Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.8, No.17, 2017
www.iiste.org

Teachers' Pedagogical Intricacies in Handling Large Science Classes in Eastern Uganda

*Masanyu Juma Peter
Makerere University, College of Education and External Studies, P.O. Box 7062, Kampala

Busulwa Henry Ssebuliba
Makerere University, College of Education and External Studies, P.O. Box 7062, Kampala

Acham Hedwig
Makerere University, College of Agricultural & Environmental Sciences, P.O. Box 7062, Kampala

The Research is not financed by any Organization

Abstract
The introduction of Universal Primary Education (UPE) in Uganda in 1997 increased the number of students who join secondary education. The beginning of Universal Secondary Education (USE) in 2007 salvaged many learners who could not afford secondary education. This resulted in congested classrooms especially in government-aided schools. The study was prompted by the continued decline in student performance in sciences ever since USE was introduced in Uganda (UNEB, 2008 – 2016) and so the need to establish what really the problem was. A quantitative cross-sectional survey administered questionnaires to head-teachers, science teachers and students in 32 secondary schools in Eastern Uganda was done. The study investigated science teachers' pedagogical innovative strategies used in teaching science in large classes. It also assessed how students cope with learning science concepts in congested classes. The results show that a majority of science teachers (84.8%) handle large classes in the same way they would do in classes with fewer learners. The students also continued to learn as if they were in an environment of fewer individuals in small classes (62.8%). This lack of sensitivity, creativity and innovations for large classes by science teachers could be the reason why comprehension of science concepts is low in a majority of learners in large USE classes, especially in rural secondary schools. The study recommends incorporation of interactive learner-centered science pedagogical approaches in teacher education programmes and endorsement of the TESSA approaches, use of OER and explicit attention to be given on how to facilitate active learner engagement in large and overcrowded science classrooms.

Keywords: pedagogical innovation, creativity, large classes

1. Introduction

Uganda embraced the Universal Primary Education (UPE) in 1997, following the Jomtien Declaration (UNESCO, 1990). By the time of the Dakar Declaration (UNESCO, 2000), many primary school children were already benefiting from UPE. Preparations were then started to plan for their Universal Secondary Education (USE) which was implemented in 2007, three years after the first UPE pupils had completed their primary leaving course (MOE&S, 2007). The number of students in Secondary Schools therefore drastically and subsequently increased per class in the years that followed (UNEB, 2010). Science subjects (Physics, Chemistry and Biology) had also been made compulsory (MOE&S, 2006), to encourage learners to opt for science related disciplines at higher levels of education (Tinkamanyire, 2010; MOE&S 2005).

The learning environments of USE schools in Uganda are characterized by inadequate facilities such as classrooms, furniture, laboratories, apparatus, chemicals and motivated teachers to adequately handle large numbers of students. Although some schools introduced double sessions in which similar facilities are used by classes at different times of the day, i.e, in morning (from 8.00 am – 1.00 pm.) and in the afternoon (from 1.00 pm – 6.00 pm), and streaming whereby students in each class were divided in different streams, this did not reduce the numbers of students in each class and this required the science teachers to use pedagogical innovations to enable them deal with large numbers of students per class. The learners consequently had to cope in order to comprehend what was being taught in sciences in crowded classes. Creativity by the teachers require them to be innovative in handling large classes and make use of inadequate facilities, learning resources and equipment such as ICT tools, few laboratory equipment and interactive learning approaches (www.tessafrica.org).

This study was based on the Constructivist Theory that was developed by Jerome Bruner. In this theory, learning is an active process where the teacher encourages learners to construct new ideas or concepts they already know (Merrill, 1991; Maureen 2000). This theory is very relevant to instruction of science in secondary school, hence, innovations should consider the fact that the teacher is a facilitator and a moderator of learners' constructed ideas, Merrill, (1991). The teacher education programmes in Uganda includes skills that enable them to be creative in handling large classes. The implementation of compulsory secondary science education policy was cognizant of the capabilities of teachers' creativity and innovativeness in using this theory.

Science classes before 2006, were smaller because science subjects were optional to students who had interest, after two years of lower secondary studies. The small numbers of students in science classes enabled effective pedagogy that included teacher centered approaches, which resulted into better performance in the UCE examinations. The increase in numbers of students due to introduction of USE in secondary schools after 2007 overwhelmed the facilities and approaches that teachers required in handling of large classes. Hence, the teachers and students needed innovations to cope with situations of learning in environments where resources were inadequate.

1.1 Study objectives

This study investigated the teachers' creativity and innovativeness in handling classes with large number of students and examined students' readiness to learn in environments with insufficient facilities. Specifically, the study investigated (i) the pedagogical innovations teachers are using in large sciences classes and; (ii) the students' coping strategies in learning sciences in schools with large classes.

2. Literature review

The traditional learning environment was teacher-centered based on the teacher as the sole source of information (Novak, 1998, Mintzes, *et al.,* 1998). It is a method where the teacher dispenses knowledge and students listen with emphasis put on passing recall examinations, and does not take into consideration the application of what has been learnt (Nazzal, 2014). This delivery mode turns into lecturing where instructors reach out to large numbers of leaners for purposes of providing information that enhances their ability to recall facts (de Caprariis, *et al* 2001). However, a combined interactive learning approach where a teacher leads a discussion results into a higher level of comprehension (Fosnot, 1989) and active involvement of the learner (Morgan, *et al*, 2000) can prove challenging in situations of large classes.

As such, modern interactive learning environments in science education especially in Uganda rural situations require the teacher to be creative and innovative to enable effective handling of large classes (Novak, 2010). The teacher has to devise means that reach out to every learner to encourage inquiry based learning, that links with real life situations, skill building, life skills and values, encourages team work, activity based learning (Barnes & Blevins (2003), which used to mainly take place in the laboratories with fewer individuals per class. Interactive based learning encourages integrative, social responsibility and civic engaging learning, and it emphasizes learning with assessment and immediate feedback (Nazzal, 2014).

2.1 Teaching in large classes

In constructivism, the teacher is a lifelong instructor who constantly brings in new approaches and learning techniques, which have to be interesting and attractive for the learners. The creativity of science teachers is essential in large classes to encourage students to understand scientific concepts, through group discussions (Perkins & Saris, 2001), team teaching (Hunt, *et al*., 2003) and student led participations (Yoder & Hochevar, 2005). However, in practice science classes especially in rural areas have continued to provide an environment which hinders learners from active participation (Carborne 1998; Stanley and Porter, 2002). Some science teachers find difficulty in organizing student-led class discussions in large classes (Ronfeldt, 2015), especially if their training did not encompass skilling them for handling large classes. Large classes would have an advantage of decreased teacher costs and efficient utilization of available resources if teacher are well skilled to handles many students using few teaching materials (McLeod, 1998). Hence a skilled teacher with good learner-teacher relationship and few resources can overcome teacher discomfort in USE schools in Uganda.

Although the recommended number of students in Uganda Secondary schools, by MOES is 45 learners per stream, (Bennel, & Sayed, 2002), large classes with streams of more than 100 students are common. These have similarly been reported elsewhere. In China, large classes can have 50-100 students or more, while in Lancaster University its estimated average number of the large class is 50 (Coleman 1989). It has been reported that it is the mindset of the teacher that determines the size of the class in the specific situation, regardless of the exact number of the students found in the class (Ur, 1996). The science teacher education programmes in Uganda should therefore ensure a pedagogical preparation that empowers the science teacher to handle large classes (Weller & Lynn, 2016). This study was set to investigate how teachers handle science classes in rural schools of eastern Uganda and find out how learners cope to comprehend sciences effectively. The study also provides a feedback to teachers' and learners' approaches in enhancing group work, class participation, class control and use of locally available teaching materials to reduce shortages of learning aids (Smith, 2015).

3. Methodology

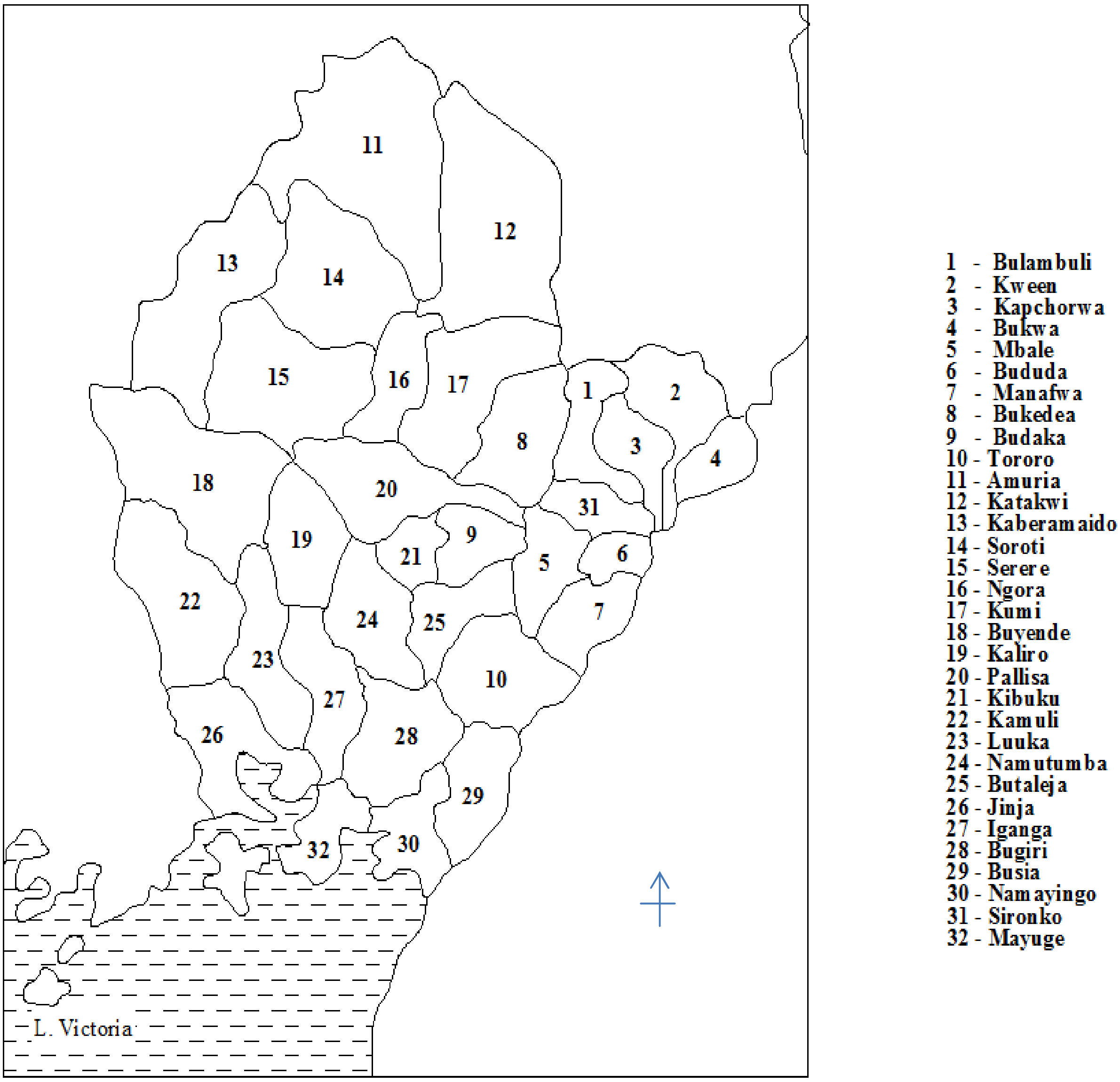
A cross-sectional survey research design was adopted because it involved sampling different groups of

Journal of Education and Practice
ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)
Vol.8, No.17, 2017

respondents from various backgrounds. In 2006, there were 377 secondary schools with examination centres of which, 237 were USE schools (UNEB, 2010). The comparative study was done in USE and Non-USE schools.
The study area consisted of 32 administrative districts in the local government structure (Figure 3.1) of Eastern Uganda. This was divided into four sub-regions (Busoga, Bukedi, Teso, and Bugisu/Sebei) from which four USE schools and four Non-USE were selected from each sub-region. The head teacher from each school was purposively selected together with the senior four science teachers of Biology, Chemistry and Physics in both USE and Non-USE schools. The sample therefore comprised of 32 head teachers, 46 science teachers in USE schools and 44 science teachers from Non-USE schools (science teachers in some schools were handling more than one science subject). 20 students of senior four in each of the 32 schools were also randomly selected according to Krejcie and Morgan (1970) to answer questionnaires to assess how they cope in studying from large class environments.

Additional information was purposively collected from the Commissioner Secondary Education MOE&S and from four District Inspectors of Schools representing each sub region sampled.

Figure 3.1: MAP OF EASTERN UGANDA SHOWING DISTRICTS IN THE REGION



4. Results

4.1 Type of schools in Eastern Uganda

The survey established that out of 32 schools, 13 schools were owned by government, 15 were private schools and 4 were managed in partnership with government and private founders.

Table 1 Category of schools found in Eastern Uganda

School ownership/ category	No. of head teachers		Total
	Single session	Double session	
Government	8 (25.0%)	5 (15.6%)	13 (40.6%)
Private	15(46.9%)	0 (0.0%)	15 (46.9%)
Public-private partnership	4 (12.5%)	0 (0.0%)	4 (12.5%)
Total	27 (84.4%)	5 (15.6%)	32 (100.0%)

Five Government schools had established a double session teaching strategy while others (27) implemented a single session. Double session is a strategy adopted by some government schools to accommodate large numbers of students admitted after establishing USE in order to teach using the few available facilities whereby some classes studied in the morning from 8.00 am to 1.00 pm while others from 1.00 pm to 6.00 pm.

4.2 Number of learners per stream

The number of learners per stream is presented in Table 2 for both USE and Non- USE schools.

Table 2 Learners per stream in USE and Non-USE Schools

Number of students per stream	Responses from Head teachers				Responses from Science teachers in USE schools				Responses from Science teachers in Non-USE schools				Responses from students	
													USE	NONUSE
	S1	S2	S3	S4	S1	S2	S3	S4	S1	S2	S3	S4	S4	S4
Below 50	3	4	3	3	0	0	0	0	9	12	6	8	0	60
Between 51 – 100	19	14	19	27	17	24	26	30	32	30	38	34	280	240
Between 101– 150	8	12	8	1	26	20	18	13	3	2	0	2	20	20
Over 150	2	2	2	1	3	2	2	3	0	0	0	0	20	0
Total	**32**	**32**	**32**	**32**	**46**	**46**	**46**	**46**	**44**	**44**	**44**	**44**	**320**	**320**

Majority of schools had streams with more than 50 students. This requires the science teacher to be innovative while teaching to the extent satisfying the learning requirements of over 150 learners in one stream.

The most common range of learners per stream of senior four was 50 – 100 implying that teachers have to inevitably be pedagogically prepared to handle large classes while students must cope if they are to comprehend in an environment where they are crowded.

4.3 Demographic characteristics of respondents

4.3.1 Age of Head Teachers and Science Teachers

Table 3 shows the age ranges for head teachers and science teachers. 56.3% of the head teachers were between 31 and 40 years while 43.7% were over 41 years. 40.9% of the science teachers in Non-USE schools were between 21 and 30 years, 45.5% were between 31 and 40 years while only 13.6% were over 41 years. In USE schools 50% science teachers were between 21 and 30 years, while 39.1% were between 31 and 40 years and 10.9% were over 41 years.

Table 3: Age Ranges of Head Teachers and Science Teachers

Age (in years)	**Head teacher**	**Science Teachers in USE Schools**	**Science Teachers in Non-USE Schools**
Between 21 and 30	**00(0.0%)**	**23(50%)**	**18(40.9%)**
Between 31 and 40	**18(56.3%)**	**18(39.1%)**	**20(45.5%)**
Over 41	**14(43.7%)**	**5(10.9%)**	**6(13.6%)**
TOTAL	**32(100%)**	**46(100%)**	**44(100%)**

From Table 3, the majority of Head teachers were in the recommended age bracket of MOE&S which stipulates that the head teacher in Uganda should have a minimum of 28 years after serving as teacher for at least five years (UNEB, 2005). The few head teachers above 41 years indicate that there are few experienced individuals who can mentor innovations. 50% of science teachers in USE schools were between 21 and 30 years. This is because most of them were volunteering with the hope of getting permanently employed by Government. Both USE and NON USE schools had relatively a good percentage of science teachers in the age range of, which is indicative of some good teaching experience and are therefore expected to have better innovations in handling large classes.

Table 4 Age ranges for students

Students' age (in years)	Number of students	Percentage
Below 16	2	0.3
Between 16 and 18	464	72.5
Above 19	174	27.2
Total	640	100.0

Majority of the students 72.5% were between 16 and 18 years, 27.2% were above 19 and only 0.3% was below 16 years.

4.3.2 Teaching Subjects

Teaching subjects were established for each respondent. Table 5 reveals that only 25% Head teachers are qualified to teach sciences while 75% are specialists in humanity subjects. In USE schools, 30.4% of science teachers taught Physics, 34.8% were for Biology and 34.8% were for Chemistry, while in the Non-USE schools, 27.2% were for Physics, 36.4% taught Biology and 36.4% were for Chemistry as seen in Table 5.

Table 5 Teaching subjects for science teachers and head teachers

Subjects	No of Head teachers	No of Science Teachers in USE Schools	No of Science Teachers in Non-USE Schools
Physics	03(9.4%)	14(30.4%)	12(27.2%)
Biology	03(9.4%)	16(34.8%)	16(36.4%)
Chemistry	02(6.2%)	16(34.8%)	16(36.4%)
Total	32(100%)	46(100%)	44(100%)

4.3.3 Duration of Head teachers in current school.

40.6% of head teachers had stayed in their current school for less than 5 years, 31.3% had spent between 6 and 10 years, 18.8% had spent between 11 and 15 years and 9.4% had spent over 15 years as seen in Table 6.

Table 6 Duration of head teachers in the current school

Period (in years)	No. of head teachers	Percentage
Below 5	13	40.6
Between 6 and 10	10	31.3
Between 11 and 15	6	18.8
Above 15	3	9.4
Total	**32**	**100.0**

4.4 Recorded responses on Pedagogical Innovations in the Teaching of Sciences

The study investigated the pedagogical innovations used by science teachers in teaching large science classes to enable students comprehend what they are taught in science subjects. The research question review was, 'What pedagogical innovations are used by teachers in teaching large Science classes?' The head teachers and science teachers in both USE and Non-USE schools gave the following responses as shown in Table 8.

Table 7: Responses from Head teachers and Science teachers about innovations

Innovations for effective teaching of Sciences	No of Responses from Head Teachers N = 32	No of Responses from teachers in USE Schools N = 45	No of Responses of teachers in Non-USE Schools N= 44
Grouping students for discussion	10(31.3%)	39(84.8%)	5(11.4%)
Using remedial teaching	10(31.3%)	4(8.7%)	2(4.5%)
Starting practical lessons early from S1 up to S4	10(31.3%)	10(21.7%)	2(4.5%)
Organize science projects, exhibitions, field study trips and seminars	9(28.1%))	-	1(2.3%)
Streaming students during classes and Practicals	8(25.0%)	-	-
Continuous assessment for students	7(21.9%)	2(4.3%)	1(2.3%)
Improvise using locally available materials to teach Practicals	6(18.8%)	4(8.7%)	1(2.3%)
Using demonstrations to teach sciences	6(18.8%)	-	-
Provision of more chemicals and apparatus for Practicals to be done	3(9.4%)	-	-
Involvement in SESEMAT activities, improved teacher-student relationship and allocating desk numbers to each student	3(9.4%)	-	-
Emphasizing team teaching and using lesson monitoring forms	2(6.3%)	6(13.2%)	1(2.3%)
Purchased more science textbooks and use of practical guides	2(6.3%)	-	-
Constructing more classrooms to stream students into manageable numbers	1(3.1%)	1(2.2%)	-
Started cyber science technologies – virtual laboratory	-	2(4.3%)	-
Introduced lunch study hour	-	1(2.2%)	-
Conducting Practicals in classrooms instead of a laboratory	-	-	2(4.5%)

Apart from discussions (84.8%) used in USE schools, most of the strategies mentioned by respondents are used by a small percentage of teachers. Only a few head teachers are aware of what takes place in classes during the teaching of science. It is surprising that some of the strategies mentioned by the head teachers are not practiced by the science teachers. The Head teachers were also not aware of the ICT technologies although they were being used in some USE schools. Most of the responses mentioned would be ideal for a trained science teacher, included in their teacher training programmes but are practiced by a few teachers. However, some teachers mentioned how they could teach sciences without laboratories (Table 8) using available materials, but these were only few teachers doing it. The teachers could handle their Practicals during the class.

Table 8: Responses of science teachers in USE and Non-USE schools where there are no laboratories

Innovations to conduct Practicals without a laboratory	USE Schools N= 46	Non-USE Schs, N = 44
Improvising apparatus using locally available materials	2(4.3%)	-
Individual and class Practicals done on week ends	5(10.9%)	-
Practicals are done in classrooms	4(8.7%)	4(9.1%)
Practicals are done in shifts	5(10.9%)	1(2.3%)
Practicals are done under tree shades	1(2.2%)	-
Science fairs where practical items are displayed once a term	1(2.2%)	-
Team teaching	-	1(2.3%)

Science teachers from USE schools proposed improvising apparatus using locally available materials (4.3%), doing Practicals outside classrooms, organizing science fairs and asking students to individually do practical on their own especially when a tool can be designed using materials that can be picked from anywhere.

The students also affirmed that where the apparatus were not enough, some teachers would teach them the practical aspects of some topics by using the methods shown in Table 9. Dividing them in groups enable them to learn from each other, however dictating notes giving theoretical explanations assisted them to pass exams without comprehending.

Table 9: Students' Responses on teachers' innovations for teaching practical aspects where there are no laboratories

Innovations to conduct Practicals without a laboratory	Number of students	Percentage
By using a computer	5	1.2
By using project method	15	3.7
By dividing the class into groups for Practicals	336	83.0
By dictating notes with a few explanations	107	26.4

4.5 Students' coping strategies of the pedagogical innovations in large classes

The research question was, 'What are students' coping strategies of the pedagogical innovations introduced in the teaching of sciences in the schools implementing USE?' Individual effort by the students was a key factor to their performance. Students may have practically not understood the importance of private study groups.

Table 10: Coping strategies students apply in order to study sciences

Coping strategies	Frequency N = 640	Percentage
Consulting the teachers privately after lessons	274	42.8
Reading very hard privately about what has been taught	250	39.1
Consulting members of my private study group after lessons	172	26.9
Participating actively during lessons by asking teachers questions for clarifications	203	31.7
Liking my teachers and the science subjects they teach	145	22.7
Attending remedial lessons organized by science teachers for a few students	103	16.1

From Table 10, most of the learning is individual effort – consulting teachers privately (42.8%), reading privately (39.1%) and participating actively during lessons (31.7%).

4.6 Discussion

This study establishes that although Uganda science teachers are prepared to pedagogically teach sciences in circumstances that include handling of large classes (Smith 2015), their effectiveness in streams with a large number of learners is short of skills for normal delivery and learning of sciences in large classes. The results have shown that effective teaching-learning of sciences is affected by the type of school where the teachers execute their duties, students' numbers per class, innovations the teachers use during lessons; and the ability of the students to learn in large class environments.

4.6.1 Type of schools in Eastern Uganda

In Eastern Uganda many schools are privately owned, with a few are owned by the private sector in partnership with government. The inspection of the school laboratories, established that most Government owned schools were in possession of chemicals and apparatus which were not effectively used because teachers' attitude hindered their preparedness to use them in large streams no matter their qualifications (Frazer, et al. 1992). Only a few teachers who improvise can move a further step in using locally available instructional materials to favour the learning of science (Bassey, 2002; Obioha, 2006; Ogunleye, 2002).

In private schools, although facilities were fewer than in government schools, their use was mostly more effective to enhance the teaching and learning of science (Yara & Otieno, 2010).

4.6.2 Age with teaching-learning of sciences

Classes with older individuals perform better than the younger ones (Vlachos & Artemis, 2015). With an average high school going age of science students ranging from18-19, it is expected that older learners would be in position to cope in large classes better than their counterparts who are younger (Voyles, 2011). Observations during lessons showed that older students were more confident and articulated well when expressing themselves than their younger counterparts. This was in agreement with the findings of Blatchford & Mortimore, (1994) who are supported by Glass, et al., (1982). Crosser (1991) and Kinard & Reinherz (1986) found that older children performed academically better than the young ones. These are supported by La Paro & Pianta (2000) and Uphoff & Gilmore (1985). However, DeMeis & Stearns (1992) found no relationship between age and student performance. This view was supported by Dietz & Wilson (1985). General Council of the Assemblies of God, (2010) assert that although older adults take long to memorize what they are taught or master a skill, they can apply the newly acquired knowledge to life faster and more accurately than the young ones. Nitrini R., et al., (2008) found that age influences the performance in incidental memory, immediate memory, learning and recall of the drawings.

Martin & Smith (1990) found that middle aged teachers were more effective in class than the young or the older ones while Goebel & Cashen (1979) revealed that young or middle aged teachers were rated higher on teaching skills than old teachers. However, Rilary and Ryan (1969), found younger teachers better than the older ones, but Delhanty (1977) found no difference in the way the old and younger teachers performed in teaching.

This study established that the middle aged teachers were better prepared during lesson observation – they had lesson plans, schemes of work, records of work covered, record of marks for exercises given and newly prepared lesson notes; and their delivery of content encouraged active learning for some of them. The young teachers had new lesson notes and record of students' marks but did not have lesson plans, schemes of work and record of work covered. The old teachers on the other hand used very old notes on brown paper and had no lesson plans, no schemes of work and no record of students' marks but had the content and would deliver it well using lecture – discussion method mainly.

4.6.3 Subjects of specialization

It was noted that schools headed by science head teachers had all facilities in enough quantities for teaching science subjects as compared to those headed by Arts head teachers where many facilities were lacking or were in short supply. A physical check in the laboratories by the Researcher using the check list that UNEB sends to MOE&S every year for distribution to schools established many USE Schools got chemicals and apparatus from the Ministry but many were not being used in some schools and where they were being used, they were not enough due to large student numbers. However, schools headed by science head teachers bought more chemicals and apparatus and added to their laboratories and so they had enough and several varieties of science teaching materials; these were mainly private schools.

In both USE and Non-USE schools some teachers taught more than one subject in senior four. This reveals the magnitude of the shortage of science teachers in secondary schools and also that there is little time available for teachers to be innovative as they are over worked. This was in support of UNEB (2010) Centre Validation Reports that revealed that many secondary schools share science teachers and most of them use part time science teachers. It was in agreement with Ezaruku, D. F. (2016) when he quoted the MOE&S reporting that at least 4000 vacancies exist for Science teachers in Government aided schools across the country and the Minister of Education Honourable Jessica Alupo (now former Minister of Education and Sports) saying that efforts to increase the number of Science teachers were constrained by funding. This has left schools that can afford to hire science teachers and pay them locally or use volunteer teachers whose performance is not effective due to low morale and others are not qualified as noted in Table 6. This is in line with Hare & Heap (2001 a) assertion that shortages are not caused by insufficient supply of teachers but by the high turnover as they leave for greener pastures. This is supported by Ingersoll (1997) and Boser (2000).

4.6.4 Role of Head teachers in current school

A majority of head teachers had spent about ten years in their current schools which, shows that many of them had the experience to mentor innovations in the teaching of sciences in their schools. The more time head teachers spend in a school, the better they complete projects for improving the teaching, learning and manage the discipline of students hence improvement in performance in the final examinations. This is supported by Head (1999) when he noted that the better behaved the students are the better they achieve academically. It therefore follows that the longer the head teacher stays in a school the better the results in the final examinations.

4.6.5 Innovations for teaching sciences in large classes

Apart from using locally available materials, use of group discussions, emphasizing team teaching and the Virtual laboratory in a few schools, there seem not to be any other specific innovations by science teachers. The responses show that the teachers implement their taught skills to enhance learning implying that they are doing what normally goes on in any classroom situation irrespective of large numbers. Even in the nine schools with limited laboratory space and apparatus, the responses included what is expected of a trained teacher such as grouping students, and using locally available materials (Tables 7 & 8).

Dividing the large classes in groups required more time from teachers, hence fewer practicals would be made leading to a risk of teaching sciences in a theoretical way that included dictating notes. Smaller class sizes (groups) would give students opportunities to write more, speak more, interact more and create more project learning (Jenkins, J., 2014). However it is interesting to note that some teachers are using computers to teach some practicals especially from the virtual laboratories connected by the Cyber Project. It was sadly discovered that some schools were connected to the Project but the facilities were not being used in the teaching of Sciences hence failing the Project objectives.

Effective teaching of sciences supports students' acquisition, retention and application of scientific knowledge which may be enhanced by forming cooperative-learning groups for conducting practicals as they perform better than individual learners if the groupings took care of ability levels and gender (Okebukola, 1992).

4.6.6 Coping strategies students apply in order to study sciences

From students' responses in Table 10, the students are also doing what they are supposed to do in a normal learning situation, which puts them at disadvantage over other learners in small classes. One would have expected the students to be able to conduct some practicals by themselves, make simulations, had peer feedback to reduce teachers' burdens of marking homework, had pair work or group work to enhance class participation, developed class rules to control noise during lessons, encouraged teachers to use flipped class model and gathered locally available teaching materials to reduce shortages of learning aids (Smith, R., 2015). The students' coping strategies as noted by Smith can easily lead to better learning if the science teachers plan their lessons that are learner centered – active learning. These may not be possible if the teachers are using traditional teaching methods.

4.7 Conclusions

Most of the teachers do not have the skills to handle large classes. They seem to be overwhelmed by the numbers of students in the class and their attitude is driven by demotivation. A few teachers could be creative while a majority thought that normal classroom practices meant to be done by any qualified science teacher are innovations. In order for students to learn sciences in crowded classes effectively, they require to work harder than usual. More time should be spent on discussions and learning from each other than learning sciences as if in classes with few students.

4.8 Recommendations

1. The teacher education programmes should take into account instruction of pedagogies which encourage science teachers to handle large classes
2. In-service training on how to deal with large classes is important and should be organized for all science teachers
3. Use of interactive and engaging methodologies would assist the students to learn from each other and so enhance learning of sciences
4. Use of the environment in the teaching and learning of sciences should be encouraged by all teachers to solve the problems of shortages in teaching materials
5. Encourage recruitment of science teachers into headship positions of secondary schools so that they can manage the teaching-learning of sciences.
6. Government should provide money in the National Budget to allow for the recruitment of science teachers so that shortages by the ban on recruitment from 1996 can be overcome and the teachers get time due to a reduced load to plan well for effective teaching of sciences, which will lead to improvement in performance.
7. MOE&S should provide enough money for inspection of schools where emphasis should be put on schemes of work, lesson plans, record of work covered, record of marks and learner-centered teaching methods for sciences.
8. Further research should be done to establish how Secondary School Science Teachers are trained at Teacher Training Institutions and Universities.

References

Ajileye, O. O. (2006). Towards Effective Science Education: Issues in Universal Basic Education Programme. *Journal of Sports Management and Education Research. 1(2), 387.*

Apata. (2007). Influence of Teachers' Academic Qualification and Experience on Students' Performance in Senior Secondary School Physics in Ikwera State. (Master Thesis). University of Ilorin, Ilorin.

Atkins, J. *et al.,* (2002). National Union of Teachers: *Impact of Class Size on Teacher Workload*

Barnes, D., & Blevins, D. (2003). An anecdotal comparison of three teaching methods used in the presentation of microeconomics. *Educational Research Quarterly, 27*(4), 41-60.

Bassey, M.P., (2002). Availability of Resources for the Teaching of Science Subject in Public Secondary Schools. A Case Study of Some Selected Secondary Schools in Alimosho Local Government.

Bennel, P. & Sayed, Y. (2002). Improving the Management and Internal Efficiency of Post-Primary Education and Training in Uganda, Kampala

Borden, V., & Burton, K. (1999 June). *The impact of class size on student performance in introductory courses.* Paper presented at the 39th Annual Conference of the Association for Institutional Research, Seattle, WA.

Boser, U. (2000). A picture of the teacher pipeline: baccalaureate and beyond. *Education Week Quality Count, 2000, 19(18), 17.*

Carbone, E. (Ed.). (1998). *Teaching large classes: Tools and strategies.* Thousand Oaks, CA: Sage Publications.

Crosser, S.L. (1991). Summer birth date children: Kindergarten entrance age and academic achievement. *Journal of Educational Research*, *84 (3), 140-146*.

De Caprariis, P., Barman, C., & Magee, P. (2001). Monitoring the benefits of active learning exercises in introductory survey courses in science: An attempt to improve the education of prospective public school teachers. *The Journal of Scholarship of Teaching and Learning, 1*(2), 1-11.

Delhanty, D. (1977). Myths about older teachers Phil Delta Kappam, 59, 262-263

DeMeis, J.L. & Stearns, E.S. (1992). Relationship of school entrance age to academic achievement. *Journal of Educational Research*, 86(1), 20-27.

Dietz, C. & Wilson, B.J. (1985). Beginning school age and academic achievement. *Psychology in the Schools*, 22 (1), 93-94.
Draku E, F. (2016, 30th January). Science Policy Threatened by Teacher Shortage. *URN Blog*.
Essam, M. & Aljifri, K. (2009). Enhancing Student Performance in Managerial Accounting: A Laptop-Based Active Learning Approach. *The Accounting Educators' Journal Volume XIX pp. 111-125.* United Arab Emirates University
Fosnot, C. (1989). *Enquiring Teachers, Enquiring Learners.* A Constructivist Approach to Teaching. New York: Teachers College Press
Frazer, B.J., Okebukola, P.A.O. & Jegede, O.J., (1992). Assessments of the Learning Environment of Nigerian Science Laboratory Classes. *Journal of Sciences. Teachers' Association of Nigeria, Vol. 27.*
General Council of the Assemblies of God, (2010). Living in the Spirit. 1445 N Boonville Ave Springfield, MO 65802.
Goebel, B. L. & Cashew, V. M. (1979). Age, sex and attractiveness as factors in students' ratings of teachers. A developmental study. *Journal of Educational Psychology, 71, 646 - 653*.
Hare, D. & Heap, J. L. (2001a). Teacher recruitment and retention strategies in mid-west: *Where are they and do they work?* Naperville, IL: North Central Regional Educational Laboratory
Head, J. (1999). Understanding the Boys: Issues of Behaviour and Achievements. New York: Palmer Press.
Hunt, D., Haidet, P., Coverdale, J., & Richards, B. (2003). The effect of using team learning in an evidence-based medicine course for medical students. *Teaching and Learning in Medicine, 15*(2), 131-139.
Ingersoll, R. M. (1997). Teacher turnover and teacher quality: The recurring myth of teacher shortages. *Teacher College Record, 99(1), 41- 44.*
Jenkins, J. (2014, 17th September). Class size: How does it affect learning? Edutopia
Kinard, E.M. & Reinherz, H. (1986). Birth date effects on school performance and adjustment: A longitudinal study. *Journal of Educational Research*, 79 (6), 366-372.
Krejcie, R. V. and Morgan, D. W. (1970). Determining sample size for research activities, Educational and psychological measurement, 30, 607-610, Sage Publications.
La Paro, K.M. & Pianta R.C. (2000). Predicting children's competence in the early school years: A meta-analytic review. *Review of Educational Research*, 70 (4), 443-484.
Martin, K. J & Smith, L. R. (1990). Effects of teacher's age and gender on student perception. *Educational Resources Information Centre (ERIC), U.S.A.*
Matthew, R. Farmer, O. S., McQueen, J. A. G. K. (2015). Teacher Collaboration in Instructional Teams and Student Achievement. *Research-article American Educational Research Journal*
Maureen Tam (2000). Constructivism, Instructional Design, and Technology: *Implications for Transforming Distance Learning. Teaching and learning Centre, Ling Nan University, Hong Kong, China. mtam@ln.edu.hk*
McLeod, N. (1998). *What teachers cannot do in large classes* (Research Rep. No. 7). Leeds, UK: Leeds University.
Merrill M. D. (1991). Constructivism and Instructional design. *Educational Technology, May, 45-53*
Mintzes, J. L., Wandersee, J. H., and Novak, J. D. (1998). Teaching science for understanding*: A human constructivist view.* New York: Academic Press.
MOE&S, (2007). USE Implementation Steering Committee Report. Kampala, Uganda: Horizon Lines.
MOE&S, (2005). The Science Policy 2005
Morgan, R., Whorton, J., & Gunsalus, C. (2000). A comparison of short term and long term retention: Lecture combined with discussion versus cooperative learning. *Journal of Instructional Psychology, 27*(1), 53-58.
Namatende Sakwa, L. (2013). Government Policy on Science Education in Uganda: *A Glass-Ceiling for Women's Access to Higher Education, Ghent University and Uganda Martyrs University, Chia Longman, Ghent University.*
Nitrini R, Brucki B. D.M.S, Smid J, Goulart C. T. M, Anghinah R, Fegyveres A. R, Bahia S. V, Damin E. A., Formigoni P. A., Frota F. A. N, Guariglia C., Jacinto F. A., Kato M. E., Lima P. E. E., Moreira D., Nóbrega B. A., Porto S. C., Senaha H. L. M., Silva M. N. M, Talarico S. N. J., Radanovic M., MansurL. L. (June 2008). Influence of age, gender and educational level on performance in the Brief Cognitive Battery-Edu. *Dementia & Neuropsychologia ; 2(2):114-118*
Novak J. D. (1998). Learning, Creating, and Using Knowledge*: Concept maps as facilitative tools for schools and corporations*. Mahwah, N.J.: Lawrence Erlbaum & Assoc.
Obioha, N.E., (2006). Science Teachers' Association of Nigeria Physics for Senior Schools. Heinemann Educational Book Publishers, Nigeria.
Ogunleye, B.O., 2002. Towards the Optimal Utilization and Management of Resources for the Effective Teaching and Learning of Physics in Schools. Proceedings of the 41st Annual Conference of the

Science Teachers' Association of Nigeria, (STAN'00), University of Lagos, Nigeria, pp.: 215-220

Okebukola A. P. (April, 1992). Concept Mapping with a Cooperative Learning Flavor. *The American Biology Teacher* Vol. 54, No. 4 pp. 218-221

Perkins, D., & Saris, N. (2001). A jigsaw classroom technique for undergraduate statistics courses. *Teaching of Psychology, 28*(2), 111-113.

Rilary, J. E. & Ryan, B. F (1969). The student hooks at his teacher. New Bren wick, N. J:
Rutgers University Press.

Schroeder, C. M., Scott, T. P., Tolson, H., Huang, T. & Lee, Y. (2007). A meta-analysis of national research: Effects of teaching strategies on student achievement in science in United States. *Journal of Research in Science Teaching, 44 pp 1436 – 1460*

Smith, R. (2015). Large Class Teaching Challenges and Possible Responses. Applied Linguistics. S1.74 Social Sciences Building, University of Warwick, CV47AL, UK.

Stanley, C., & Porter, E. (Eds.). (2002). *Engaging large classes: Strategies and techniques for college faculty.* Bolton, MA: Anker Publishing Company.

Tinkamanyire, D. (2010, 13th April). New Science Policy unfair. New Vision

UNEB, (2005). Qualifications for one to Head Examination Centres. *Unpublished requirements for Head teachers in UNEB Examinations Centres.*

UNEB, (2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016). UCE Results Books.

UNEB, (2009). UCE Entries for 2009

UNEB, (2010). Centre Validation Reports for Phases I and II

UNEB, (2010). UCE Entries for 2010

UNESCO. (1990). World Declaration on Education for All: Paris.

Uphoff, J.K. & Gilmore, J. (1985). Pupil age at school entrance –How many are ready for success? *Educational Leadership*, 43, 86-90.

Voyles, M. J. (2011). Student Academic Success as Related to Student Age and Gender. A Dissertation Submitted to Faculty of the University of Tennessee at Chattanooga for the Award of Doctor of Education Degree in Learning and Leadership.

Wamboga-Mugirya, P. (2005, 22nd February). Science Education gets double boosting in Uganda. New Vision.

Weller, J. & Lynn, A. B. (October 25, 2016). What It Takes to Teach Science in a Rural School. *Rural science teachers, knowledge isn't enough.*

Yara, O. P. & Otieno, O. K. (2010). Teaching/Learning Resources and Academic Performance in Mathematics in Secondary Schools in Bondo District of Kenya. *Asian Social Science, Vol. 6 No. 12*. www.ccsenet.org/ass

Yoder, J. & Hochevar, C. (2005). Encouraging active learning can improve students' performance on examinations. *Teaching of Psychology, 32*(2), 91-95.