Effect of Smart Classroom on Learners' Performance in Chemistry at selected secondary schools in Kicukiro district: A case of advanced level students

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Abstract

This study intended to investigate the effect of smart classroom on learners' performance in chemistry. It revealed that smart classroom components which are projector, computer, interactive white board and video simulation motivate learners in teaching and learning chemistry. From the study carried out on 101 senior five students selected purposively, the results were analyzed using t-test, linear regression analysis and descriptive statistics demonstrated that there is a positive effect of smart classroom on learners' performance in chemistry. These were indicated by the students' results in pre-test and post-test in both control and experimental group.

Keywords: Learners' performance, Smart classroom, Smart learning

Introduction

In 2016, the government of Rwanda through the 'ICT-in –Education policy', provisioned the "Smart classroom" as a key of digitizing education from a paper-based system to technological based system that allow learners to access a variety of teaching and learning resources (ICT –in education 2016). In view of this, this study was constructed on the Stimulus-Response theory and Social Cognitive Theory. Stimulus is a combination of visual event, sound, taste, touch and smell (Franco et al., 2017). This study therefore intended to investigate the relevance of smart classroom on students learning 'outcomes in chemistry. According to National Institute of Statistics of Rwanda report, KICUKIRO district has a high level of computer literacy rate of the population aged 15 and above (EICV4 and EICV5 2018).

Rwanda has embarked on the trajectory of transformation of knowledge-led economy to information-rich economy where access to digital content will become key tool to doing business in all sectors (MINICT, 2018). The Government of Rwanda's Education Sector Strategic Plan for 2018/2019 to 2023/24 (ESSP) stated that the use of ICT is "vital" to accomplish the socio-economic development envisaged in Vision 2050.

Smart classroom which is based on ICT usage influences learning outcomes of the students (Zeitlin & Bower, 2018). Yang, Pan, Zhou and Huang (2018) described a smart classroom as a physical classroom space that is active for presenting instructional activities of the content. It helps learners to access learning resources and combines appropriate instructional activities as well as interaction.

Smart classroom responds to the needs and role of new learning of the current education and the future (Bautista & Borges, 2013). Smart classroom enhances teaching and learning of some abstract concepts found in chemistry and as a result increases students motivation and helps learners to achieve the learning objectives

intended in the curriculum (Ganaie & Delhi, 2016). Malik & Shanwal , 2019, Phoong et al., 2019, Ganaie & Delhi ,2016, Jena ,2013, Jo & Lim, 2015) all agreed that smart classroom enhances teaching and learning as well as student's achievement. Smart classroom came as one of the strategies that could help teachers to teach chemistry effectively.

In view of this fact, ICT infrastructure and device associated with national curriculum and teacher capacity building have been set up in secondary schools (Munyantore & Mbalire, 2017). More than 692 smart classrooms in Rwanda have been built in schools to progress the quality of teaching and learning but only 55% of secondary school have smart classroom (REB, 2018).

However, the use of smart classroom did not replace the teacher because it is the teacher who determines what to teach and how to teach it. By supporting this supposition, research findings illustrated that the effectiveness of smart classroom offer opportunity to adapt learning materials that are suitable for a given learning styles or strategies as well as the needs of learners for each level (Al-hunaiyyan et al., 2017). Al-hunaiyyan's study hypothesized that:

i. There is no significant mean difference between the control group and the experimental group in the pretest (H01).
ii. There is no significant difference between the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method (H02).
iii. There is no significant difference in performance in chemistry between girls and boys taught through smart classroom or taught without smart classroom (H03).

As for the study conducted by Ganaie and Delhi (2016) revealed that the use of smart classroom in teaching and learning chemistry improves academic performance of the learner. In smart learning, computer, internet and multimedia in classroom teaching are used (Ashfaque et al., 2014). These help to move from teacher to learner-centered approach (Taleb & Hassanzadeh, 2015).

Smart classroom when combined with learner-centered approach was regarded as the proposed solution to increase the competences of learners and creates the educational structure which is attractive and interactive thereby motivating the students to build their own learning (Phoong et al., 2019). Smart learning motivates learners to create knowledge which offer a basis in linking chemistry to daily life (Chaudhary et al., 2014).

Furthermore, integration of technology was regarded as an effective and attractive way of teaching and learning in private and public schools in which teachers were able to fruitful help learners with special need education by providing specific arrangement (Balmeo et al., 2014). The integration of smart classroom in teaching

and learning lies with the Rwanda's Education Sector Strategy Plan (ESSP) policy that emphasizes reducing poverty by focusing on digital literacy (Mineduc, 2013).

Methodology

Research design and sample

This research adopted positivist paradigm that lead to knowledge based on experience of senses and can be obtained by observation and experiment. This design was found appropriate for this study because it helps the researcher to manipulate the relationship between independent and dependent variables that were discovered by causal inferences as a result of experimental design (Pham, 2018).

The target population was learners and teachers in Kicukiro district from schools with chemistry combination and having a smart classroom. Therefore, a purposive sampling technique was employed to select the two schools and teachers who participated in this study. The availability of electricity, computers, smart boards, and internet were considered to select these two schools.

Data collection sample and sampling technique

Before collecting data, a piloting study was conducted to check the clarity of the research tools. The pilot study was conducted in two schools different from the schools where the full study was conducted. As a result, some questions were revised. The research sampled 101 chemistry secondary students and 2 teachers.

A total number of 101 chemistry learners were put in two groups: School 1: 54 students were allocated to the control group (taught with conventional method) and school 2: 47 students were allocated to the experimental group (taught using smart classroom) (See Table 1 below).

Table 1. Distribution of respondents 'group type

	No.of learners in control group	**No. of learners in experimental group**	
			Total
School 1	26	28	54
School 2	24	23	47
Total (%)	50 (49.5%)	51 (50.50)	101 (100%)

Data collection process

A pre-test and post-test were used to collect data on learners' achievement in chemistry subject. Closed questions were used in both pre- and post-test to collect the data of achievement in both groups. The questions used in both

tests were the same but in post-test, changing the number of questions and use of synonyms were emphasized. Reliability of questionnaire was ascertained based on results from three evaluator specialists (lecturers in university) who are familiar with the reliability of closed questions.

Learners of experimental group were put in smart classroom where students had access to a laptop. The experimental group did the post-test using computer whereas those in control group used the conventional method of chalkboard. Both learners' tests were marked, recorded and then a descriptive statistic and t-test were used to analyze the results to determine the effectiveness of smart classroom in instructional activities.

Teachers for control group used PowerPoint presentation and video simulation through smart classroom equipped with a computer and a projector. Both teachers: the control group and experimental group taught the same content: carbonyl compounds: aldehydes and ketones in senior five on both control and experimental groups.

A chemistry test out of 20 marks was given to the learners. Independent-samples t -test was used to analyze the difference between the control and experimental group (Horn, 2009). The results of this test showed that there was homogeneity of learners' performance. The minimum scores for school 1 were 8 and 7 for school 2 while maximum scores were 15 and 16.5 for school 1 and 2 with average marks of 14.67 and 14.09 respectively.

Research findings and discussions

Independent sample t- test

The descriptive analysis results for pre-test in control and experimental group for both school 1 and school 2 are presented in Table 2 and Figure 1 below.

Table 2: Significance of the difference between the mean of the control and experimental group in pre-test for selected schools

School	Type of group	N	Mean	S. D	t-value	Df	Sig. (two tailed)	95% CI of the difference	
School 1	Control	26	7.55	2.77	-.156	52	.877	Lower	Upper
	Experimental	28	7.67	2.91				-1.67642	1.43466
School 2	Control	24	7.08	2.20	.051	45	.960	Lower	Upper
	Experimental	23	7.04	3.10				-1.53783	1.61754

Figure 1

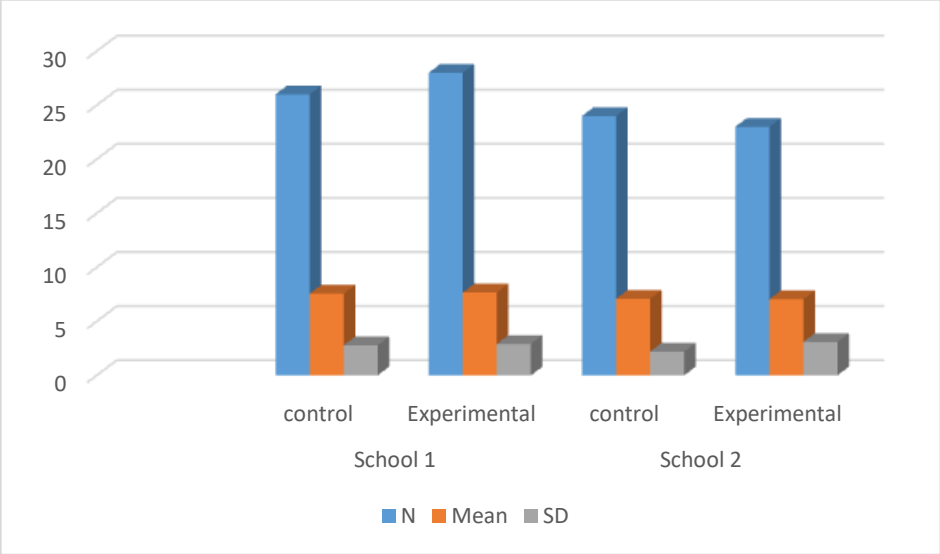


Figure 1. Mean score and standard deviation of the control and experimental group in pre-test for selected schools.

As shown in table 2 and figure 1 above, the mean values for pre-test are 7.55 in the control group and 7.67 in the experimental group for school 1 with 54 participants; while it was 7.08 in the control group and 7.04 in the experimental group for school 2 with 47 participants.

To determine the significance of difference between the control and experimental group in the pre-test, the t-test was used. The calculated t- values (Table 2) were -.156 with p = .877 for school 1 and 0.51 with p = .960 for school 2. Since $p \geq \alpha$ at .05 significant level (.877 ≥ .005 for school 1 and .960 ≥ 0.05 for school 2), we fail to reject the first null hypothesis (H01).

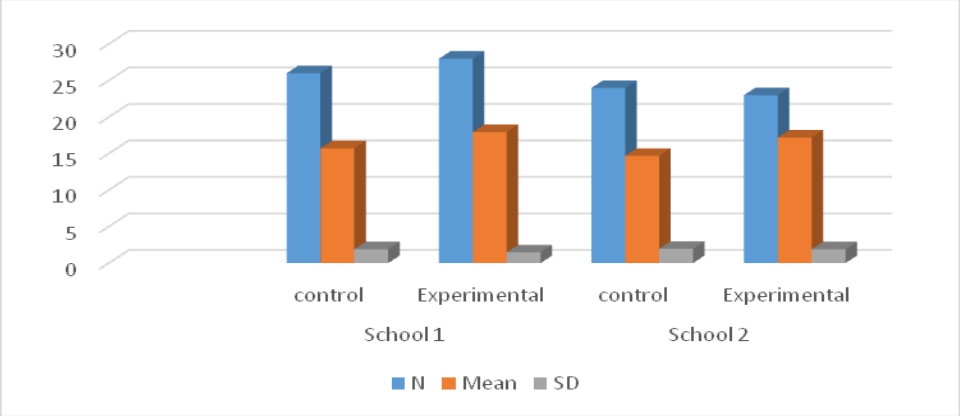
This implies that there was no significant mean difference between the control and experimental group in the pre-test. These data motivated the researcher to introduce smart classroom approach to the experimental group and teach the control group through traditional method to evaluate the smart classroom effect on learners' performance.

After three weeks of introducing the respective treatments: smart classroom approach for experimental group and traditional method approach for the control group, the same achievement test was administrated to both groups, and the results of the test are given as indicated in table 3 and figure 2.

Table 3: Significance of the difference between the mean of the control and experimental group in post-test for selected schools

Schools	Type of group	N	Mean	S. D	t-value	Df	Sig. (two tailed)	95% CI of the difference	
School 1	Control	26	15.73	1.91	-4.783	52	.000	Lower	Upper
	Experimental	28	17.95	1.48				-3.14514	-1.28618
School 2	Control	24	14.7	1.96	-4.381	45	.000	Lower	Upper
	Experimental	23	17.2	1.90				-3.61426	-1.33773

Figure 2. Mean score and standard deviation for post-test in control and experimental group.



The results from figure 2 and table 3 showed that the average score of post-tests in control group is 15.73 and 17.95 for experimental with the standard deviation of 1.91 and 1.48 respectively for school 1, while it was 14.7 for the control and 17.2 for experimental with the standard deviation of 1.96 and 1.90 respectively for school 2.

In order to determine the significance of the difference between the control and experimental group in the post-test, the t- test was used. As shown in the table 3 above, the calculated t- values were t = -4.783, and p = .000 for school 1. As $p \leq \alpha$ at .05 significant level ($.000 \leq .05$), therefore the rejection of the second null hypothesis (H02). This implies that there is a significant difference between the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method at school 1.

Similar results were obtained from school 2 where the average score of post-test was 14.7 for the control group and 17.2 for the experimental group with the standard deviation of 1.96 and 1.90 respectively. The calculated t-value was -4.381 with p-value of .000 at .05 of significance level. As $p \leq \alpha$ ($.000 \leq .05$), we also reject the null hypothesis H02 at school 2 which implies that there is a significant difference between the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method. In addition, table 2 and table 3 showed that the average score of pre-test and post-test are significantly different. This demonstrates that the implementation of smart classroom in teaching and learning improved students' performance in chemistry.

Table 4: Linear regression analysis of post-test between control and experimental group at selected school

school	Model	Mean square	df	Standard error	F	Sig.	t	p-value
School 1	Regression	71.43	1	.737	25.64	.000[a]	18.1	.000
School 2	Regression	72	1	.888	19.19	.000[a]	13.76	.000

Results in table 4 indicate that, F=25.64 for school 1, F= 19.19 for school 2 and p-value=.000 meaning reject null hypothesis Ho2, there is no significant difference between the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method at two schools.

The control and experimental group results from two schools were then combined in order to analyze the significance of the difference between them after introducing smart classroom over traditional teaching method, and the results are given in table 5 below.

Table 5: Significance of the difference between the mean of the control and experimental group in post-test for selected schools

Type of group	N	Mean	S. D	t-value	Df	Sig. (two tailed)	95% CI of the difference	
Control	50	15.17	1.96	-6.653	99	.000	Lower	Upper
Experimental	51	17.61	1.70				-3.15109	-1.70330

The results in table 5 above showed that the post-test average score of control group is 15.17 and 17.61 for experimental group. The calculated t-test is -6.653 with .000 p-values at .05. We know that if $p \leq \alpha$, where α is equal to .05, hence the rejection of the second null hypothesis. This implies that there is a significant difference between

the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method.

Table 6: Linear regression analysis of post-test between control and experimental group

Model	Mean square	df	Standard error	F	Sig.	t	p-value
Regression	148.62	1	.582	44.26	.000[a]	21.9	.000

Results in table 6 indicate that, F=44.26 and p-value=.000 meaning rejection of the null hypothesis Ho1, there is no significant difference between the post-test mean score in chemistry of learners taught through smart classroom and those taught through conventional method.

Conclusion

This study examined the efficiency of smart classrooms on learners' performance in chemistry. The results showed that learners exposed to smart classroom performed better than learners taught using conventional method of teaching. This shows that smart classroom helps instructors and learners to achieve learning outcomes in chemistry as a subject.

Furthermore, the results showed that learners exposed to smart classroom with e-resource and learner-centered learning strategy is motivated to learn some abstract concepts. Therefore, smart classroom should be used in teaching and learning of science subjects in general since it helps to clarify abstract concepts.

Suggestions for further studies

The covid-19 pandemic and fund limitation pushed the researchers to carry out this study in only two schools. Other researchers may replicate this study by using more than two schools so that results can easily be generalized.

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