

Cloud Resources Utilisation and Science Teacher's Effectiveness in Secondary Schools in Cross River State of Nigeria

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ABSTRACT

Background: This study investigated the impact of cloud resources, a component of cloud computing, on science teachers' effectiveness in secondary schools in Cross River State. Three (3) research questions and three (3) alternative hypotheses guided the study. **Method:** The descriptive survey design was adopted for the study. The population of the study comprised 1209 science teachers in public secondary schools of Cross River state. **Sample:** A sample of 487 teachers was drawn from the population using stratified random sampling technique. The researcher-made structured questionnaire with 18 was used for data collection for the study. Research question one was answered using the Pearson Product Moment Correlation, while research question two and the hypotheses were answered using the Analysis of Variance (ANOVA) statistics in the Statistical Package for Social Sciences (SPSS) at a 0.05 level of significance. **Results:** The results of the study revealed that there is a positive correlation between the utilization of cloud resources in teaching and teaching effectiveness among science teachers in secondary schools in Cross River state; there is a negative correlation between gender and utilization of cloud resources among science teachers in secondary schools in Cross River state; and that there is a significant correlation between teaching experience and the utilization of cloud resources among science teachers in secondary schools in Cross River state. **Conclusion:** The study justifies the effectiveness of the Cross River state government policy of introducing cloud computing into the education sector. The study recommends that the policy should be sustained.

Keywords: Cloud Resources, Science Teachers, Effectiveness

Background

Science and technology are pivotal for global development, with scientific education gaining prominence in emerging nations seeking to compete with developed ones. Leading countries prioritize technological integration in education, especially in science. Governments heavily invest in technology procurement

and deployment to enhance teaching, focusing on cloud computing in the post-COVID era. Cloud computing offers flexible access to computer resources, empowering seamless learning and collaboration (Souley & Aniobi, 2014). Cloud computing enables the consolidation of teachers and learners onto a versatile platform (Misra & Adewumi, 2016), requiring no prior service knowledge. Users online can interact with multiple servers simultaneously, facilitating information exchange (Akpanobong & Frank, 2018). Traditional education relied on textbooks and classroom settings, but now, connected computers and mobile devices redefine teaching and learning, with cloud computing driving this transformation (Rilwan Muhammad & Mamman Abdulrahman, 2015).

Emeya and Udukeke (2020) highlight how cloud computing enables students to enroll in courses offered by colleges located remotely, eliminating the need for physical infrastructure. This technology streamlines virtual services, enhancing instructional delivery in science education. "Effective" teaching denotes accomplishing desired outcomes promptly (Iji et al., 2017). Igwebuike (2008) defines effectiveness as achieving tasks correctly. Teaching effectiveness involves meeting predetermined learning objectives, gauged by students' knowledge acquisition (Omoraka, Ajuar, and Okandeji, 2012). Cloud computing potentially enhances teaching efficacy by making lessons engaging and facilitating positive learning outcomes, contingent on teachers' adeptness with the subject and technology (Emeya & Udukeke, 2020).

Cloud Resources and Teacher Effectiveness

Cloud resources encompass both physical and virtual assets that developers can request from the cloud, such as virtual machines (VMs) with specific computational and storage capabilities, allocated to customers as cloud instances based on availability and pricing (El-Seoud et al., 2013). Customers can rent these instances as needed. Cloud services cater to diverse requirements including network bandwidth, CPU, memory, and storage (Singh et al., 2021). Additionally, cloud services address factors like network topology, jurisdiction, and application interaction, all managed in shared data centers with resources dynamically allocated based on demand (Sungkur, Sebastien, & Singh, 2020). Clients and developers often perceive these resources as limitless, facilitated by tools like RAS (Reliability, Availability, and Serviceability) (Charness & Boot, 2016). For the teacher, cloud resources are online tools in the cloud that form the pool of his resources, which he relies upon to enhance his teaching. Studies by Salome & Udukeke, (2018) indicated that the use of cloud resources plays a significant role in the effectiveness of the teacher.

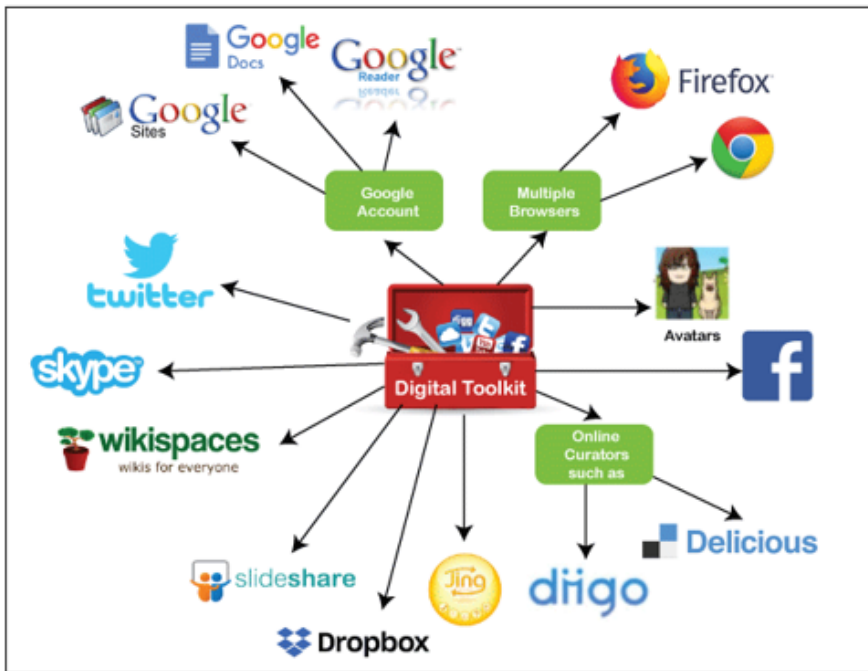


Figure 1. ICT tools available in the cloud for the teacher. Source: Java Point (2021)

Several studies conducted in different countries, including Kenya, Malaysia, and Tanzania, emphasize the significant impact of teachers utilizing cloud resources on their effectiveness. For instance, research by Machii (2016), Ghavifekr & Rosdy (2015), and Mwakisole, Kissaka & Mtebe (2018) supports this notion. Surveys by Etim, Upula, & Ekpo (2016) and Akpanobong & Frank (2018) reveal that teachers frequently utilize platforms like Google Drive, Google Doc, Dropbox, and iCloud to share resources with students, enhancing the teaching and learning process.

Science education, encompassing subjects like Biology, Physics, Chemistry, and Agriculture, along with the methodologies of learning and teaching science, plays a crucial role in shaping learners' understanding and application of scientific knowledge. Nwachukwu's (2014) study underscores the importance of human capital investment in Nigeria's economic growth, particularly focusing on the qualifications and experiences of secondary school teachers. However, Nigeria's educational sector faces challenges such as a shortage of qualified teachers, inadequate infrastructure, and unreliable electricity supply, severely impacting the quality of science and technology education. Recommendations from studies by Babajide & Smith, (2022) stress the need for improved funding, provision of electrical generators, maintenance of facilities, and skilled personnel to enhance S&T education in Nigerian secondary. Babajide & Smith, (2022) listed a few issues with science education in Nigeria, including but not limited to:

1. Inadequate administration of government money
2. A lack of trained teachers
3. Students' negative attitudes toward the subject
4. Poor teaching techniques
5. Inadequate lab supplies
6. Students aren't exposed to enough laboratory activities
7. Science teachers who receive insufficient incentives or compensation have unfavourable views toward their jobs.
8. Teachers' working conditions are subpar, and students' learning environments are poor.
9. Students' low socioeconomic status results in a lack of learning resources.
10. Students' poor performance in science

Point number 4 in the aforementioned list highlights the critical role of the teacher in ensuring effective instruction, as emphasized by Ghavifekr & Rosdy (2015). Many science teachers predominantly rely on traditional lecture-based or teacher-centered methods, leading to poor student performance (Osuafor, 1999; Adesoji & Olatunbosun, 2008). Given the active nature of science, instruction should adopt various methods, such as practical activities, peer tutoring, and the use of models, to engage students in constructing their own understanding (Iroegbu & Babajide, 2010). Babajide's (2022) research underscores the impact of instructional methods on science achievement, attributing declining performance in Physics to ineffective teaching approaches. In Cross River State, Nigeria, science education receives significant emphasis, with ongoing teacher training through workshops and seminars aimed at enhancing their teaching methods. Challenges include overcrowded classrooms, lack of practical materials, and inadequate provision of practical sessions in school timetables. The scarcity of laboratory space and equipment exacerbates the situation, with chemistry laboratories designed for fifty seats accommodating up to two hundred students, often lacking essential chemical reagents and apparatus.

The timetable currently in use in public secondary schools in Cross River State is not designed to encourage effective teaching of science. Because of the introduction of so many subjects into the curriculum of senior secondary education in Cross River State, like Tourism studies and Civic education, it is difficult to allocate double periods to science subjects that require adequate time for practical. Nta (2013) argued that all science subjects ought to be given double periods at least twice a week if the teaching of science is considered important and for the effectiveness of the teacher. This position was agreed to by Etim, Upula, & Ekpo (2016) in their research on cloud utilization for English teachers in Cross River State where they found out that little time is allocated for core subjects in public schools, for which English was one.

Beyond the challenge of an adequate time frame for science subjects in the timetable, the challenge of the teacher's readiness and method of teaching science subjects is another critical issue affecting the smooth teaching of science in Cross River State. Ekuri (2012) discovered that only 27 percent of the 300 science teachers sampled have the requisite knowledge of how to use the lab for practical, and 20% of this number regularly conduct practical sessions with students. With this background, the stage is set for us to critically examine if the utilization of cloud computing tools will have a positive or negative impact on the effectiveness of science teachers in Cross River State. Statistically, Cross River State has 293 public secondary schools and 1209 science teachers in the three educational zones of the state.

Several attempts have been made to unearth the relationship between the utilization of cloud computing and the effectiveness of the teacher deploying the tool. Specifically, Etim, Upula, & Ekpo (2016) looked at the relationship between cloud computing and English teachers' effectiveness and found that a significant positive relationship existed. According to the study, teachers teach better when they use cloud resources. The study also found that some teachers are yet to switch completely to the utilization of cloud technology in teaching. The population of this study are university lecturers. Similarly, a study by Akpanobong & Frank (2018), carried out on lecturers of Entrepreneurship in Akwa Ibom State, Nigeria, showed that some lecturers were yet to fully tap into the full potential of cloud technology in their lectures and, as such, were performing far below average. Akwa Ibom State is a neighboring state to Cross River State, but the population in the study are still lecturers in tertiary institutions in the state. Additional research work by Rilwan Muhammad & Mamman Abdulrahman (2015), Olalere & Ph (2006) and Ofemile (2015) still centres on the relationship between cloud computing and teacher effectiveness among university lecturers in Nigeria. Again, we see that the population of these studies are lecturers at tertiary institutions. Recently, a study by Emeya and Udukeke (2020) posited that lecturers see cloud computing as a new option to improve their content and make their delivery of lectures superb.

Cloud Resources and Gender Utilisation

Researchers have long been curious about whether there is a difference between how men and women use technology, particularly in the field of education. Significant findings about gender differences in cloud resource usage among teachers and students have been documented by numerous studies conducted all over the world. Alkaabi, Albion, & Redmond (2017) reported about a study conducted in 2012 to explore the influence of gender and personality on an individual's use of cloud resources. They found that females use social media and cloud resources for educational purposes more than males. A similar survey conducted in the United Arab Emirates in 2010 found that female university students were more dependent on Facebook to expand their social networks and gain access to additional experiences and information than their male counterparts. (Alnjadat, *et al.*, 2019). The studies conducted by Akpanobong & Frank (2018) and Salome & Udukeke (2018) discovered that the differences between how male and female lecturers use cloud resources were just statistical and could not be regarded as significant enough to change the narrative; therefore, gender was not a factor in how the university instructors they investigated used cloud resources.

Cloud Resources and Teaching Experience

There is a growing relationship between the age of a person on a job and the expertise displayed in that job specification. The utilization of information and communication technology tools in the teaching and learning process requires two basic components. First, the ability to use the tool, and secondly, knowing the timing to use the tool. Etim, Upula, & Ekpo (2016) found out in their study that teachers with long years of service tend to reject the use of cloud resources and are generally not easily motivated to adjust to the use of technology in their lecture process. Salome & Udukeke, (2018) agrees with the position of Etim, Upula, & Ekpo (2016). However, a study carried out in Kenya does not seem to agree that the relationship seems to exist. Machii, (2016) found out that more experienced teachers are easily persuaded to use new technology and quickly blend their teaching method with the technological tool they see as easy to help them transfer the knowledge to the learners. Further studies by Akpanobong and Frank (2018) revealed that the choice of a "tech tool" by a teacher depends greatly on the perceived usefulness of that tool in the teaching and learning process by the teacher.

Despite numerous research endeavors, secondary school teachers in Nigeria have been overlooked. Based on Federal Ministry of Education data, Nigeria boasts 238,000 public secondary school teachers, with Cross River State contributing 6406 to this figure (Orijii & Anikpo, 2019). Moreover, there are 513,000 secondary school teachers across both public and private sectors. The absence of significant research assessing the relationship between cloud resource utilization and teacher effectiveness in Nigeria is concerning. This study addresses this gap, particularly considering the substantial investment in science education by the Cross River state government and the recent integration of cloud computing into secondary school curricula amid the COVID-19 pandemic, aiming to determine its impact on teacher efficacy and subsequent learning outcomes in the public-school sector.

This is summarised in Table 1.

Table 1: Extent of Research Covered

| S/N | Category | Comment |
|-----|--|----------------|
| 1 | Tertiary School Lecturers | Researched |
| 2 | Secondary School Level Teachers/Tutors | Not Researched |
| 3 | Primary School Level Teachers | Not Researched |

Objective of the Study

The objective of this study is therefore to investigate the relationship between the utilization of cloud resources and science teacher's effectiveness in Secondary schools in Cross River State.

Specifically, the study intends to

1. Investigate the correlation between the use of cloud resources and teaching effectiveness among science teachers in secondary schools in Cross River State.
2. Examine the correlation between gender and cloud resource utilization among science teachers in secondary schools in Cross River State.
3. Identify the correlation between teaching experience and the utilization of cloud resources among science teachers in secondary schools in Cross River State.

Conceptual Framework

The conceptual framework is illustrated clearly in the chart below.

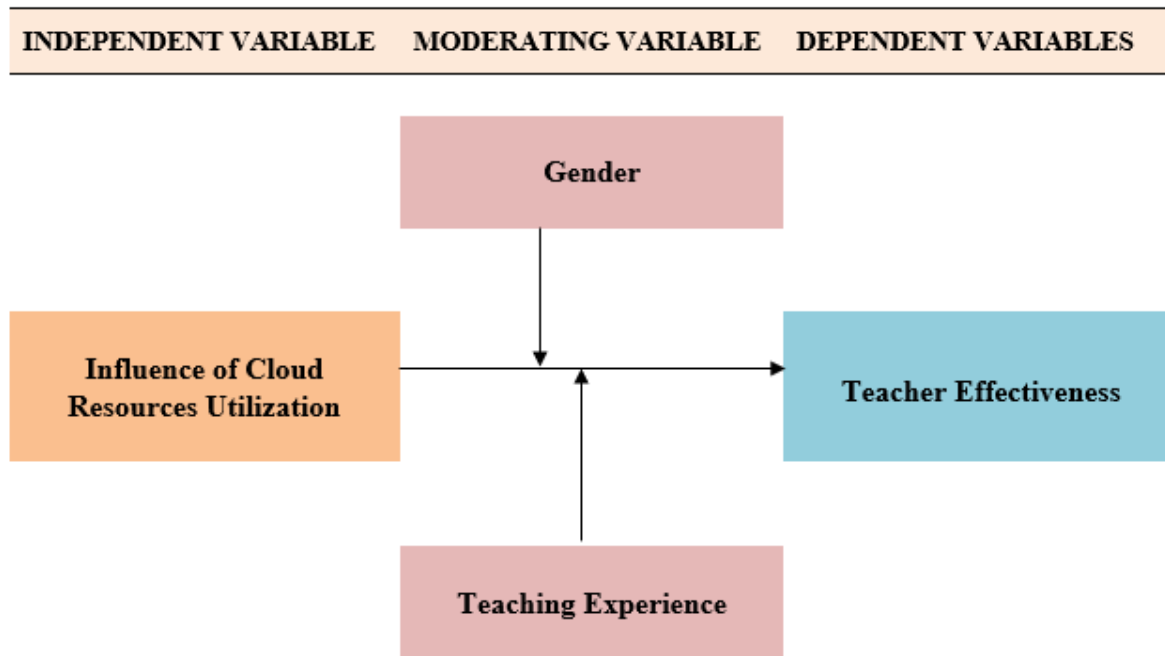


Fig 1: Conceptual Framework of the Study

Source: Researcher

The independent variable is Cloud Resource Utilisation while teacher effectiveness is the dependent variable. The gender of the teacher and his or her years of teaching experience are thought to be moderating variables.

Research Hypothesis

The following research hypothesis was developed for the study from the conceptual framework:

- H₁ There is a significant correlation between the use of cloud resources and teaching effectiveness among science teachers in secondary schools in Cross River State.
- H₂ There is a significant correlation between gender and the utilization of cloud resources among science teachers in secondary schools in Cross River State.
- H₃ There is a significant correlation between teaching experience and the utilization of cloud resources among science teachers in secondary schools in Cross River State.

Methods

The descriptive survey design was adopted for the study. The study was conducted in Cross River State. The population of the study comprised 1209 science teachers in Cross River State.

A sample of 487 teachers was drawn from the population using simple random sampling techniques. The researcher-made structured questionnaire with 18 items was titled: Utilization of Cloud Resources and Science. The Teacher's Effectiveness in Secondary School Questionnaire (UCRSTESSQ) was used for data collection for the study. The questionnaire was divided into three sections (A, B, and C). Section 'A' contained the personal data of the respondents. Section 'B' contained the questions on Cloud Resources sub variables grouped into three clusters (1-3), namely, Google Cloud Use, Cloud Learning Platform, and Videos in the Cloud. Section 'C' contained questions on teacher effectiveness. The response options were drawn from a four-point Likert scale: strongly disagree: 1 point; disagree: 2 points; agree: 3 points. And Strongly Agree: 4 points. The instrument was subjected to face-to-face validity by three validators in the Department of Educational Foundation of Veritas University, Abuja, Nigeria. The internal consistency of the instrument was determined using Cronbach's technique, and a reliability coefficient of 0.87 was obtained. 500 questionnaires were administered to the respondents by the researchers, and only 487 copies were returned.

The calculated values of Pearson's product moment correlation statistics (r) were employed to answer the research questions. While interpreting the results of the research questions, any calculated correlation of r below 0.50 was considered weak, while the ones above 0.05 were considered strong. Each hypothesis was tested at the 0.05 level of significance by comparing the p -value of Pearson's product moment correlation with the level of significance of 0.05. Hypotheses whose p -values were less than or equal to 0.05 were rejected, while those that were greater than 0.05 were accepted.

Results

Research Hypothesis

Hypothesis One

There is a significant correlation between the use of cloud resources and teaching effectiveness among science teachers in secondary schools in Cross River State.

Table 2: ANOVA Table Showing Correlation Between the Use Cloud Resources Utilization and Teaching Effectiveness.

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|-----------------|-------------------------|-----|-------------|------------|-------|---------------------|
| Corrected Model | 10.890 ^a | 8 | 1.361 | 220.468 | 0.000 | 0.787 |
| Intercept | 4555.899 | 1 | 4555.899 | 737863.692 | 0.000 | 0.999 |
| Cloud Resour | 10.890 | 8 | 1.361 | 220.468 | 0.000 | 0.787 |
| Error | 2.951 | 478 | 0.006 | | | |
| Total | 6328.422 | 487 | | | | |
| Corrected Total | 13.842 | 486 | | | | |

Table 2 above shows that the p -value of 0.00 is less than the level of significance (p -value < 0.05). The alternative hypothesis is accepted. Therefore, it is concluded that there is a significant correlation between the use of cloud resource utilization in teaching and teaching effectiveness among science teachers in secondary schools in Cross River State.

Hypothesis Two

There is a significant correlation between gender and the utilization of cloud resources among science teachers in secondary schools in Cross River State.

Table 3: ANOVA Table Showing Correlation Between Gender and Utilization of Cloud Resources

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|-----------------|-------------------------|-----|-------------|-----------|-------|---------------------|
| Corrected Model | 0.144 ^a | 1 | 0.144 | 2.040 | 0.154 | 0.004 |
| Intercept | 5590.924 | 1 | 5590.924 | 79034.210 | 0.000 | 0.994 |
| Gender | 0.144 | 1 | 0.144 | 2.040 | 0.154 | 0.004 |
| Error | 34.309 | 485 | 0.071 | | | |
| Total | 5707.266 | 487 | | | | |
| Corrected Total | 34.453 | 486 | | | | |

Table 3 above shows that the p-value of 0.154 is greater than the level of significance (p-value > 0.05). The alternative hypothesis is not accepted. Therefore, it is concluded that there is no significant correlation between gender and utilization of cloud resources among science teachers in secondary schools in Cross River State. This is the case because there is no digital divide among genders, as no gender (male or female) is disadvantageous in the utilization of cloud resources in Cross River State.

Hypothesis Three

There is a significant correlation between teaching experience and the utilization of cloud resources among science teachers in secondary schools in Cross River State.

Table 4: ANOVA Table Showing Correlation Between Teaching Experience and Utilization of Cloud Resources

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---------------------|-------------------------|-----|-------------|------------|-------|---------------------|
| Corrected Model | 26.383 ^a | 3 | 8.794 | 526.286 | 0.000 | 0.766 |
| Intercept | 4841.683 | 1 | 4841.683 | 289748.989 | 0.000 | 0.998 |
| Teaching Experience | 26.383 | 3 | 8.794 | 526.286 | 0.000 | 0.766 |
| Error | 8.071 | 483 | 0.017 | | | |
| Total | 5707.266 | 487 | | | | |
| Corrected Total | 34.453 | 486 | | | | |

Table 4 above shows that the p-value of 0.00 is less than the level of significance (p-value < 0.05). The alternative hypothesis is accepted. Therefore, it is concluded that there is a significant correlation between teaching experience and utilization of cloud resources among science teachers in secondary schools in Cross River State. This is the case because the younger teachers make use of cloud resources more effectively than the older teachers, who encounter more challenges in adapting to modern-day technology.

Discussion

The findings of the study revealed that there is a positive correlation between the use of Cloud Resources and teachers' effectiveness among science teachers in secondary schools in Cross River State. For the teacher, cloud resources are online tools in the cloud that form the pool of his resources, which he relies upon to enhance his teaching. So according to the findings of this study, when teachers use these cloud resources, their knowledge base is deepened, thus leading to their effectiveness in the teaching and learning process. This finding agrees with the studies of Akpanobong & Frank (2018), Etim, Upula, & Ekpo (2016), and Salome & Udukeke, (2018). This study affirms that the use of cloud resources plays a significant role in the effectiveness of the teacher. The finding is also in line with similar studies in Kenya (Machii, 2016), Malaysia (Ghavifekr & Rosdy, 2015), and Tanzania (Mwakisole, Kissaka & Mtebe, 2018), which concluded that the use of cloud resources by teachers has a great influence on their effectiveness.

The response from the research instruments shows clearly that many teachers now use cloud resources in the preparation of their lessons and in the building of their capacity in their subject area. The Nigeria Learning Passport, an online cloud resource center for all audio-visual content for both the teacher and the students, is heavily utilized by the respondents, as indicated in Fig 4. 2. 78% of the 487 respondents agree that they use already-prepared lesson notes from the learning platform. The implication of this is that learning will be smooth, the content delivery will be uniform, and the same lesson will be shared virtually with all teachers at different locations across the state. The slight difference will, however, be noticed in the method of presentation by the individual teachers due to individual differences.

Interestingly, 75% agree that they have a functional cloud account (Google Drive, iCloud, and Dropbox), but only 57% of the 487 samples agree that they use it to store their documents. This sharp decline may arise from technical know-how. This agrees with the proposition of the Technology Acceptance Model (TAM): people tend to use a technology based on its ease of use and perceived usefulness. The findings of this study throw up another debate about the reaction of teachers to a policy that is very strange to them. Only 45% of the 487 respondents use cloud resources for personal development. This implies that over 55 percent only use it for the strict purpose of getting information to teach children and nothing more.

Furthermore, 76% of the respondents agree that they share videos with other teachers, obviously in the same WhatsApp group. We can infer that teaching and learning are ongoing, even among teachers. Technology is creating room for teachers to share their discoveries. The more ICT-savvy teachers search for information and share it with others, the more the flow of knowledge goes around. The study also found that there is no significant correlation between gender and the utilization of cloud resources in teaching among science teachers in secondary schools in Cross River State. The contextual usage of the term significant is narrowed to pure statistics. Globally, there is the thinking that females are more meticulous than men and, as such, will handle tech tools more than men. 53% of males and 47% of females were surveyed, and their responses did not show any significant shift to suggest that any of the genders does well with cloud computing above the other.

The findings of this study agree with the findings of Salome & Udukeke, (2018), who conducted a study on vocational studies lecturers and found that there is no significant difference in the mean responses of male and female lecturers on the influence of cloud assessment on their teaching effectiveness in Vocational Education in tertiary institutions in Akwa Ibom State. The study, however, disagrees with the findings of Alnjadat *et al.*, (2019), who conducted a study in 2018 to explore the influence of gender and personality on an individual's use of social networking and other cloud resources. They found that females use social media and cloud resources for educational purposes more than males. The finding also disagrees with a study in the United Arab Emirates by Alkaabi, Albion, & Redmond (2017), which revealed that Facebook was more essential for female university students to extend their social network and access more information and experiences than their male counterparts.

The research unveiled a direct link between teaching experience and the adoption of cloud computing among science educators in secondary schools in Cross River State. Younger teachers demonstrate a higher proficiency in utilizing cloud technology compared to their older counterparts, who often face hurdles in adapting to modern technology. This aligns with prior research by Etim, Upula, & Ekpo (2016), and Salome & Udukeke (2018), indicating that veteran teachers are generally resistant to integrating cloud resources into their teaching practices. However, it contrasts with findings from a study by Machii (2016) in Kenya, suggesting that experienced teachers are more receptive to embracing new technology. Analyzing the responses in Fig. 3 reveals additional insights, particularly when grouped according to years of service.

45% of respondents with 0 to 10 years of teaching experience believe that "the utilization of cloud computing resources has enriched their perspective on teaching," whereas only 6% of educators with over 30 years of service share this view. This suggests that younger teachers are enthusiastic about employing cloud computing because they perceive it as beneficial for broadening their teaching horizons, contrasting with the perspective of veteran educators. This observation resonates with the findings of Akpanobong & Frank (2018), who emphasize that teachers' adoption of technology hinges on its perceived relevance in the teaching and learning process. Seasoned teachers, having taught for decades without such technology, may view its integration into teaching as unnecessary or inconsequential to their established methods. Regarding the impact on subject mastery, 48% of respondents with less than 10 years of service agree that "the use of cloud resources has enhanced their grasp of content and subjects." Conversely, only 8% of educators with over 30 years of experience concur. This suggests that less experienced teachers are more inclined to embrace technology to enhance their teaching skills, while those with extensive tenure may prioritize other aspects as they approach retirement.

From the statistical analysis in this study, we can safely conclude that there is a strong correlation between the use of cloud computing and teacher effectiveness. We can also say that teachers with fewer years of service tend to embrace technology more than teachers with a long stay in the field.

Conclusion and Recommendations

The utilization of cloud resources by science teachers in Cross River State of Nigeria, is a well-thought-out policy of the Cross River State government. Teaching and learning have been made interesting with the introduction and utilization of it by science teachers.

Drawing from the study, the following are the recommendations:

1. The use of cloud resources in the teaching and learning process should be sustained.
2. There should be training for the older and more experienced teachers who are generally challenged in the use of cloud resources to help them improve their use.
3. There should be regular retraining of all teachers in ICT, especially in cloud computing, so that the teachers will be kept abreast of current innovations in technology and education and the modalities to deploy both in the teaching and learning process.

Declarations

Ethics Approval & Consent to Participate: Permission was obtained from the Cross River State Ministry of Education's Secondary Education Board before collecting data. Teachers were guaranteed privacy, with no personal details included in the questionnaire's demographic section to safeguard anonymity.

Conflict of Interest: Not applicable.

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