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# Learning Science in Large Classes of Universal Secondary Education Schools and Non-Universal Secondary Education Schools, Eastern Uganda

**Masanyu Juma Peter[1*], Busulwa Henry Ssebuliba[1], Acham Hedwig[2]**

[1]College of Education and External Studies, Makerere University, Kampala, Uganda
[2]College of Agricultural & Environmental Sciences, Makerere University, Kampala, Uganda
Email: *jpmasanyu@gmail.com, hsbusulwa@cees.mak.ac.ug, hedwigacham@gmail.com

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## Abstract

The study compares how students in Universal Secondary Education (USE) schools and non-USE schools cope with learning science in very large versus standard classes across the four Eastern Uganda sub-regions. Using questionnaires, lesson observations, interviews, an achievement test, and an inventory of laboratory resources, the authors relate pedagogical practices, student motivation and resource availability to test performance. A t-test shows significantly higher mean scores in non-USE schools, which the authors attribute to smaller class sizes, stronger supervision and more engaging teaching. They conclude that learner interest and motivation can offset some constraints of an overcrowded science classroom.

## Keywords

Learners' Interest, Cope, Science Concepts

## 1. Introduction

Learner-centered pedagogies in science education have been encouraged in many countries because of their impact in motivating and imparting skills to learners (Kola, 2013). They provide interactive approaches that promote creativity and innovation in new technologies, which are useful to the development of a nation (Kola, 2013). Professionals in sciences are an outcome of an effective learner-centered interaction in which students are enabled to observe carefully and thoroughly, report accurately, organize information acquired, generalize, predict on the basis of acquired information and generalizations. They can design experiments (including controls, where necessary, to check the predictions), use models to explain phenomena, where appropriate, and continue the process of inquiry when new data do not conform to predictions. Motivated learners use problem-solving approaches and open-ended field or laboratory exercises, Mani (1982), argues that effective teaching of Sciences should integrate learners' existing ideas, values and beliefs into their classroom experiences; these are supported by Kola, 2007 and Fakunle, 2010. Effective pedagogy in science subjects in schools where there is a shortage of qualified science teachers, apparatus and chemicals yet in environments of increase in number of students in class, can embrace learner-centered approaches, where learners who have understood can interest those who have not. Learning science with teaching aids such as apparatus and chemicals provides teachers with a practical opportunity to impart critical thinking and skills required for effective learning. In conventional learning, a smaller number of learners per class, makes it easier for the science teacher to attend to individual problems of the students during teaching. However, in streams with large numbers, students' intellectual development is driven by motivation from teachers who prepare learners for opportunities for future study and work, and choices of career as well as their capacity to make informed decisions. Good pedagogical practices are an exposure that encourages learners' interest in large class sizes, to use available facilities and their interactions and experiences assist learners to improve performance in conditions of inadequate learning environments. He is supported by Ukwuma, 1990.

In a practical classroom situation for proper teaching of sciences, both the Constructivist theory and the Behaviorist theory should be employed to different sections of a topic—the areas that require the teacher to give more explanations will lean more on Behaviorist theory while those areas that need student-based teaching will be good for the Constructivist theory.

Rural schools in Uganda are disadvantaged because the teaching of sciences continues with inadequacies of apparatus and chemicals caused by very high enrollment per class. The teachers follow the syllabus and the overwhelming numbers of learners make it a challenge to enhance learning and practicability of what has been taught. This leads to low comprehension and poor performance in final examinations (UNEB, 2016). The question is, how do some students manage to do well in environments of massive enrollments, coupled with a high scarcity of apparatus, chemicals and other teaching materials? This study tries to assess how learning of sciences takes place amidst few science teachers and inadequate facilities especially in the USE schools with large numbers in classes. National examination records over the years have continued to report a decline in performance in the science subjects (UNEB, 2006-2016), however, some individuals in USE schools perform well. The factors that learners use in environments where facilities are reasonably inadequate shall be used to encourage and motivate learners in similar learning environments.

### 1.1. Statement of the Problem

The introduction of USE in secondary schools from 2007 resulted in a sharp rise in the number of students. However, this was done without increasing the facilities required for proper pedagogy in sciences especially practical lessons and constructing enough classrooms. Large classes against few teaching facilities caused the teachers to introduce pedagogical innovations to be able to teach the students in USE schools as they could not teach in the same ways they were teaching while handling small classes. Records of UCE results at UNEB over the years indicate a general decline in performance in the science subjects. The decline in performance may have been brought about by teaching difficulties and inadequacies of apparatus, chemicals, and inefficient methods of teaching and a shortage of qualified teachers. Teachers teach to complete the syllabuses and follow UNEB question papers. No studies have been done to establish how teaching is done in this era of scarcity and large classes. Hence, there is a need to establish how students are coping with the new innovations (such as virtual laboratories, project work, class and group discussions) in teaching and how the current teaching is affecting candidate scores in class exercises and the final National Examinations. This will be achieved by comparing test scores obtained by candidates from USE schools and those of candidates from Non-USE schools. This comparison will help establish the relationship between the current pedagogical innovations in the teaching of sciences in USE schools and candidates' performance in sciences. Also, the comparison of results from science tests for candidates in USE schools with those from Non-USE schools will enable us to establish whether there is a difference in pedagogy in these two categories of schools.

### 1.2. Study Objectives

The study investigated students' learning environments in large classes of Universal Secondary schools in Uganda and how this influenced their performance. The study focused on what motivates learning in large classes in environments with inadequate facilities and attention from the teacher. Specifically, the objectives included:

1) To establish the influence of pedagogical innovations on student participation during lessons (teaching-learning process) and student performance.

2) To compare candidates' scores obtained from the tests in Science Subjects from USE schools with those from Non-USE schools.

## 2. Methodology

The study was conducted in Eastern Uganda's four sub-regions—Busoga, Bukedi, Bugisu-Sebei and Teso from February to September 2015. The region consisted of 32 Administrative Districts by 2015 from which 4 USE and 4 Non-USE schools were selected from each sub-region. Information was obtained by observation of lessons (3 times in each school) and administering questionnaires to 32 head teachers together with 46 and 44 science teachers, from USE and Non-USE schools respectively. An assessment of what was taught was administered through a test to a sample of 2350 students from 16 USE schools and 2045 from 16 Non-USE. A physical inspection of availability of teaching materials was done by recording the equipment and chemicals in the schools visited. 20 randomly selected finalists of the lower secondary education science curriculum were given questionnaires in every school to respond to.

First, only Day schools with Examination Centre Numbers, which had presented candidates in senior four for Uganda Certificate of Education in 2006, a year before the introduction of USE were stratified according to Sub-regions. Each school in the strata was assigned a number from 1, 2, 3, 4, … up to the last number corresponding to the number of schools in the sub-region. The numbers corresponding to the schools were written on pieces of paper, properly folded, mixed up thoroughly and dropped in a basin. By selecting randomly, without replacing these pieces of paper at a time, and opening them to read the numbers, the four schools in one sub-region were selected. The procedure was repeated until all sixteen schools in the four sub-regions for USE schools were selected.

The above procedure was repeated for the four sub-regions to select the sixteen schools in the Non-USE schools.

At the school level, head teachers were purposively selected because every school had one head, science teachers were only those who were teaching senior four classes and in case a school had more than one Biology, Chemistry or Physics teacher handling senior four then we purposively chose the one teaching practicals. This was done for both USE and Non-USE schools.

All students found at school on our visit sat the test so 2350 and 2045 were the total number of candidates present in USE and Non-USE schools respectively on the days the tests were done.

To develop the Table of Random Numbers that was used to select the twenty candidates per school to answer questionnaires, Epitools—Ausvet was used to come up with a Table beginning from 20 to 800 candidates. Numbers were written on cards from 1, 2, 3, … 800 properly arranged in ascending order prior to visiting each school. After answering the test, all senior four candidates were asked to make a single line starting with a girl followed by a boy then a girl (in simple words a girl, boy, girl, boy and so on) until one sex was over then the rest would be the sex with a larger number of candidates. The last number on the card given out would correspond to the number of candidates present and using the Table the twenty candidates would be read out following the row corresponding to the number on card given out last. Implying purely Random selection of participants. It should be noted that students in the same class and school have similar contextual factors, for instance, very many are brilliant, very many have medium ability, very many have low ability, very many were admitted with similar range of aggregates, etc., so a sample of 20 was representative enough for every school to answer the questionnaires.

## 3. Results

**Availability of laboratory facilities**

The researcher took inventory of the available laboratory facilities in the sampled secondary schools by using the list of chemicals and apparatus Uganda National Examinations Board sends to the Ministry of Education and Sports for distribution to all schools so that they can equip their laboratories to help in teaching and in preparation for UCE/UACE Examinations at the end of the year. The findings were summed up in Table 1.

Some USE schools (12.5%) hardly had any chemicals at all and head teachers claimed Government had not supplied them and 6.25% never had apparatus so they were rated as very inadequate. The chemicals and apparatus available compared to the number of students in the school led us to rate them using a four-rater scale. On comparing the available facilities with school population and establishing that they were fair enough to conduct basic experiments, these were rated inadequate. When the facilities were good enough to conduct most of the experiments such schools were rated as adequate and if the schools had excess facilities they were rated very adequate. The student population was determined per stream then multiplied by the number of streams.

**Table 1.** Shows number of schools with laboratory facilities indicated.

| Summary | USE Schools Facilities | | Non-USE Schools Facilities | |
|---|---|---|---|---|
| | Chemicals | Apparatus | Chemicals | Apparatus |
| Very inadequate | 2 (12.50) | 1 (6,25) | 0 (0.00) | 0 (0.00) |
| Inadequate | 3 (18.75) | 4 (25.00) | 4 (25.00) | 3 (18.75) |
| Adequate | 8 (50.00) | 9 (56.25) | 9 (56.25) | 12 (75.00) |
| Very adequate | 3 (18.75) | 2 (12.50) | 3 (18.75) | 1 (6.25) |

In each of the categories (USE and Non-USE), 18.75% of the schools had excess chemicals and apparatus and for the case of USE these were the very schools which had virtual laboratories indicating the unequal distribution of these facilities by MOE&S.

In determining the student-to-teacher ratio, the researchers established the size of a stream since each time the science teacher goes to class a stream is handled so the ratio of students to the teacher was equivalent to the total number of students divided by the number of teachers per subject. In some USE schools the ratio was found to be as high as 350:1 while in Non-USE schools the highest was100:1 but most schools had 70:1. The data collected about students per stream was recorded in Table 2.

From Table 2, Science teachers and head teachers agree that no stream in No Non-USE School had more than 150 candidates per stream in senior four. It is clear that over 50% of Non-USE schools had below 50 candidates per stream while 6.3% of USE schools had more than 150 candidates per stream in senior four,

Table 2. Responses of head teachers and science teachers on number of students per stream from senior one to four.

| Number of students per stream | Responses from Head teachers in USE Schools | | | | Responses from Head teachers in Non-USE Schools | | | | Responses from Science teachers in USE schools | | | | Responses from Science teachers in Non-USE schools | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 |
| Below 50 | 0 (0.0) | 1 (6.3) | 0 (0.0) | 1 (6.3) | 7 (43.8) | 8 (50.0) | 9 (56.3) | 8 (50.0) | 0 (0.0) | 2 (4.3) | 0 (0.0) | 2 (4.3) | 21 (47.7) | 26 (59.1) | 25 (56.8) | 24 (54.5) |
| Between 51 - 100 | 8 (50.0) | 7 (43.8) | 8 (50.0) | 7 (43.8) | 7 (43.8) | 7 (43.8) | 6 (37.5) | 7 (43.8) | 24 (52.2) | 21 (45.7 | 24 (52.2) | 21 (45.7) | 21 (47.7) | 18 (40.9) | 17 (38.6) | 18 (40.9) |
| Between 101 - 150 | 6 (37.5) | 7 (43.8) | 6 (37.5) | 7 (43.8) | 2 (12.5) | 1 (6.3) | 1 (6.3) | 1 (6.3) | 18 (39.1) | 21 (45.7) | 18 (39.1) | 21 (45.7) | 2 (4.5) | 2 (4.5) | 2 (4.5) | 2 (4.5) |
| Over 150 | 2 (12.5) | 1 (6.3) | 2 (12.5) | 1 (6.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 4 (8.7) | 2 (4.3) | 4 (8.7) | 2 (4.3) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Total | 16 100 | 16 100 | 16 100 | 16 100 | 16 100 | 16 100 | 16 100 | 16 100 | 46 1000 | 46 100 | 46 100 | 46 100 | 44 100 | 44 100 | 44 100 | 44 100 |

Source: Masanyu Juma Peter, Vol. 8 No. 17 (2017).

12.5% in senior one and senior three, only 6.3% of the schools had 6.3% of the schools with less than 50 candidates per stream in senior four. This clearly shows that USE Schools were crowded.

**Education of Head Teachers and Science Teachers**

The study found that science teachers were trained with qualifications of Diploma in Secondary Education, holders of Bachelors' Degree, Master's Degree and a few had Uganda Advanced Certificate of Education, especially in USE schools, Table 3.

Table 3. Level of education of head teachers, science teachers in USE and Non-USE schools.

| Level of Education | Head teachers | Science Teachers in USE Schools | Science Teachers in Non-USE Schools |
|---|---|---|---|
| UACE | 00 (0.0%) | 02 (4.3%) | 00 (0%) |
| Diploma | 00 (0.0%) | 29 (63%) | 24 (54.5%) |
| Bachelor's Degree | 20 (62.5%) | 13 (28.3%) | 19 (43.2%) |
| Master's Degree | 12 (37.5%) | 02 (4.3%) | 01 (2.3%) |
| Total | 32 (100%) | 46 (100%) | 44 (100%) |

A majority of the Science teachers were qualified to teach in secondary schools except in two universal secondary schools which had a shortage of science teachers and had two senior six leavers teaching. Some head teachers especially in Government USE (37.5%) had graduate training up to Master's level. A majority of teachers had teaching experience of less than 10 years (Table 4).

**Students' Class Participation**

Lesson observations showed that students participated at different levels depending on their eagerness and interest in class and the type of lesson—whether the lesson was a practical, a demonstration or a theory (lecture). In large classes (with more than 70 students in a stream) students with interest occupied the front seats. A few keen students would still major out in their groups during Practical lessons. Standard classes (with about 50 students), had students who showed interest in learning sciences irrespective of where they sat in class whether front, middle or at the back. However, despite the large numbers of students in class, some teachers had not adequately prepared for teaching (Table 5).

Table 4. Head teachers' and science teachers' teaching experience.

| Teaching Experience (years) | Number of Head teachers | Number of Science Teachers in USE Schools | Number of Science Teachers in Non-USE Schools |
|---|---|---|---|
| Below 5 | 00 (0.0%) | 13 (28.3%) | 14 (31.8%) |
| Between 6 and 10 | 13 (40.6%) | 25 (54.3%) | 19 (43.2%) |
| Between 11 and 15 | 15 (46.9%) | 06 (13.0%) | 07 (15.9%) |
| Over 15 | 04 (12.5%) | 02 (4.3%) | 04 (9.1%) |
| Total | 32 (100%) | 46 (100.0) | 44 (100.0%) |

Table 5. Teachers' preparedness before handling classes.

| Type of document | No of science teachers in USE Schools (N = 46) | | No of science teachers in Non-USE Schools (N = 44) | |
|---|---|---|---|---|
| | Had | Lacked | Had | Lacked |
| Lesson plans | 18 (39.1%) | 28 (60.9%) | 42 (95.5%) | 2 (4.5%) |
| Schemes of work | 16 (34.8%) | 30 (65.2%) | 38 (86.4%) | 6 (13.6%) |
| Record of work covered | 13 (28.3%) | 33 (71.7%) | 32 (72.7%) | 12 (27.3%) |
| Record of marks | 20 (43.5%) | 26 (56.5%) | 40 (90.9%) | 4 (9.1%) |
| Lesson notes | 46 (100%) | - | 44 (100%) | - |

Motivation to prepare for lessons was more in Non-USE schools than USE schools.

**Attitude to performance**

Head teachers, Science teachers and Students were asked to rate general performance in sciences with reference to UCE results and they gave the following responses shown in Table 6.

Failure was rated poor, Pass was Fair, Credit was Good and Distinction was Very Good.

Students in USE schools (100%) rated their performance as poor while 54.1% in Non-USE stated that the performance was good.

**Reasons stated for performance rating**

Respondents were asked for the reasons for the performance they had chosen and their responses were summarized in Table 7.

**Table 6.** Rating of general performance of candidates in sciences in final examinations.

| Performance | Head teachers | Science teachers in USE Schools (N = 46) | Science teachers in Non-USE Schools (N = 44) | Students | |
|---|---|---|---|---|---|
| | | | | USE (N = 320) | Non-USE (N = 320) |
| Poor | 5 (15.6%) | 12 (26.1%) | 0 (0.0%) | 320 (100.0%) | 95 (29.7%) |
| Fair | 23 (71.2%) | 30 (65.2%) | 22 (50%) | 00 (0.0%) | 52 (16.3%) |
| Good | 4 (12.5%) | 4 (8.7%) | 21 (47.7%) | 00 (0.0%) | 173 (54.1%) |
| Very good | 0 (0.0%) | 0 (0.0%) | 1 (2.3%) | 00 (0.0%) | 00 (0.0%) |
| Total | 32 (100%) | 46 (100%) | 44 (100%) | 320 (100%) | 320 (100%) |

**Table 7.** Responses from head teachers, science teachers and students about causes of poor performance.

| Causes of poor performance | Head teachers (N = 32) | Science teachers in USE schools (N = 46) | Science teachers in Non-USE (N = 44) | Students | |
|---|---|---|---|---|---|
| | | | | USE (N = 320) | Non-USE (N = 320) |
| Shortage of textbooks, chemicals and apparatus | 1 (3.1%) | 4 (8.6%) | 15 (34.1%) | 305 (95.3%) | 16 (5.0%) |
| Negative students' attitude towards sciences | 10 (31.3%) | 5 (10.9%) | 20 (45.5%) | 300 (93.8%) | 8 (2.5%) |
| Lack/shortage of qualified science teachers | 2 (6.3%) | 6 (13.0%) | - | 230 (71.9%) | 27 (8.4%) |
| Poor teaching methods by science teachers and harsh teachers | 1 (3.1%) | - | - | 176 (55.0%) | - |
| Science teachers lack commitment to teaching lessons | 1 (3.1%) | - | - | 93 (29.1%) | - |
| Lack of laboratories so Practicals are not adequate | 2 (6.3%) | 3 (6.5%) | 1 (2.3%) | 158 (49.4%) | - |
| Low syllabus coverage | 3 (9.4%) | 5 (10.9%) | 7 (15.9%) | 57 (17.8%) | - |
| Large student population in class | 1 (3.1%) | 4 (8.7%) | 5 (11.4%) | 42 (13.1%) | 40 (12.5%) |
| Students do not get lunch at school | 3 (9.4%) | 1 (2.2%) | - | 24 (7.5%) | 20 (6.3%) |
| Frequent change of science teachers | - | 1 (2.2%) | - | 21 (6.6%) | 58 (18.1%) |
| Little time allocated to sciences on timetable and always in afternoon | - | - | 2 (4.5%) | 13 (4.1%) | 6 (1.9%) |
| Students miss lessons due to fees | - | 1 (2.2%) | 2 (4.5%) | 13 (4.1%) | 3 (0.9%) |
| Teachers are not accommodated at school and students move long distances to school | - | - | 4 (9.0%) | 22 (6.8%) | 37 (11.6%) |

Students in USE schools reported poor teaching methods by science teachers, harsh teachers, lack of commitment by science teachers leading to dodging lessons and lack of laboratories and so inadequate practicals were taught as some of the causes of poor performance in these schools. (Table 8)

**Table 8.** Responses for good performance.

| Causes of good performance | Head teachers (N = 32) | Science teachers in USE schools (N = 46) | Science teachers in Non-USE schools (N = 44) | Students in Non-USE Schools (N = 320) |
|---|---|---|---|---|
| Continuous assessment and tests in sciences | 4 (12.5%) | 2 (4.3%) | 7 (15.9%) | 41 (12.8%) |
| Practicals are conducted regularly from S1due to availability of teaching materials | 5 (15.6%) | 3 (6.5%) | 11 (25.0%) | 25 (23.1%) |
| Availability of enough qualified science teachers | 4 (12.5%) | 2 (4.3%) | 1 (2.3%) | 51 (15.9%) |
| Science teachers organize tours, seminars/workshops/ excursions for students | 3 (9.4%) | 2 (4.3%) | - | 4 (1.3%) |
| Early syllabus coverage before exams | 3 (9.4%) | 1 (2.2%) | 3 (6.8%) | 6 (1.8%) |
| Well-disciplined and hardworking students | - | - | - | 118 (36.9%) |
| Head teachers properly supervise science teachers to ensure effective teaching | - | - | - | 11 (3.4%) |
| Remedial lessons are conducted in sciences | 2 (6.3%) | - | 1 (2.3%) | 4 (1.3%) |
| Good teaching method by science teachers like use of ICT | 3 (9.4%) | 1 (2.2%) | - | 13 (4.1%) |

It should be noted that students in Non-USE schools reported that students' good discipline and hard work due to interest in sciences as a result of proper motivation during lessons by the science teachers coupled with proper supervision of science teachers by head teachers are some of the unique causes of good performance. On the other hand, some USE students stated during sharing that they derived motivation, which aroused their interest in Sciences through use of virtual laboratories (ICT) during lessons.

From lesson observations indeed the two assertions came out clearly from both USE and Non-USE school students based on the way they participated during lessons. Where the researcher had chance to find a practical lesson using a virtual laboratory, the class was very vibrant in USE Schools while little participation was observed during theory lessons. A follow-up of results in schools where ICT was used showed that many students performed better than those in schools where we found theoretical lessons. As for the Non-USE schools most of the streams had less than 50 students and so the science teachers were able to apply student-based learning and so participation was high.

**Proposed ways of improving Performances in sciences**

The respondents also proposed ways of improving performance (from poor, fair, good and very good to excellent) in sciences and their responses were recorded in Table 9.

**Assessment between USE and Non-USE schools**

The mean score assessment administered to students were analyzed using a t-test and it was found that there is a significant difference in candidates' scores obtained from the tests in Science subjects between USE Schools and Non-USE Schools.

**Table 9.** Ways of improving performance in sciences.

| Ways of improving performance | Head teacher N = 32 | Science teachers in USE schools N = 46 | Science teachers in Non-USE (N = 44) | Students | |
|---|---|---|---|---|---|
| | | | | USE (N = 320) | Non-USE (N = 320) |
| Providing learning materials such as text books, chemicals and apparatus | 20 (62.5%) | 26 (56.5%) | 33 (75.0%) | 320 (100.0%) | 95 (29.7%) |
| Science teachers should use student based teaching methods | - | 9 (19.6%) | 21 (47.7%) | 61 (19.0%) | 20 (6.3%) |
| Increase science teachers' remuneration | 14 (43.8%) | 16 (34.8%) | 16 (36.4%) | 21 (6.6%) | - |
| Covering the syllabus in time | 7 (21.9%) | 8 (17.4%) | 15 (34.1%) | 22 (6.9%) | - |
| Students should be guided and counselled on importance of sciences | 26 (81.3%) | 14 (30.4%) | 15 (34.1%) | 8 (2.5%) | 5 (1.5%) |
| Practicals should be conducted continuously right from S1 | 18 (56.3%) | 15 (32.6%) | 13 (29.5%) | 97 (30.3%) | - |
| Conduct continuous assessment in sciences | 8 (25.0%) | 6 (13.0%) | 8 (18.2%) | 59 (18.4%) | 15 (4.7%) |
| Resource Persons should talk to students, seminars be organized and encourage students' discussion groups | 8 (12.5%) | 9 (19.6%) | 8 (18.2%) | 21 (6.6%) | 15 (4.7%) |
| Employ more science teachers | 24 (75.0%) | 24 (52.2%) | 5 (11.4%) | 240 (75.0%) | 52 (16.3%) |
| Organize remedial lessons in sciences | 3 (9.4%) | - | 4 (9.1%) | 52 (16.3%) | 10 (3.1%) |
| Emphasize students' discipline | - | - | 4 (9.1%) | - | 10 (3.1%) |
| Students interest and working by themselves in groups | 5 (15.6%) | 12 (26.1%) | 2 (4.5%) | 86 (26.9%) | 20 (6.3%) |
| Raise minimum S1 entry points to improve the quality of students | 4 (12.5%) | 3 (6.5%) | 2 (4.5%) | - | - |
| Emphasize team teaching, use of computers and student-centered teaching methods | 12 (37.5%) | 1 (2.2%) | 2 (4.5%) | - | - |
| Employ qualified laboratory technicians | - | - | 1 (2.3%) | 6 (1.8%) | - |
| Paying fees on time to avoid students being sent away | 9 (28.1%) | 1 (2.2%) | 1 (2.3%) | 5 (1.6%) | 10 (3.1%) |
| Increase USE funds and Government should release it at the beginning of the term | 8 (25.0%) | 4 (8.7%) | - | - | - |
| Teachers to attend to individual problems | 2 (6.2%) | 2 (4.3%) | - | 67 (20.9%) | 20 (6.3%) |
| Strict supervision of teachers to ensure they teach all lessons | 1 (3.1%) | - | - | 91 (28.4%) | - |
| Establish hostels to accommodate students from far | 1 (3.1%) | - | - | 7 (2.2%) | 5 (1.5%) |
| Provide lunch to all students at school | - | 6 (13.0%) | - | 8 (2.5%) | 5 (1.5%) |
| Students should consult science teachers | - | 5 (10.9%) | - | 287 (89.7%) | 95 (29.7%) |
| Science teachers should avoid corporal punishment | - | - | - | 25 (7.8%) | 20 (6.3%) |

Table 10. Results of the t-test of the students' scores between USE and Non-USE schools.

| Type of school | Total number of students | Mean marks | Standard error mean |
|---|---|---|---|
| NON-USE | 2045 | 7.062 | 0.1339 |
| USE | 2350 | 6.122 | 0.1159 |

t-Test = 5.336 $P < 0.05$. Table 10 shows the results of outcome.

## 4. Discussion

Although a high teacher-student ratio was observed during the study, some students performed well despite the challenges of studying in large classes. Presence of qualified teachers is therefore important as it provides the technicalities required by the student to learn science, but not many experienced teachers would stay in schools. Studies by Hanushek & Rivkin, 2010; Kingdon & Teal, 2010; Rivkin, et al., 2005 and Rockoff, 2004 show that the quality of the teachers determines the achievement levels of students. Failure rates are attributed to inadequate skills for teachers to be able to handle large classes and motivate learners for better results. The situation in USE schools with more experienced staff had challenges caused by numbers of students in classes. Non-USE schools had pedagogies with more engaging lessons. It is therefore emerging that the performance of the students who excelled in sciences was triggered by their interest rather than the way they were taught.

It has been reported that in absence of teachers' innovations it would be difficult for teachers to interest learners (Owolabi et al., 2012). During lesson observations, teachers' creativity imparted more skills despite their qualifications and this would enhance student performance. This was in agreement with Danhui, 2008; Schroeder et al., 2007; Walberg, 1984; and Wise & Okey, 1983. Although teachers were qualified, their enhancement with modern pedagogies was short of skills to handle large classes and the few learners that could cope would pick up an interest that helped them to perform well. Even in the case of more experienced teachers, staying in the profession for a long time without gaining more skills during in-service training would not motivate learners in large classrooms. They were short of skills to enable content delivery and have more engaging lessons and students' involvement during the learning process.

In Non-USE schools where strict supervision and preparation were observed (Table 3) there were more students interested and performing better.

Teachers who had just joined the profession surprisingly had productive lessons (Clotfelter et al., 2007; Ladd, 2008). This implies that the young teachers have been exposed to interactive learning pedagogies than those who have spent more time in the profession. This requires them to do more in-service training to be able to cope with the challenges of large classes (Harris & Sass, 2007; Kane et al., 2006; Boyd et al., 2007). In both categories of schools, only students with interest and added extra effort would comprehend the concepts and perform well in science subjects. Implying that teachers who have just joined the profession or those who remain in the profession after serving for 15 (**Table 2**) would produce similar results so long as they have learners who are interested in the subjects they are handling. Even non-qualified teachers can teach so long as they can motivate learners (Uganda Government, 1992). Keeping experienced teachers in the profession is also a challenge because many look for other opportunities. Without in-service skilling of teachers, the motivation of science education will continue to be dominated by teachers with less than 10 years of teaching.

Pedagogical innovations are supposed to improve the teaching of sciences and increase students' participation in class during lessons. Increased students' interest in the learning process leads to their understanding which causes better performance in exercises, tests and examinations. In classes with many learners, the onus is on the student who must cope with what is being taught (Masanyu et al., 2017). From lesson observations, good performance could only go to students who were interested in what was being taught by teachers. The teacher education programmes should therefore target methodologies that encourage learners to depend less on the teacher, which also inculcate in them skills and creativity to engage in research and innovation as they learn more.

**Comparison between USE and Non-USE schools**

Although learning takes place in both USE and Non-USE schools, a significant difference in the performance was found in Non-USE schools with better preparation, supervision and more engaging classes (t-test = 5.336, $P < 0.05$). Those in Non-USE schools perform better because they make a choice not to join USE schools so that they receive more attention; however a number of learners despite this effort still failed science subjects. In large classes in USE Schools motivation is by interest and understanding the environments in which they are learning.

The smaller numbers in private schools encourage learners to be more focused as was observed in Kenyan private secondary schools (Yara & Otieno, 2010).

## 5. Conclusion

Learning in large classes can take place in the same way it does in small classes if learners are motivated to take an interest in the subjects they are doing. Teaching experiences and interactive pedagogies are very pertinent to learners' interests and performance. Students in better learning environments still fail to cope with scientific concepts if they have no interest in what they are doing. Learners should appreciate the environments where learning takes place and the methodologies applied in order to comprehend what is being taught. Student's self-assessment and peer learning methodologies can also comprehend what the few qualified teachers can do. Teacher education programmes should emphasize methodologies that interest learners in being able to do much of the work by themselves rather than relying on teachers who are overwhelmed with large classes. Learning materials should be developed to assist students to learn in environments where there are inadequacies so that they understand science concepts that trigger skills development, creativity and innovations. Virtual laboratories should be established in all secondary schools to foster teaching and learning of sciences. In-service training on how to deal with large classes is important and should be organized for all science teachers by DES with the support of MOE&S.

DES should inspect schools regularly with emphasis put on schemes of work, lesson plans, record of work covered, record of marks and learner-centered teaching methods for sciences. MOE&S should recruit more science teachers so that their workload is reduced in order to be more efficient and prepare effectively for the lessons without any excuse of too much work.

Further research should be done on how Universities and other Teacher Training Institutions do it with a view to harmonizing and improving the training programmes.

## 6. Limitations

There are several limitations to this study. First, the self-reported data from interviews may make respondents more likely to report positive coping strategies as a desirable response, either to paint themselves in a more positive light or to present a more positive experience to the interviewer (social desirability bias). A second pitfall is that students may not have been candid if they felt that their interview data would be used by individuals affiliated with the course. To help alleviate this bias, the author and interviewer explained that their identity and responses would remain anonymous and their names would be kept strictly confidential. Specifically, interviews were recorded and transcribed so that anyone who taught or assigned grades would only see the transcript with the name replaced for data analysis after the participant received a final grade in the course. By compiling each student's coping processes, this study captured many, but certainly not all, of the coping strategies, responses, and emotions that students may experience due to the complexity of emotions and individual circumstances.

Cross-sectional design's inability to infer causality was overcome by the use of triangulation whereby data about a particular item was collected through several ways. In this way, more reliable data was collected.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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