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Student's Internet Connectivity Used to Engage in Mathematics Education

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Abstract:

The study investigated into assessing the effectiveness of internet connectivity on students' engagement with mathematics education, utilizing a quantitative methodology. Drawing from a structured survey, 1802 students from two selected secondary schools in Kigali City constituted the study's population, with 327 students being randomly sampled for analysis. Through the collection of quantitative data, the researchers evaluated the quality and accessibility of internet connectivity in these areas and its correlation with students' involvement in online mathematics learning resources. The results highlighted a noteworthy relationship between the quality of internet connectivity and students' utilization of online mathematics resources, emphasizing the essential role of equitable internet access in shaping educational outcomes (overall mean of 3.58). This study added valuable quantitative insights to the ongoing dialogue regarding the significance of internet connectivity in shaping students' learning, particularly within the domain of mathematics education.

***Keywords**: Internet connectivity, Online mathematics resources, Students' academic performance.*

1. Introduction

In an era dominated by technology, the role of the Internet in education cannot be overstated. Its integration into the learning process has reshaped traditional methods, offering students vast resources at their fingertips. The present study explored into the utilization of internet connectivity for studying mathematics

among students in selected public secondary schools. Thoughtful how students engage with online resources displayed the effectiveness of this approach, guiding students in enhancing learning experiences.

The universal presence of the Internet has revolutionized education, granting unique access to information and educational materials. However, its impact on specific subjects, such as mathematics, licenses closer examination. Mathematics often presents unique challenges for students, and raising online resources offered supplementary support. Exploring how students utilized internet connectivity to tackle mathematical concepts outbuilding light on emerging leanings and potential areas for improvement in educational practices.

Despite the widespread availability of internet connectivity, the extent to which students utilize online resources for studying mathematics remains unclear. The present study directed to address this gap by investigating the usage patterns and preferences faced by students in accessing and utilizing internet connectivity for mathematical learning.

The motivation behind the present study came from the recognition of the evolving background of education, characterized by the increasing integration of technology. Caring how students engage with internet connectivity for mathematics studies was crucial for adapting teaching methodologies to meet their evolving needs. Revealing the factors influencing students' utilization of online resources, teachers improved interventions to enhance learning outcomes and raise a more conducive learning environment in public secondary schools.

2. Literature Review

Internet connectivity has become an integral part of modern education, offering students access to a vast array of online resources, tools, and platforms that enhance their learning experiences. Synthesizing existing studies and identifying gaps in the current knowledge base, this literature review contributed to a deeper understanding of the complex relationship between internet connectivity and mathematics learning in secondary school settings.

2.1. The use of the internet in Mathematics Education

Internet connectivity facilitates collaborative learning in mathematics. Students engage in virtual study groups, participate in online forums, and work on math projects with peers from different geographic locations. Internet connectivity enables students to access a wealth of online learning resources, including textbooks, video tutorials, interactive simulations, and mathematical software (Niyibizi, et al., 2023). The importance of equitable access to these resources to bridge educational inequalities in mathematics education. Students with reliable internet access explore diverse learning materials that provide to various learning styles and preferences.

The introduction of innovation in technology and human development at the beginning of the twenty-first century, where traditional education has been modified for the current digital age, is characterized by ongoing, worldwide innovation in technology (Scherer, et al., 2019; Osondu, et al., 2022). The field of education has seen a significant transition in the twenty-first century. The time when teaching was restricted

to a classroom setting is long past. How learning is conducted has undergone a paradigm shift as a result of the advent of the internet. Education has been brought into everyone's hands outside the revered walls of colleges (Sarkar, 2020).

Students started learning through laptops and other devices that were connected to establish a network even though the internet hadn't yet been created (Sarkar, 2020). The teachers are diligently evaluating and getting ready to gather data, which enhances instructional techniques and practices. The classroom discussions are available to students at any moment, which helps them comprehend. Not all students have reliable internet access. Without superior instructional tools, several students had connectivity issues (Munyengabe, et al., 2017; Osondu, et al., 2022).

Enabling access to services, resources, distant exchanges that are available, and cooperation, the utilization of the Internet for educational purposes is considered a way to increase connectivity, efficiency, and the standard of instruction (Munyengabe, et al., 2017). A new method of learning is now possible thanks to the availability of the Internet. The difficulty is caused by having access to the internet, though. Users are going to be able to navigate inside their surroundings thanks to internet connectivity, improving their access to information that is particularly necessary to improve academic achievement.

The digital divide, characterized by disparities in internet access and technology, has been a longstanding concern in education. Jackson et al. (2003) investigated the usage of online resources for mathematics learning. They discovered that students who had consistent access to the internet were more likely to utilize online math resources such as tutorials, videos, and interactive simulations. They found that students with limited internet access faced challenges in accessing online educational resources, including mathematics materials. They also found that students with high-speed, reliable internet connections tended to perform better in online mathematics courses compared to those with slower or less stable connections.

The Covid-19 pandemic accelerated the adoption of online learning platforms. Barbour et al. (2020) discussed how students' access to reliable internet influenced their ability to engage effectively in remote mathematics education. Students with stable internet connections were better equipped to attend virtual math classes, participate in online discussions, and access instructional materials. They found that students with reliable internet connections were more likely to participate in discussions, complete assignments on time, and stay motivated in online math courses. The digital divide remained a critical issue, impacting students' ability to improve online learning.

The present study aimed to outbuilding light on how variations in internet connectivity affect students' engagement with mathematics education. The study pursued to address the following key research question: To what extent does the availability of online resources and tools for mathematics education impact students' utilization of the internet for learning mathematics?

2.2. Theoretical framework

In an increasingly digital age, access to the internet has become a fundamental resource for students worldwide. The influence of internet connectivity on educational practices has garnered significant attention from researchers, teachers, and policymakers alike. The present study investigated into the specific context of Kigali City, where the digital divide persists, and investigates how internet connectivity affects the study habits of students in the realm of mathematics. Kigali City, the capital of Rwanda, represents a dynamic urban landscape with a burgeoning student population in its secondary schools. Students' access to online resources, educational platforms, and information through the internet shape their learning experiences, particularly in subjects like mathematics, which often require additional support and resources outside the classroom. The present study focused on two carefully selected secondary schools within Kigali City, aiming to provide insights into the role of internet connectivity in shaping students' attitudes, behaviors, and outcomes in mathematics education.

In light of technological advancements, students and teachers utilize the internet as an interactive learning environment. The Connectivism theory, which served as the basis for this study, says that students acquire knowledge when they have connections with one another, and in this way, the internet keeps students and teachers connected. Thus, the internet connection, one of the most modern forms of communication, aids each student in keeping in touch with their teachers and vice versa. Because of this, the study goes on to clarify the interaction involving students and instructors and talk about how it affects their academic achievement in general.

3.Methodology

The methodology employed in researching the relationship between internet connectivity and students' utilization of online resources for studying Mathematics in Kigali City's selected secondary schools was a critical component of this study.

3.1.Research Design

Research design played a pivotal role in the field of academic inquiry, serving as the blueprint for the systematic investigation of a particular phenomenon. In this context, we investigated into a study focused on the correlation between internet connectivity and its impact on students' use of online resources for studying mathematics in two selected secondary schools within Kigali City. Through surveys, the study aimed to identify trends in internet usage among students. Additionally, it was investigate how students incorporate online resources into their mathematics studies. The two selected secondary schools within Kigali City were served as microcosms for this investigation, allowing for a focused examination of the local context while providing insights that was applicable to broader educational settings.

In the present study, the researchers utilized a descriptive study methodology. For the purpose of providing an overview of current occurrences, descriptive research focuses on acquiring data. In order to ascertain the extent to which students use internet connectivity for learning purposes, a descriptive approach

was adopted in this study. The researchers used this strategy given that the purpose of the study was to gather trustworthy first-hand information for the creation of suggestions for improvement.

3.2.Population of the study

The population of the study referred to the specific group of students within these schools who are the subjects of interest for the study. Kigali City, the capital and largest city of Rwanda, served as the backdrop for this study, highlighting the significance of understanding how internet connectivity influences the academic pursuits of secondary school students in an urban setting. The selection of two secondary schools within Kigali City suggested a careful effort to gain a comprehensive understanding of this phenomenon by including a diverse range of students from different educational institutions.

Thoughtful the population of the study, it was conducted systematically and effectively, ultimately contributing to a more informed assessment of the impact of internet connectivity on students' learning experiences in the realm of mathematics education. In order to provide a representative sample of schools in Kigali City, two public secondary schools were specifically chosen so that they had internet connectivity. The study's participant population included 1802 students from two selected secondary schools in Kigali City, Rwanda, who were enrolled in the current academic year 2022-2023.

3.3. Sampling technique and Sample size

In the digital age, access to the internet has become a fundamental tool for learning, and its impact on education is profound. In Kigali City, Rwanda, as in many other urban areas around the world, secondary school students increasingly rely on the internet for studying mathematics and accessing educational resources. To accomplish this, the researchers employed a sampling technique to select a representative sample of students.

In the present study, the use of simple random sampling was utilized in the study and was based on Slovin's formula. Use Slovin's formula in practice by calculating $n = N / (1 + N(e)^2)$, $n = 1082 / (1 + 1082(0.05)^2)$, and $n = 327$, where n is the required sample size, N is the population size, and e is the acceptable margin of error. 174 male students and 153 female students made up the sample of 327 students.

3.4.Data collection

To gain a comprehensive understanding of this investigation, data collection became pivotal, as it enabled the researchers to acquire, analyze, and interpret relevant information related to internet access, its impact on studying mathematics, and the experiences of students in these schools. They were all given and returned questionnaires to assess and draw conclusions from the results. A survey questionnaire served as the study's primary tool. A survey questionnaire, which was divided into two sections, was created to gather primary data. The learners' fundamental demographic characteristics were shown in the first section. The learners use of the internet was assessed in the second section, with twelve items in total.

3.5.Data analysis

Data analysis played a pivotal role in understanding the dynamics of contemporary education, especially in the context of Internet connectivity and its impact on students' study practices. In this study, we investigated into the intricate relationship between internet connectivity and how students in Kigali City, Rwanda, utilize it to enhance their study of mathematics education. In the present study, the data was assessed using the mean, according to a survey, assessing how internet connectivity affects students' use of internet-based tools for learning mathematics was done at intervals like 1.00 to 2.49, 2.50 to 3.49, and 3.50 to 5.00 in order to gain significant insight into the way various levels of connectivity influence academic performance. The range from 1.00 to 2.49 denoted no usage, 2.50 to 3.49 denoted neutral use, and 3.50 to 5.00 denoted use.

3.6.Validity and reliability

Internet connectivity is a crucial factor for students studying mathematics, especially in the modern age where online resources. Assessing internet connectivity for students studying mathematics was vital for optimizing their online learning experiences. Validity and reliability were critical aspects of ensuring that the results accurately reflect students' connectivity status. By carefully considering content, criterion-related, and construct validity, as well as test-retest and internal consistency reliability, the researchers made informed decisions to support students in their mathematical studies effectively.

3.7.Ethical consideration

Prior to starting the data collection, the researchers got the study's approval. Once approval was given, a written permission form was created. Students who agreed willingly to take part of this study then signed a written consent form. Students were given the assurance that any information gathered in conjunction with the study that was linked to them remain private and not be released. Guidance was given to the respondents before they completed the survey. Five days were provided to the respondents to complete the aforementioned questionnaire. The data collection then came to a stop. For data analysis and interpretation, the replies gathered were taken into account.

4.Findings and Discussion

On the basis of data acquired from research participants from the two public secondary schools in Kigali City, Rwanda, analysis and discussion of the findings were conducted. It also provides the student's consent to using an internet connection for study-related activities.

Table 1: Students' views on the use of internet connectivity

Students' views	Mean	Interpretation
To use of the internet to study mathematics.	4.80	Use
To watch math-related videos or lectures online.	4.06	Use

To prefer e-books or online textbooks over traditional printed math textbooks.	4.07	Use
To use online platforms or websites to find most useful for learning math.	3.75	Use
To use math-specific apps or software for practicing and solving problems.	3.48	Neutral
To collaborate with peers on math assignments using online tools or apps.	3.37	Neutral
To explore virtual math simulations or interactive tools.	3.98	Use
To engage with math-related content on educational platforms.	3.81	Use
To use online quizzes and practice tests to assess a math knowledge.	3.59	Use
To utilize online tutoring or educational platforms for math help.	4.17	Use
To explore open educational resources (OERs) for math materials.	2.01	No use
To use math-related software like equation solvers.	1.94	No use
Overall mean	3.58	Use

In accordance with Table 1, to explore open educational resources (OERs) for math materials (M = 2.01) and to use math-related software like equation solvers (M = 1.94) indicated that the two stated aspects were not used based on their mean. Nevertheless, to use math-specific apps or software for practicing and solving problems (M = 3.48) and to collaborate with peers on math assignments using online tools or apps (M = 3.37) based on their mean, suggested that the two items given were neutral. Conversely, to use of the internet to study mathematics (M = 4.80), to watch math-related videos or lectures online (M = 4.06), to prefer e-books or online textbooks over traditional printed math textbooks (M = 4.07), to use online platforms or websites to find most useful for learning math (M = 3.75), to explore virtual math simulations or interactive tools (M = 3.98), to engage with math-related content on educational platforms (M = 3.81), to use online quizzes and practice tests to assess a math knowledge (M = 3.59), and to utilize online tutoring or educational platforms for math help (M = 4.17) indicated that every one of the eight items stated was used based on each of their mean. Therefore, this quantitative investigation gave important insights into a positive connection between connectivity to the internet and students' usage of online resources for studying mathematics. The overall mean (M = 3.58) was lying in the range of 3.50 to 5.00, which signified use.

The Connectivism theory, which provided the basis for this study, holds that connection within one another are essential for the development of knowledge, and that the internet contributes to maintain these links between students and teachers. The current findings are consistent with this theory. The current findings are also in line with Munyengabe et al. (2017); Osondu et al. (2022); Niyibizi et al. (2023) highlighted that using the internet for learning purposes is seen as a means to improve connection, effectiveness, and the quality of teaching and learning by providing a variety of resources, services, and other available remote interactions

and collaboration. The results are also consistent with a study by Barbour et al. (2020), which examined how learners' having access to trustworthy internet connections affected their capacity to participate successfully in online mathematics instruction. Stable connections to the internet made it easier for students to access educational resources, take part in online conversations, and attend virtual math sessions. They discovered that participation in online math conversations, timely submission of homework, and sustained motivation were all higher among students with dependable internet connections. They also discovered that students' access to and participation in online mathematics education materials is significantly influenced by their internet connectivity. The capacity of pupils to use internet resources for learning is impacted by the digital divide, which is still a serious problem.

5.Conclusion and Recommendation

5.1.Conclusion

In conclusion, this quantitative analysis provided valuable insights into the interplay between internet connectivity and students' utilization of online resources for studying mathematics. Internet connectivity played a crucial role in shaping the way students study mathematics today. It has opened up a world of resources, from online tutorials and interactive learning platforms to collaborative forums and access to vast libraries of mathematical knowledge. However, many students lacking reliable access to the internet, delaying their educational opportunities as indicated by overall mean of 3.58. Bridging this gap is essential for ensuring equitable access to quality mathematics education, enabling students to thrive in an increasingly digitized world. These findings had important implications for teachers, policymakers, and technologists seeking to bridge the digital divide and enhance mathematics education in the digital age.

5.2.Recommendation

To address the issue of internet connectivity and its impact on students' mathematics education, it is crucial for governments, educational institutions, and communities to invest in infrastructure and initiatives that expand broadband access to underserved areas. Additionally, schools and teachers should integrate offline resources and alternative teaching methods for students with limited internet access, ensuring that they do not fall behind. Furthermore, raising digital literacy skills among students and providing affordable devices help maximize the benefits of internet connectivity for mathematics learning. As educational secondary schools continue to embrace online learning platforms, policymakers, teachers, and stakeholders must address the digital divide to ensure that all students have equal opportunities for success in mathematics education.

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