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Contribution of Smart Class Platform on Grade Seven Students' Achievement and Interest in Mathematics in Nyagatare District, Rwanda

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Abstract: This study desalt with contribution of Smart Class platform on grade seven students' achievement and interest in mathematics, using the experimental research design. The target population was 8620 grade seven students from 92 public secondary schools of Nyagatare District in Rwanda. Two schools were purposively selected as they fulfilled conditions of having students who can use computer assisted technologies very well. From the two sampled schools, 174 grade seven students were selected to participate in the study whereby 87 constituted the control and 87 constituted the experimental group. During the intervention, the control group was taught using conventional approaches while the experimental group was taught using technology. Data was analyzed using paired sample t-test. The study established that the use of technology in teaching significantly enhanced the mathematics achievement and interest of grade seven pupils in the experimental group who were taught using technology during the intervention period. Therefore, the use of technology enhanced both the interest and the achievement in mathematics. Based on the conclusions, the study recommends that teachers should use technology along with conventional ways in teaching mathematics so as to enhance mathematics interest and achievement in Secondary Schools.

Keywords: Smart Class Platform; students' achievement; and Students' interest.

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Introduction

Educational programs in terms of content production and delivery, instructional methods and evaluation, student-teacher interaction as well as research and staff development have undergone fast change as a result of technological progress (Raja & Nagasubramani, 2018). Application for online learning has recently shown a significant success in the field of education (Iyamuremye et al., 2022). These advances allowed for the emergence of distance learning as a supplement and alternative to traditional educational systems, especially in the twenty-first century (Sevindik, 2010). Particularly, Smart Classrooms are advantageous for online learning environments (Galy et al., 2011).

The most recent COVID-19 epidemic served as a reminder of the growing influence of technology on education (Onyema et al., 2020) as many educational institutions throughout the world relied on technology to maintain instruction during the

Coronavirus emergency. Numerous institutions switched entirely to e-learning and cancelled all of their in-person courses, including laboratories (Ukobizaba & Nizeyimana, 2021). Educational institutions that had appropriate e-learning facilities throughout the crisis were able to reduce chances for school closures brought on by COVID-19. For instance, the Rwanda Basic Instruction Board used its e-learning platform to supply its students and employees with online education and training during the COVID-19 lockdown.

The use of e-learning platforms is growing as more students attend remote or virtual schools (Sobejana, 2016). E-learning is quickly replacing the traditional classroom instruction around the world. Because it allows for more flexible access to information and instruction from any location, e-learning has gained popularity (Chan et al., 2007). As a result, e-learning is a common learning strategy in higher education institutions. According to Oye et al. (2012), e-learning technologies and learning management systems are used in today's classrooms in both online and traditional classrooms to capture students' cognition and include them in the learning process (Galy et al., 2011). Learning is nowadays possible because of e-learning systems, which remove the constraints of time, space, and physical proximity (Oye et al., 2012).

Smart Class platform is a web-based learning platform designed to help students to linkup with their fellow students from different schools, to share ideas, discuss challenges and have access to e-library and e-mentorship. Smart Class platforms were used in other places other than Rwanda. For instance, Smart Class has been influential in improving the outcomes of science courses and interest of learners in Spain (García-Peñalvo et al., 2020). Onyema et al., (2020) showed that high school students achieved more when engaged in blended mode of learning in Nigeria. In Rwanda, Sibomana et al. (2021) and Uwurukundo et al. (2022) revealed that there is a need of integrating ICT in the teaching of mathematics for improved performance.

Mathematics has become the backbone for prosperity in every sphere of life especially in the twenty-first century (Desli & Dimitriou, 2014) and it is often referred to be the "Father of All Sciences" (Clements & Sarama, 2016) any scientific inquiry would be hard to imagine without the use of mathematics (Desli & Dimitriou, 2014; Clements & Sarama, 2016; Maloy et al., 2010; Mcleod et al., 2017). Student's aptitude in the area of mathematics is referred to as their mathematical achievement. It is measured using a test result for mathematical ability (Mcleod et al., 2017). Mathematics is one of subjects taught in Rwandan secondary schools. It is compulsory at the ordinary level (O-Level) and optional at the Advanced level (A-Level). While mathematics remains an essential branch of science, MINEDUC, 2018) indicated that students' achievement in the subject has continued to decline over the past years. Additionally, the report indicated that students' interest in mathematics has declined, which affect negatively the academic performance.

Study findings of Sibomana et al. (2021) and Uwurukundo et al. (2022) in Rwanda revealed that students' achievement in mathematics is low and there is a need for improvement of traditional teaching methods that persist in secondary schools, which could be key factors for low achievement in mathematics. This calls for innovative ways of teaching mathematics to attract students' attention and interest (Das, 2019). Picturesque mathematics results in Rwanda are not convincing probably due to the limitation of the traditional methods of teaching (Sibomana et al., 2021). Therefore, a compelling and captivating approach should be advocated to help children better learn, grasp and retain mathematics concepts so as to enhance their involvement and success. Weinhandl et al., (2020) and Iyamuremye et al., (2021) contend that the online teaching environment approach is effective in enhancing the performance in mathematics subject.

As mentioned by Ukobizaba and Nizeyimana (2021), Rwandan primary and secondary students have a low-interest in mathematics subject and they hate the subject which leads to poor performance. Iyamuremye et al., (2022) highlighted that the presence of a high percentage of low-achieving students in Rwandan secondary schools is most likely attributable to teacher-led instruction which continues to dominate mathematics classes in the majority of Rwandan schools. It should be emphasized that students in each classroom have varying talents and hence produce varying results and needs varying support from different corners (Maloy et al., 2010) which can be possible through the use of online approaches.

Given the encouraging findings of Iyamuremye et al., (2022) which highlighted that web-based

learning helped secondary school students interact with their classmates and increased their interest and the findings of Onyema et al., (2020) which showed that high school students achieved more when engaged in blended mode of learning, the researchers in this study expected that an instructional web-based learning platform will help students develop and maintain interest in mathematics and improve their mathematics achievement. *However, d*espite efforts made in the provision of educational inputs to improve the achievement and interest in science subjects, especially Mathematics, there still exists a wide gap in the achievement and interest of students in mathematics.

Over the past years, there has been over increasing decline in mathematics academic achievement among mathematics students in secondary schools of Rwanda (REB, 2018). Rwanda Basic Education Board expressed a concern about mathematics' persistent poor performance and lack of interest in mathematics and science subjects which can affect individual students by getting discouraged and subsequently losing interest in mathematics which is a fundamental subject (Musbahu et al., 2021). In addition, most students believed that mathematics cannot be understood like other subjects unless memorized (Ukobizaba et al., 2020). Therefore, raising and improving students' achievement in Mathematics has been a major concern to researchers in recent times (Ukobizaba et al., 2020). This study aimed at investigating the contribution of Smart Class Platform on grade seven students' achievement and interest in mathematics in the Nyagatare District.

Related Literature

Comparing traditional classrooms and Smart Classrooms, traditional classrooms are those where instruction is restricted to four walls of a room. On the other hand, in Smart Classes, students are given chance to access content anytime and anywhere (Hemant & Sharma, 2016). While traditional classes are still appropriate, one must adapt to technological advancements (Bazelais & Doleck, 2018) for better teaching and learning outcomes. According to Hemant and Sharma (2016), technology should be incorporated into schools as the internet is now a key to advancement in the 21st century and globalization has made technological integration a must in today's education. Therefore, we must be aware of the rapid pace of technological advancement and remain vigilant by adjusting our methods as needed (Pandey, 2017).

According to Noor ul Amin and Jan (2018), Smart Class teaching and learning is defined as a technology enhanced classrooms that foster opportunities for teaching and learning by integrating learning technologies such as computers, tablets, specialized software, audience response technology, assistive listening devices, networking and audio/visual capabilities. It is a digital initiative which is rapidly changing the approach and methodology that teachers used in teaching in an innovative manner using technology. It has made teaching learning process more colorful and interesting.

Smart Class teaching and learning is mainly delivered using e-learning platforms and it give both students and teachers access to global education (Kanjilal & Saha, 2020). Smart Class teaching and learning changed how teachers and students operate and increased their performance(Arkorfula & Abaidoo, 2014). E-learning is one of greatest educational approaches as it addressed personal needs of the learner (Galy et al., 2011). Using Smart Class teaching and learning tools helps students better understand the value of homework in the learning process (Ntalindwa et al., 2022). In contrast to a typical classroom, Smart Class teaching and learning fosters an interactive environment where students may openly express themselves with greater confidence (Sevindik, 2010). Students' confidence and abilities to lead debates and think critically can be improved when they use Smart Class teaching and learning via e-learning platforms (Raja & Nagasubramani, 2018).

According to research by the British Open University, as cited by Onyema et al., (2020), Smartclass teaching and learning via e-learning generates 85 percent less CO_2 emissions per student and uses on average 90 percent less energy to produce and deliver courses than traditional face-to-face instruction. According to Gutierrez, (2016), Smart Class teaching and learning via e-learning often takes 40–60% less time than learning the same topics in a traditional classroom environment and increases students' retention rate from 25 to n60% compared to 8 to10% during face-to-face learning in the physical classroom (Gutierrez, 2016).

Sometimes traditional and online learning can be combined for better outcomes. When e-learning and traditional classroom instruction are combined,

it creates blended learning, also known as hybrid learning, where it is possible to assign both print-based and online materials to facilitate learning (Rao CS, 2019). Blended learning caters for all types of learners by ensuring that each student has access to both traditional and online learning, according to their interest. It provides an opportunity for both students and teachers to combine face-to-face physical learning with online learning, maximizing the benefits of both approaches. Blended learning strategy fill some of the teaching gaps in e-learning that may require the use of additional teaching methods.

Methodology

Design

This study adopted a true experimental design (Randomized Pretest-Posttest Control Group Design) of the quantitative research approach. As shown in figure 1, participants were randomly allocated to control and treatment groups when the pre-intervention test was conducted. It was followed by an intervention (the use of Smart Class Platform) that was given to the treatment group only while the control group was taught using conventional ways of teaching. After the intervention, a post intervention test for each group was conducted to establish the difference.

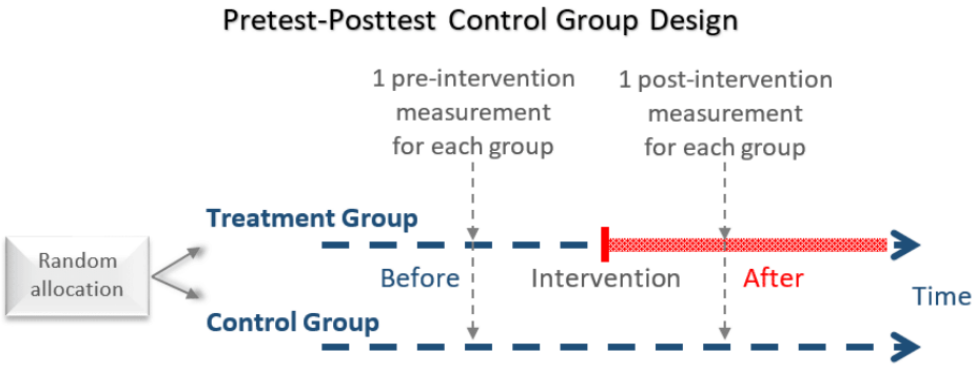

Figure 1: Randomized Pretest-Posttest Control Group Design (adapted from Fraenkel et al. (2012)

Smart Class Platform

Smart Class platform as an independent variable of the study is a web-based learning platform designed by the researchers to help students to linkup with their fellow students from different schools, to share ideas, discuss challenges and have access to e-library. This was a treatment given to the experimental group to establish if it contributed to the achievement and interest of grade seven students. To facilitate students' interaction with teachers and fellow students, the platform was made data-free for all the users to help students who might find it difficult to access the platform due to financial problems. During the intervention period, students were directed on how to use the SCP and they started using it. The platform did not interrupt the normal way of teaching as students used the platform in their free time. It was expected that students meet on the platform with fellow students and teachers across the country and get support in whatever challenges they face. Students were able to have access to e-mentorship.

For the first time, students were requested to join the community and register. They were supposed to have usernames and passwords that would allow them to log in. Figure 2 indicates the procedure of student registration and all the requirements. It is even well indicated that student who forgot the login credentials could easily reset them via the Forgot password tab.

After logging in, students were able to have access to different tabs that easily helped them to get different services. Figure 3 shows the orientation to students on how to get started with the Smart Class platform.

Figure 4 indicates a raised challenge by a student on the topic of probability: A student was asking the meaning of i) outcomes ii) at least and ii) more than. It is clearly showing that the student received four responses from classmates and one response from the teacher. The responses given can easily be accessed via pressing on students' answers or teachers' answers depending on what the student wants.

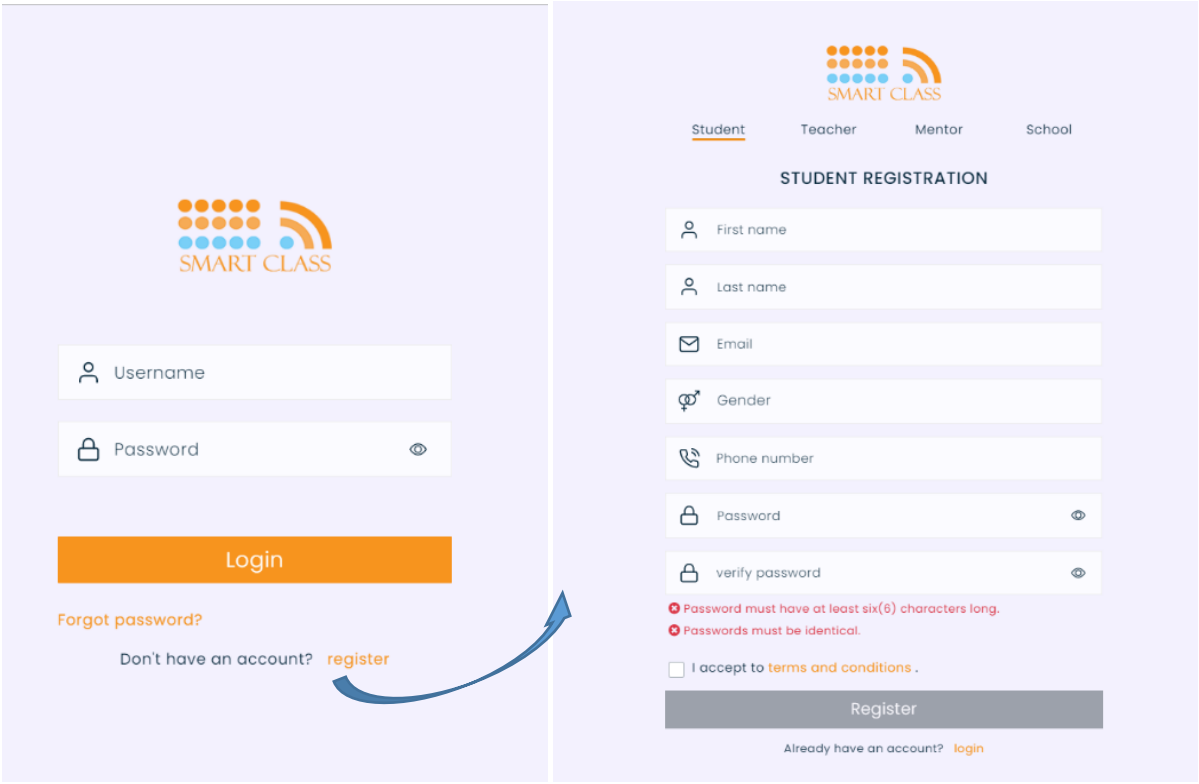

Figure 2: Student registration details

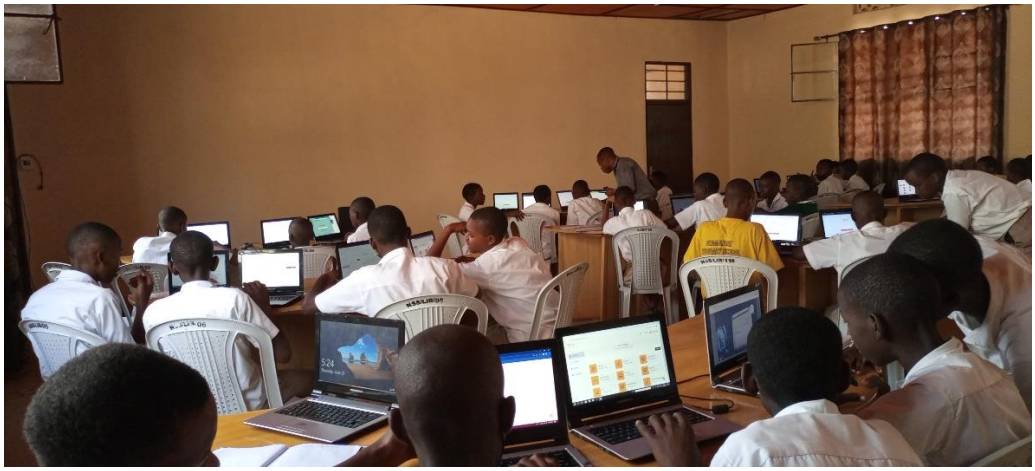

Figure 3: Orientation on how to create accounts on the SCP platform

There was a possibility of writing a question on the platform or uploading it as file. While providing an answer. Figure 5 shows the uploaded challenge by a student who was asking about solving the equation.

Population and Sampling

The target population for this study was 8620 grade seven students from 92 public secondary schools of Nyagatare District in Rwanda. Two schools were purposively selected as they fulfilled conditions of having students who can use computer assisted technologies very well. From the two sampled schools, 174 grade seven students were selected to participate in the study.

Instruments

Two instruments created by the researchers consisted of a Mathematics Achievement Test (MAT) and a Register of Students' Interest in Mathematics (RSIM). MAT was made up of 10

questions rated out of 100. RSIM was of Likert scale type of Strongly Agree (5 points), Agree (4 points), Undecided (3 points), Disagree (2 points) and Strongly Disagree (1point). The RSIM had 15 items that assessed students' interests in mathematics. Every item in RISM was designed to provoke a certain amount of interest, which is then scored. The scores from each item were added together to get the final score for each student. Each RSIM item had a minimum score of 1 mark. The lowest degree of interest for 15 things required a minimum score of 15. For ease of comprehension, scores were converted to percentages.

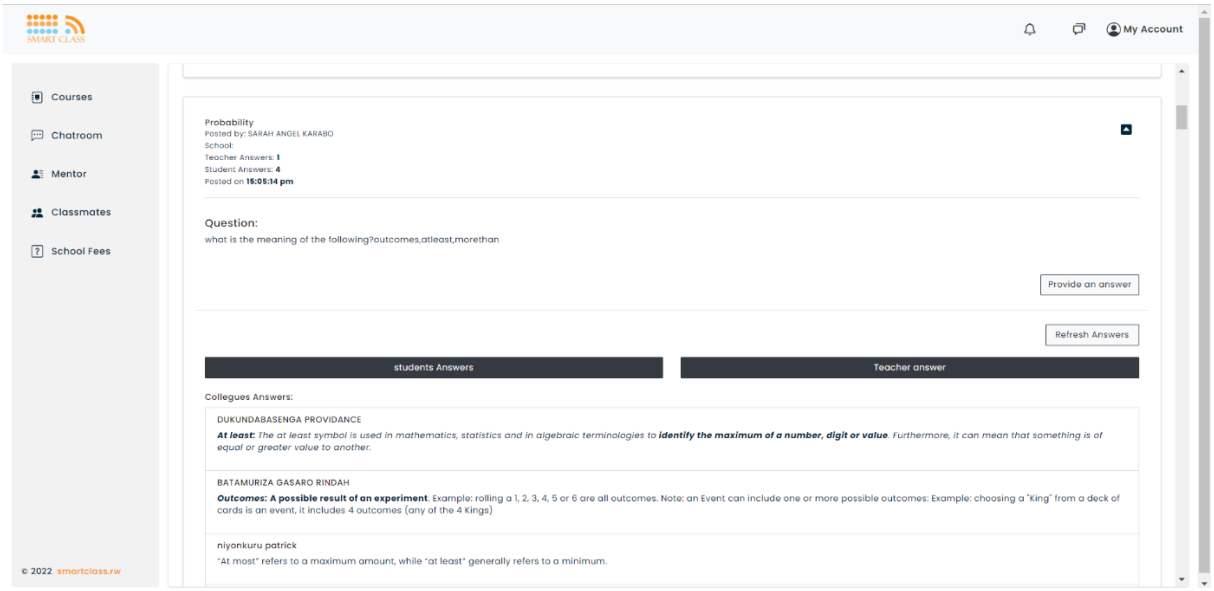

Figure 4: Challenge and answer page

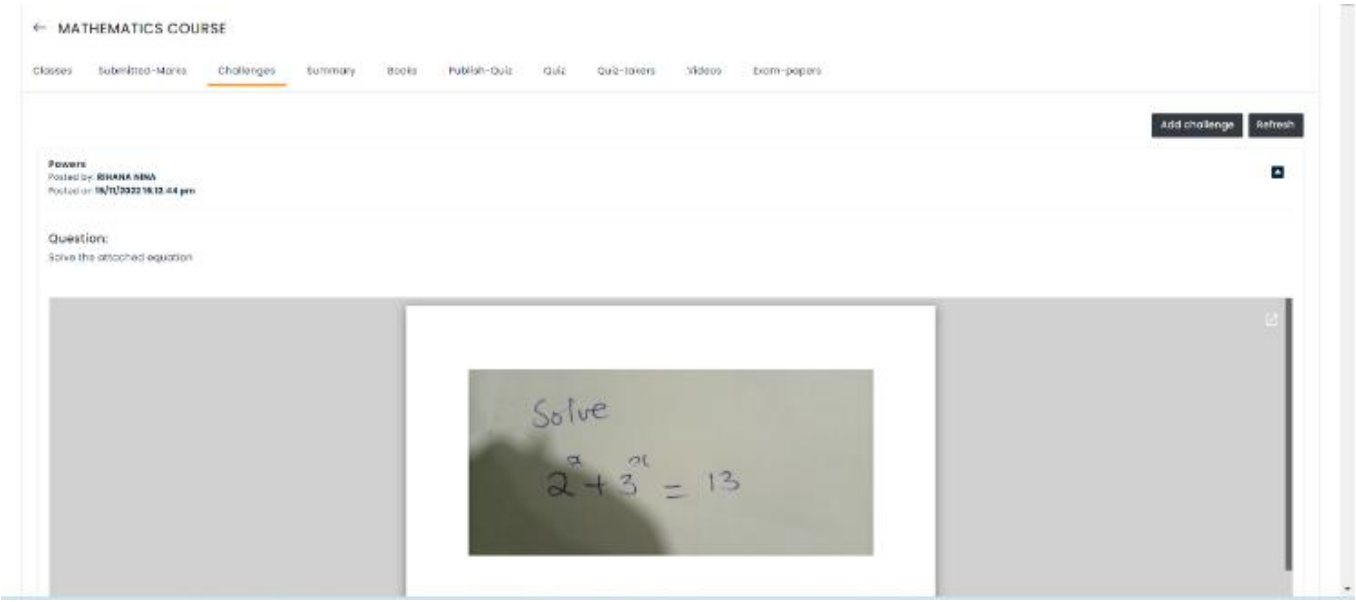

Figure 5: Challenge window for both students and teachers

Validity

The tools' content validity was examined to gauge how much the study's goals were being met by using them. The researchers employed the expert-judgment technique to confirm the instruments' validity in terms of their content. The researchers particularly asked two professionals in the Mathematics, Science and Physical Education and the Department of Early Childhood and Primary Education at the University of Rwanda for assessment and comments. The experts were given the instruments and the research objectives to make judgment whether items were related to the

intended objectives. Their opinions were incorporated before administering the instruments for the data collection process.

Reliability

A test-retest method was employed to ascertain the instrument stability. Ten respondents from grade seven were purposefully chosen from schools that would not be included in the main study and were given the study's instruments twice. Data from the two administrations of the instrument were correlated using the Spearman rank order correlation coefficient. The Spearman rank order correlation coefficient was calculated and the reliability coefficient indices yielded 0.82 and 0.79 for MAT and RSIM respectively. Therefore, the instruments used in this investigation were reliable.

Treatment of Data

From the two sampled schools, 174 grade seven students were selected to participate in the study whereby 87 constituted the control and 87 constituted the experimental group. During the intervention, the control group was taught using conventional approaches while the experimental group was taught using technology. Data was analyzed using the paired sample t-test so as to establish differences in interest and in mathematics achievement between the experimental and the control groups.

Ethical Considerations

The researchers made sure that all the instruments used in this study were valid and reliable before gathering data from respondents. The researchers received an approval from the University of Rwanda, College of Education's unit of research and innovation. Additionally, to be able to gather data in the district's chosen schools, the researchers requested permission from the Nyagatare District authorities. Finally, the researchers respected respondents' right to anonymity by requesting them not to put their names on the survey.

Results and Discussion

This section presents results of the study, guided by four research questions:

Research Question 1: Is there a significant difference in achievement between the control and the experimental group before the intervention?

This research question sought to establish the difference in achievement between the control and the experimental group before the intervention. The question called for testing the following null hypothesis using the paired sample t-test as indicated in table 1 to 2: There is no significant difference in achievement between the control and the experimental group before the intervention.

Table 1: Paired Sample Statistics for Achievement before Treatment

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Experimental Pre-test Scores	44.9195	87	20.09756	2.15468
	Control Pre-test Scores	45.6552	87	17.27535	1.85211

Table 2: Paired Sample Test for Achievement before Treatment

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Experimental Pretest Scores Control Pre-test Scores	-.73563	20.82343	2.23251	-5.17371	3.70244	-.330	86	.743

Table 1 indicates the mean score of 44.9195 for the experimental group while that of the control group was 45.6552. The p-value of .745 in table 2 is greater than the critical value (.05) suggesting that the null hypothesis should be accepted, thus maintaining that the initial mean score difference between the experimental and the control group was not significant. Therefore, there is no significant difference in achievement between the control and the experimental group before the intervention.

Research Question 2: Is there a significant difference in achievement between the control and the experimental group after the intervention?

This research question sought to establish the difference in achievement between the control and the experimental group after the intervention, whereby the experimental group was taught using the Smart Class Platform while the control group was taught using the conventional approach of teaching. The research question called for testing the following null hypothesis using the paired sample t-test as indicated in table 3 to 4: There is no significant difference in achievement between the control and the experimental group after the intervention.

Table 3: Paired Sample Statistics for Achievement after Treatment

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Experimental Post-test Scores	52.7471	87	20.57444	2.20581
	Control Post-test Scores	46.1609	87	16.79277	1.80037

Table 4: Paired Sample Test for Achievement after Treatment

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Experimental_PosttestScores – Control Post-test Scores	6.58621	20.38613	2.18562	2.24133	10.93108	3.013	86	.003

Table 3 indicates the mean score of 52.7471 for the experimental group while that of the control group was 46.1609. The p-value of .003 in table 4 is lesser than the critical value (.05) suggesting that the null hypothesis should be rejected, thus maintaining that the final mean score difference between the experimental and the control group is significant. Therefore, there is a significant difference in achievement between the control and the experimental group after the intervention.

Initially, the control group slightly outperformed the experimental group (table 1) even though the difference was not statistically significant (table 2). However, after the treatment, when the control group was taught using the conventional approach while the experimental group was taught using technology, the experimental group outperformed the control group and the mean score difference was statistically significant. This implies that the use of technology in teaching significantly enhanced the achievement of the experimental group members who were taught using technology during the intervention period. Findings in this study are in harmony with those by Onyema et al. (2020) which revealed that incorporating emerging technology into the teaching and learning process raises students' achievement. For instance, Costley (2014), established that the use of technology is of great impact in enhancing students' learning outcomes. The author further mentioned that those exposed to technology passed mathematics content with higher grades than those not exposed to technology. In another scenario, Mathematics received notable achievements and students increased their interest due to the usage of technology (Carstens et al., 2021).

Table 5: Paired Sample Statistics for Students' Interest before Treatment

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Experimental Interest Before	75.9083	87	14.33389	1.53675
	Control Interest Before	77.2570	87	9.53776	1.02256

Table 6: Paired Sample Test for Students' Interest before Treatment

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Experimental Interest Before – Control Interest Before	-1.34874	15.43544	1.65485	-4.63847	1.94100	-.815	86	.417

Table 5 indicates the mean score of 75.9083 for the experimental group while that of the control group was 77.2570. The p-value of .417 in table 6 is greater than the critical value (.05) suggesting that the null hypothesis should be accepted, thus maintaining that the initial mean score difference between the experimental and the control group was not significant. Therefore, there is no significant difference in students' interest between the control and the experimental group before the intervention.

Research Question 4: Is there a significant difference in students' interest in mathematics between the control and the experimental group after the intervention?

This research question sought to establish the difference in students' interest between the control and the experimental group after the intervention, whereby the experimental group was taught using the Smart Class Platform while the control group was taught using the conventional approach of teaching. The research question called for testing the following null hypothesis using the paired sample t-test as indicated in table 7 to 8: There is no significant difference in students' interest in mathematics between the control and the experimental group after the intervention.

Table 7 indicates the mean score of 85.6100 for the experimental group while that of the control group was 80.7510. The p-value of .000 in table 4 is lesser than the critical value (.05) suggesting that the null hypothesis should be rejected, thus maintaining that the final mean score difference between the experimental and the control group is significant. Therefore, there is a significant difference in students' interest in mathematics between the control and the experimental group after the intervention.

Table 7: Paired Sample Statistics for Students' Interest after Treatment

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Experimental Interest After	85.6100	87	10.24753	1.09865
	Control Interest After	80.7510	87	8.84616	.94841

Table 8: Paired Sample Test for Students' Interest before Treatment

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1 Experimental Interest After Control Interest After	4.85897	5.94543	.63742	3.59182	6.12611	7.623	86	.000

Initially, the control group slightly outperformed the experimental group (table 5) even though the difference was not statistically significant (table 6). However, after the treatment, when the control group was taught using the conventional approach while the experimental group was taught using technology, the experimental group outperformed the control group and the mean score difference was statistically significant. This implies that the use of technology in teaching significantly enhanced the interest of the experimental group members who were taught using technology during the

intervention period. Findings in this study are in harmony with those by Onyema et al. (2020) which revealed that incorporating emerging technology into the teaching and learning process raises students' interest in the subject matter. Findings further agree with (Neema-Abooki & Kitawi, 2014) finding which revealed that the usage of e-learning methodologies at Strathmore University in Kenya had a beneficial impact on students' academic achievement. Additionally, the study of Oye et al. (2012) revealed that students at higher education institutions who used e-learning platforms outperformed those who used traditional learning methods. Likewise, the study of Zare et al. (2016) found that e-learning improves students' academic performance. Chen and Lee (2011) established that students who engaged in e-learning platform activities outperformed those who studied conventionally.

Conclusions and Recommendations

Based on findings, the study concludes that the use of technology enhanced mathematics interest and achievement of grade seven pupils in the experimental group who were taught using technology during the intervention period. Therefore, the use of technology enhances both interest and achievement in mathematics. Based on the conclusions, teachers should use technology along with conventional ways in teaching Mathematics so as to enhance mathematics interest and achievement in Secondary Schools.

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