and Basic Teachers' Basic Computer skills

	Single-boys		Single-girls		Both boys and girls		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
19	4.67	0.500	4.57	.535	4.41	0.657	0.530	2	0.265	0.694	0.504	0.029
20	4.56	0.527	4.71	.488	4.35	0.646	0.905	2	0.452	1.221	0.304	0.049
21	4.22	0.667	4.71	0.488	4.38	0.697	0.986	2	0.493	1.103	0.340	0.045
22	4.44	0.726	4.71	0.488	4.29	0.719	1.070	2	0.535	1.108	0.339	0.045

Wilks' Lambda value was 0.872 and non-significant (F = 0.782, p = 0.62, η^2 = 0.066).

Table 22: Descriptive Statistics and ANOVA values for Highest academic Qualification and Science Teachers' Competency in Basic Computer Skills

Item	Postgraduate		Bachelors		Diploma		Tests of Between-Subjects Effects				p	η^2
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F		
19	4.47	0.624	4.59	0.501	3.75	0.957	2.460	2	1.230	3.609	0.035	0.133
20	4.65	0.606	4.45	0.506	3.50	0.577	4.265	2	2.133	7.132	0.002	0.233
21	4.65	0.606	4.38	0.494	3.50	1.291	4.290	2	2.145	5.693	0.006	0.195
22	4.47	0.717	4.48	0.509	3.25	0.957	5.553	2	2.777	7.160	0.002	0.234

Wilks' Lambda value was 0.634 and was ono-significant (F = 2.820, p = 0.008, η^2 = 0.204).

Factors that influence Science Teachers' Competency in Advanced Computer Skills

The values of Descriptive statistics and ANOVA for factors that influence science teachers' competency in advanced computer skills are presented in Tables 23, 24, 25, 26 and 27.

Table 23: Descriptive Statistics and ANOVA Values for Gender and Science Teachers' Competency in Advanced Computer Skills

Item	Male		Female		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
23	4.18	0.635	4.06	0.659	0.170	1	0.170	0.410	0.525	0.008
24	3.27	0.761	3.41	0.870	0.217	1	0.217	0.340	0.563	0.007
25	3.58	0.751	3.76	0.752	0.401	1	0.401	0.709	0.404	0.015
26	4.67	0.479	4.47	0.800	0.431	1	0.431	1.179	0.283	0.024

Wilks' Lambda value was 0.904 and non-significant (F = 1.188, p = 0.329, η^2 = 0.096).

Table 24: Descriptive Statistics and ANOVA Values of Location of the School and Teachers' Competency in Advanced Computer Skills

Item	Urban based		Rural based		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
23	4.30	0.559	4.00	0.679	1.15	1	1.15	2.926	0.094	0.057
24	3.70	0.765	3.00	0.679	6.01	1	6.01	11.601	0.001	0.195
25	3.83	0.576	3.48	0.849	1.475	1	1.475	2.718	0.106	0.054
26	4.70	0.47	4.52	0.700	0.39	1	0.39	1.062	0.308	0.022

Wilks' Lambda' value was 0.774 and non-significant (F = 3.287, p = 0.019, η^2 = 0.226).

Table 25: Descriptive Statistics and ANOVA Values for Category of the School and Teachers' Competency in Advanced Computer Skills

Item	Boarding only		Both day and boarding		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
23	4.33	0.617	4.06	0.639	0.801	1	0.801	2.000	0.164	0.040
24	3.67	0.816	3.17	0.747	2.575	1	2.575	4.367	0.042	0.083
25	3.93	0.594	3.51	0.781	1.844	1	1.844	3.447	0.070	0.067
26	4.73	0.458	4.54	0.657	0.381	1	0.381	1.038	0.313	0.021

Wilks' Lambda's value was 0.908 and non-significant (F = 1.142, p = 0.349, η^2 = 0.092).

Table 26: Descriptive Statistics and ANOVA values for Type of the School and Teachers' Competency in Advanced Computer Skills

Item	Single-boys		Single-girls		Both boys and girls		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
23	4.22	0.667	4.57	0.535	4.03	0.627	1.78	2	0.89	2.293	0.112	0.089
24	3.22	0.667	4.00	0.816	3.21	0.770	3.766	2	1.883	3.264	0.047	0.122
25	3.78	0.667	3.53	0.788	3.64	0.749	1.494	2	0.747	1.349	0.269	0.054
26	4.57	0.535	4.59	0.657	4.60	0.606	0.050	2	0.025	0.066	0.936	0.003

Wilks' Lambda' value was 0.815 and non-significant (F = 1.188, p = 0.315, η^2 = 0.097)

Table 27: Descriptive Statistics and ANOVA Values for Highest Qualification and Science Teachers' Competency in Advanced Computer Skills

Item	Postgraduate		Bachelors		Diploma		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
23	4.29	0.686	4.17	0.468	3.25	0.957	3.603	2	1.801	5.157	0.009	0.180
24	3.59	0.795	3.31	0.660	2.25	0.957	5.805	2	2.903	5.441	0.007	0.188
25	3.76	0.562	3.69	0.660	2.75	1.500	3.504	2	1.752	3.429	0.041	0.127
26	4.59	0.507	4.72	0.455	3.75	1.258	3.339	2	1.670	5.353	0.008	0.186

Wilks' Lambda's value was 0.655 and significant (F= 2.596, p = 0.014, η^2 = 0.191).

Factors that influence Science Teachers' Competency in Using Learning Management Systems

Descriptive statistics and ANOVA values for factors that influence science teachers' competency in using learning management systems are presented in Tables 28, 29, 30, 31 and 32

Table 28: Descriptive Statistics and ANOVA Values for Gender and Science Teachers' Competency in Using Learning Management Systems

Item	Male		Female		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
27	2.61	0.966	2.76	0.97	0.282	1	0.282	0.302	0.585	0.006
28	2.97	0.81	3.00	1.00	0.010	1	0.010	0.013	0.908	0.000
29	2.67	0.99	2.53	1.007	0.211	1	0.211	0.213	0.646	0.004
30	3.36	0.822	3.35	1.169	0.001	1	0.001	0.001	0.970	0.000

Wilks' Lambda value was 0.968 and was non-significant (F = 0.366, p = 0.832, η^2 = 0.032).

Table 29: Descriptive Statistics and ANOVA Values for School Location and Teachers' Competency in Using Learning Management Systems

Item	Urban		Rural		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
27	3.00	0.953	2.37	0.884	4.924	1	4.924	5.865	0.019	0.109
28	3.48	0.665	2.56	0.801	10.574	1	10.574	19.222	0.000	0.286
29	2.96	0.976	2.33	0.920	4.823	1	4.823	5.390	0.025	0.101
30	3.74	0.689	3.04	1.018	6.122	1	6.122	7.858	0.007	0.141

Wilks' Lambda value was 0.712 and was significant (F = 4.556, p = 0.004, η^2 = 0.288).

Table 30: Descriptive Statistics and ANOVA Values for Category of the School and Science Teachers' Competency in Using Learning Management Systems

Item	Boarding Only		Both Day and Boarding		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
27	3.13	0.990	2.46	0.886	4.801	1	4.801	5.701	0.021	0.106
28	3.53	0.640	2.74	0.852	6.561	1	6.561	10.353	0.002	0.177
29	3.20	1.014	2.37	0.877	7.209	1	7.209	8.528	0.005	0.151
30	3.73	0.799	3.20	0.964	2.987	1	2.987	3.537	0.066	0.069

Wilks' Lambda value was 0.782 and was significant (F = 3.138, p = 0.023, η^2 = 0.218).

Table 31: Descriptive Statistics and ANOVA Values for Type of School and Science Teachers' Competency in Using Learning Management Systems

	Single-boys		Single-girls		Both boys and girls		Tests of Between-Subjects Effects					
Item	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
27	2.67	1.000	3.57	0.535	2.47	0.929	7.035	2	3.518	4.330	0.019	0.156
28	3.11	0.782	3.71	0.488	2.79	0.880	5.104	2	2.552	3.763	0.030	0.138
29	2.78	1.093	3.14	1.215	2.47	0.896	2.897	2	1.448	1.517	0.230	0.061
30	3.56	1.014	4.00	0.000	3.18	0.968	4.357	2	2.178	2.614	0.084	0.100

Wilks' Lambda value was 0.802 and was non-significant ($F = 1.280$, $p = 0.264$, $\eta^2 = 0.104$).

Table 32: Descriptive Statistics and ANOVA Values for Highest Academic Qualification and Science Teachers' Competency in Using Learning Management Systems

Item	Postgraduate		Bachelors		Diploma		Tests of Between-Subjects Effects					
	Mean	SD	Mean	SD	Mean	SD	Type III Sum of Squares	df	Mean Square	F	p	η^2
27	2.76	0.903	2.72	0.96	1.75	0.957	3.618	2	1.809	2.044	0.141	0.080
28	3.24	0.970	2.93	0.753	2.25	0.957	3.309	2	1.655	2.310	0.110	0.089
19	2.59	1.064	2.76	0.912	1.75	0.957	3.602	2	1.801	1.916	0.159	0.075
30	3.47	1.007	3.41	0.825	2.50	1.291	3.250	2	1.625	1.897	0.161	0.075

Wilks' Lambda value was 0.811 and was non-significant ($F = 1.211$, $p = 0.302$, $\eta^2 = 0.099$).

In regard to the factors that influence science teachers' competency in designing and implementing online lessons, it was found out that the location of the school and academic qualifications of teachers had a great influence on the competencies of online learning and course design, digital communication skills, basic and advanced computer skills and in using learning management systems. Those who worked in urban schools and those with high academic qualifications had greater competency. This could be related to the fact that urban schools have access to electricity compared to the rural schools of which some may not have electricity access. This hinders rural schools from using gargets that use electricity. [23] in a similar study found out that inadequate infrastructure and instructional materials such as inadequate computers, low server capacity and poor internet prevalent in rural based institutions were a hindrance in designing online courses.

CONCLUSION

In order to sustain student learning even when schools were closed due to Covid-19 outbreak, online learning become the immediate means to address this challenge. So, the competencies possessed by teachers to be able to design for and implement online lessons are crucial. This study revealed that generally, teachers were competent in areas of learning and course design, digital communication skills, and basic computer skills. However, they to some extent lacked competencies in advanced computer, and in Using Learning Management Systems. The findings further indicated that science teachers' competency in designing and implementing online lessons were generally influenced by location of the school and teachers' highest academic qualification - with those in urban areas and those with higher qualifications being more competent. The findings of this study give great insights related to teachers' online competencies which can be a reference point for higher education officials and school administrators to

support these teachers for better realization of online educational goals.

REFERENCES

1. Chao, C., Tsai, C., & Lin, M. (2021). Fully digital problem-based learning for undergraduate medical students during the COVID-19 period : Practical considerations. *Journal of the Formosan Medical Association*,*xxxx*.https://doi.org/10.1016/j.jfma.2021.11.011
2. Ng, M. L., Bridges, S., Law, S. P., & Whitehill, T. (2013). Designing, implementing and evaluating an online problem-based learning (PBL) environment-A pilot study. *Clinical Linguistics and Phonetics*, *28*(1–2),117–130. https://doi.org/10.3109/02699206.2013.807879
3. Suryanti, S., Sutaji, D., Nusantara, T., & Subanji. (2021). An Assessment of Teachers ' Readiness for Online Teaching. *Journal of Physics: Conference Series*, *1933*, 1–7. https://doi.org/10.1088/1742-6596/1933/1/012117
4. Means, B., Toyama, Y., Murphy, R., Bakia, M., & Jones, K. (2009). Evaluation of evidence-based practices in online learning: A meta-analysis and review of online learning studies. U.S. Department of Education. repository.alt.ac.uk/629
5. Bracher, J. (2013). A survey of online teaching by native-speaker English instructors at Japanese universities. *Jaltcalljournal*, *9*(3), 221–239.
6. Aslan, A. (2021). Computers & Education Problem- based learning in live online classes : Learning achievement , problem-solving skill , communication skill , and interaction. *Computers & Education*, *171*(May), 104237. https://doi.org/10.1016/j.compedu.2021.104237
7. Spector, J. M., & De la Teja, I. (2001). *Competencies for online teaching*. ERIC Clearinghouse on Information & Technology, Syracuse University. http://ericit.org/digests/EDO-IR-2001-09.pdf
8. Berge, Z. L. (1995). The role of the online instructor/facilitator. *Educational technology*, *35*(1), 22-30.http://www.emoderators.com/moderators/teach_online.html.
9. Queiroz, V., & Mustaro, P. N. (2003). Roles and Competencies of Online Teachers. *The Internet TESL Journal*, *IX*(7). http://iteslj.org/
10. Donnelly, R. (2007). Online Problem-Based Learning Approach in Higher Education. In L. Tomei (Ed.). *Online and Distance Learning: Concepts, Methodologies, Tools and Applications*.https://arrow.tudublin.ie/ltcbk Part
11. Slavin, R. E. (2013). Cooperative learning and achievement: Theory and research. https://psycnet.apa.org/record/2012-28463-008
12. Johnson, D. W., & Johnson, R. T. (2010). Cooperative learning and conflict resolution: Essential 21st century skills. *21st century skills: Rethinking how students learn*, 201-219.https://www.academia.edu/download/59917701/Cooperative_Learning_and_Conflict_Resolution20190702-23047-1ntffld.pdf. https://www.sciencedirect.com/science/article/pii/S0929664621005313
13. Cloud, T. (2014). Cooperative learning in the classroom. *Journal on Best Teaching Practices*,1(2),7-8.http://teachingonpurpose.org/wp content/uploads/2015/03/Cloud-T.-2014.-Cooperative-Learning-in-the-Classroom.pdf
14. Henaku, E. A. (2020). COVID-19: Online learning experience of college students: The case of Ghana. International Journal of Multidisciplinary Sciences and Advanced Technology, 1(2), 54-62.
15. Aboagye, E., Yawson, J. A., &

Appiah, K. N. (2021). COVID-19 and E-Learning: The Challenges of Students in Tertiary Institutions. Social Education Research, 1, 1-8. https://doi.org/10.37256/ser.122020422

16. Gyampoh, A. O., Ayitey, H. K., Fosu-Ayarkwah, C., Ntow, S. A., Akossah, J., Gavor, M., & Vlachopoulos, D. (2020). Tutor perception on personal and institutional preparedness for online teaching-learning during the COVID-19 crisis: The case of Ghanaian colleges of education. African Educational Research Journal, 8(3), 511-518.https://doi.org/10.30918/AERJ.83.20.088
17. González-Sanmamed, M., Sangrà, A., & Muñoz-Carril, P. C. (2017). We can, we know how. But do we want to? Teaching attitudes towards ICT based on the level of technology integration in schools. Technology, Pedagogy and Education, 26(5), 633-647. https://doi.org/10.1080/1475939X.2017.1313775
18. Woods, H. C., & Scott, H. (2016). Sleepyteens: Social Media Use in Adolescence Is Associated with Poor Sleep Quality, Anxiety, Depression and Low Self-Esteem. Journal ofAdolescence,51,41-49.https://doi.org/10.1016/j.adolescence.2016.05.008
19. Howard, N. R., Howard, K. E., Busse, R. T., & Hunt, C. (2023). Let's Talk: An Examination of Parental Involvement as a Predictor of STEM Achievement in Math for High School Girls. Urban Education, 58(4), 586-613. https://doi.org/10.1177/0042085919877933
20. Hosny, S., Ghaly, M., Alsheikh, M. H., Shehata, M. H., Salem, A. H., & Atwa, H. (2021). Developing , Validating , and Implementing a Tool for Measuring the Readiness of Medical Teachers for Online Teaching Post-COVID-19 : A Multicenter Study. *Advances in Medical Education and Practice*, *12*, 755–768.
21. Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010) Multivariate Data Analysis. 7th Edition, Pearson, New York.
22. Byrne, B. M. (2010). Structural Equation Modeling with Amos: Basic Concepts, Applications, and Programming (2nd ed.). New York: Taylor and Francis Group
23. Bwire, F., Bagarukayo, E., & Muyinda, P. B. (2020). Online learning challenges in academia: The case of uganda. CSEDU 2020 - Proceedings of the 12th International Conference on Computer Supported Education, 2(Csedu), 484–489. https://doi.org/10.5220/0009794504840489

Appendix: Questionnaire on science teachers' competencies in planning and implementing online lessons

Section A: Background information

1. Initials of your name: .....
2. Gender: Male..... Female.....
3. Location of your school: Urban based..... Rural based.....
4. Category of the School: Boarding Only, Day Only, Both day and boarding
5. Type of the School: Single Boys Single Girls Both boys and girls
6. Highest Level of your Education: Postgraduate (masters, PhD), Bachelors, Diploma, No professional Qualification

Section B: Science teachers' online competencies

Item	Strongly Agree	Agree	Not sure	Disagree	Strongly Disgree
During teaching, I incorporate online learning activities that are connected to real-world applications (ie, using real day-to day cases, reflecting on applying knowledge in life uses... etc.).					
I am oriented with online course planning.					
I feel comfortable designing online interactive learning activities that provide students opportunities to interact with their peers, their instructor, and course content.					
I feel comfortable writing measurable learning outcomes based on Blooms taxonomy.					
I enjoy online teaching to my students for most of the class period.					
I know how to check for plagiarism in student's written assignments.					
I expect online teaching to take more time than face-to-face instruction, and I am prepared for it.					
I am always keen to participate as a learner in online workshops, discussion forums, webinars... etc., to update my knowledge and skills in online teaching.					
I am good at creating online teaching materials (eg, lessons, notes, manuals, assignments... etc.).					
I understand the copyright law and Fair Use guidelines when using copyrighted materials in education.					
I feel comfortable conducting interactive learning activities (eg, small group case-based discussions, PBL, TBL, seminars...) where students can interact with their peers and teacher					
I am able to create schedules for myself and stick to them					
I feel comfortable using social media tools to communicate with students and colleagues.					
I feel comfortable communicating through speaking.					
I feel comfortable communicating through writing.					
I am ready to timely respond to communication requests from students and colleagues.					

I am available to my students on a regular basis for questions and assistance.					
I am willing to provide timely and constructive feedback to student performance.					
Basic Computer Skills					
I can send and receive emails, including opening and sending email attachments.					
I can perform file management on my computer, such as copying, moving, renaming, and deleting files or folders					
I can use Internet browsers, such as Google Chrome, Firefox, or Safari, to locate resources for teaching.					
I can use Microsoft Office tools such as Word and PowerPoint to create documents and presentations.					
I am familiar with at least one synchronous online teaching platform, like Zoom, Microsoft Teams, Canvas... etc.					
Advanced Computer Skills					
I can add audio/video files to my presentations.					
I can encrypt (lock with passwords) files on my personal computer to protect important data.					
I can record audio/video using phone, tablet or computer.					
I am comfortable using the learning management system or other online assessment tools (such as: quizzes, exams, assignments, rubrics... etc.) to evaluate student performance.					
I am comfortable using tools in the learning management system (such as: uploading learning materials [reading materials, audio/video files...], synchronous and asynchronous communication, posting feedback, building forums... etc.) to facilitate student learning.					
I am comfortable using the learning management system tools to develop an online course.					
I am comfortable using the learning management system to record and report student grades.					

Strongly Agree (SA) Agree (A) Not Sure(NS) Disagree (D) Strongly Disgree (SA)

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