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EXPLORATION OF FACTORS CONTRIBUTING TO LOW ACHIEVEMENT OF LEARNERS IN CHEMISTRY AT ORDINARY SECONDARY LEVEL IN KATRINI SUB COUNTY, UGANDA

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Abstract: The purpose of this study was to explore factors contributing to low achievement of learners in chemistry at ordinary secondary section in Uganda. A qualitative research approach with a case study design was applied. The sample size had twenty-two participants made up of ten females and twelve males in the following categories: one head teacher and one chemistry teacher purposively selected, ten old students sampled using snowball sampling technique and ten current senior three learners selected using simple random sampling method. Findings showed that there were several factors contributing to low achievement of learners: categorized as school factors, and learner factors. The school factors were: poorly equipped smaller laboratory making the teachers teach chemistry theoretically not practically and also the teachers fail to use the environment in teaching and learning of chemistry, smaller library with few textbooks for chemistry, few chemistry teachers, inadequate ICT services, inadequate preparation by the teachers, learner factors include: negative attitude of learners, missing lessons, negative peer influence and poor health of learners. The new findings include: teachers fail to use the environment in teaching and learning of chemistry, inadequate preparation by teachers, and negative peer influence. The study recommends that government needs to recruit more chemistry teachers and improve classroom, laboratory, and library facilities, the school administration needs to provide bursaries and guidance for learners and teachers need to teach practically and use the environment to teach chemistry.

Keywords: Learner, Achievement, Factors, Ordinary Secondary level, Mixed secondary School.

INTRODUCTION

Chemistry is one of the compulsory science subjects taught to learners in the ordinary secondary section in Uganda. It is a practical subject that is supposed to be handled practically in classrooms and learners many a times do not perform well in the subject. Many scholars have over the years paid attention to the learners' participation in science education all over the world because compared to the other disciplines, the performance in science has not been as expected. Chemistry as a Science, Technology, Engineering, and Mathematics, STEM subject helps learners to join several courses in universities and other institutions of higher learning, some of these courses include: medical, engineering, industrial, education, and computer courses which enable them to specialize in more specific fields in these mentioned general courses (Michalopoulou et al., 2019). According to Kricorian et al. (2020), several factors influence the participation of learners in STEM. These include both internal psychological factors and extrinsic contextual variables such as academic mindset, STEM attitude, school facilities, teachers' dynamics in the class, and family backgrounds as well as their mentorship experiences and preferences. According to Singh and Mukherjee (2018), these factors can be categorized into, school factors, learner factors, home factors and teacher factors. At the learner level their attitude towards the subject, lesson attendance, personal study, health status of the learners, and peer group influence involving their interaction at their level also known as collaborative learning (Supena et al., 2021). These matter a lot in understanding the concepts in chemistry. In East Africa, the performance of learners in chemistry has been poor over the years much as there is a tremendous increase in the number of learners in the schools as a result of the fee-free education policy.

A study conducted by Musyoki (2015) showed that learners perform poorly in chemistry in the public secondary schools of Kenya as seen in the results of Kenya certificate of education. The Ugandan government has made several attempts to promote sciences like making sciences compulsory in 2005, giving more scholarships for admission to science-related courses in the universities, and the most recent being paying the government-employed scientists well including the science teachers but still the achievement of learners in chemistry has remained low across the country (Nandugwa, 2018). In 2018 out of 330,721 learners who sat Uganda Certificate of Education, UCE all over Uganda, their worst performance was registered in chemistry, and this was attributed to language deficiencies, cram work, and teachers forging questions to candidates (Editor, 2019). In 2019 out of 330,592 candidates who sat UCE, almost half failed chemistry. This means virtually half of the number of candidates did not pass the subject. According to JJingo (2021), the executive secretary of UNEB, Dan Odongo, revealed that nearly half of the 330,060 candidates did not achieve the minimum pass eight level in science

subjects in 2020 UCE and chemistry was one of the worst-done science subjects as it has been in the previous years. This means that the number of learners studying the subject is high at the ordinary secondary level but very few pass the subject to proceed with it to the next level. This thus reduces the number of students offering chemistry-related courses in the institutions of higher learning and the universities in Uganda. It was, therefore, necessary to establish the factors contributing to low achievement of learners in chemistry at the ordinary secondary level.

Statement of the Problem

The science subjects taught at ordinary secondary level in Uganda include Chemistry, Physics, Biology, Agriculture, Food and nutrition, General Science, and Health Science. Learners after passing these subjects at the ordinary level will continue to study them at the advanced level or other certificate awarding courses like nursing, grade three teacher training, pre-primary teacher training, certificate engineering courses, and others. In Uganda, it is a critical subject for the learners to pass because it forms part of several science combinations at the advanced level like PCB (Physics, Chemistry, Biology), PCM (Physics, Chemistry, Mathematics), PCICT (Physics, Chemistry, Computer Studies), MCICT (Mathematics Chemistry, Computer Studies), BCICT (Biology, Chemistry, Computer Studies), BCM (Biology, Chemistry, Mathematics). The students qualify to offer Chemistry at an advanced level when they score at least a credit six that means learners who can offer Chemistry in Advanced level need to score it from distinction one or distinction two and the credits three, four, five, and six which usually range from around 50% or even below depending on the performance of the learners in a particular year. The performance of learners in chemistry has been poor over the years all over the country amidst all the efforts put by the government to bring up the sciences in the country. The low performance of learners in chemistry in Uganda has led to fewer chemistry teachers, engineers, doctors, nurses, meteorologists, and environmental officers, and others. The learners need better performance in chemistry to increase the number of science professionals in health, chemistry teaching, engineering, environment, food, and nutrition, and also climate studies (Lubaale, 2021). The performance of learners is not encouraging in chemistry as a science subject in Terego District as well. Therefore, there was a need to establish the factors contributing to low achievement of learners in chemistry at ordinary level. Several studies have been done on the factors affecting learners' achievement in sciences generally, but little has been done regarding learners' achievement in chemistry in Uganda. This study, therefore, was done to establish the factors contributing to low achievement of learners in chemistry in Katrini subcounty, Terego District, West Nile sub region in Uganda.

Research Objectives

1. To establish the school factors leading to low achievement of learners in chemistry
2. To establish the learner factors leading to low achievement of learners in chemistry

Research Questions

1. What are the school factors contributing to low achievement of learners in ordinary secondary chemistry?
2. What are the learner factors contributing to low achievement of learners in ordinary secondary chemistry?

Literature review

The purpose of this study was to explore the factors contributing to low achievement of learners in chemistry in ordinary secondary level.

School factors affecting learner achievement.

These are factors mainly concerning the management of the school in areas like: school facilities and activities, and also other stake holders including the parents and teachers' association, the board of governors, the District and the Ministry of Education and Sports, MOES, and the government at large. According to Nandugwa (2018), learner's achievement in sciences is greatly affected by the extent to which school facilities like library and laboratory are equipped.

Mwangi (2016), argues that it is not only the above that make up the school factors but also availability and effective use of the teaching and learning resources to ensure practical handling of the science subjects including chemistry. Ilomo and Mlavi (2016), agrees with the above in a study on the availability of teaching learning resources and their effects on academic performance of learners that insufficient laboratory facilities will make the learners loose interest in the subject since it will be taught theoretically yet it is a practical subject. This makes the learners not to appreciate the subject and it demotivates them from learning the subject since the laboratory activities would stimulate the interest of the learners to like the subject as they engage in useful scientific activities and the experiments.

According to Mahwasane (2017b), in a study on the role of Library in sustaining quality education in secondary schools, said the library is the backbone of all education institutions, that it is the chief source of information for both staff and learners. The learners can use the books in the library to understand what they have not understood well in class and also enable them to do more research on their own.

Shintia et al. (2021), agrees with this point on the contribution of the library in a study on the influence of school library utilization and reading interest on the achievement of the learners. The study puts it clear that the state of the library interms of the number of textbooks, space available and their effective use has a positive impact on the achievement of the learners. This is because the library is the source of knowledge in a number of aspects for the learners. If the learners use the library affectively to read and research on academic issues, it will improve on their academic achievement but if they move in the library with other motives of doing nonacademic aspects, it will have a negative impact on their achievement. According to Ojha (2016), there are many topics in chemistry that require computational techniques to understand and use of ICT enhances the learning activity of learners as well as easing the delivery of knowledge by the teachers hence improves the achievement of learners in the subject.

Evangeline et al. (2021), when teachers conduct teacher centred lessons in chemistry class, the learners are given very little chance to contribute in class during lessons which makes them believe that the teacher is the sole source of knowledge in the subject which kills their interest. According to Majo (2018), teachers have to use the most convenient pedagogies in teaching science like inquiry-based learning which is learner centred and encourages the participation of the learners but many times it is not the case

instead the teachers use the traditional teacher centered pedagogy to deliver knowledge in the subject. This approach leaves the learners surely idle in class and makes them believe that the only source of knowledge for them is the teacher, so they do not work on their own.

According to Childs et al. (2015), a study carried on the role of teaching and learning of chemistry, another key issue that affects the learners understanding of the ideas in chemistry as a science subject is the language and mathematics emphasizing that these two are the pillars on which chemistry and other science subjects stand. Markic and Childs (2016), agrees with the above study in research on language and teaching and learning of chemistry and puts it clear that the language used in teaching and learning of chemistry is a problem that the students face at both secondary and tertiary levels, and it is one of the major sources of learning difficulties in the subject.

Learner factors contributing to low achievement of learners in chemistry.

According to Kabunga et al. (2018), the interest of learners in natural sciences determines their achievement in science and the intention to peruse studies in science courses.

There is a strong relationship between the learner's achievement and their perception towards science subjects because the perception of the learners on a particular subject determines their concentration in that particular subject. According to Hassan and Murtaza (2020), in a study on secondary student attitude towards learning chemistry, comparison by gender, age, and educational stream in Pakistan discovered that mainly female learners have a negative attitude towards chemistry as a science discipline, by age those from 14-15 have a more negative attitude compared to those from 15-16, 16-17 years of age. The study showed that male students have a positive attitude compared to their female counter parts. The attitude of a learner towards a subject greatly affects the understanding of the subject's content.

According to Musengimana et al. (2021), learners' attitude is a major factor contributing to their performance in chemistry. This paper puts it clear that before addressing the negative attitude of the learners towards the subject, the stake holders must start by recognizing the root cause of the negative attitude of the learners in sciences some of which include gender, instructional method, and the grade level, many other studies have shown that female learners have a negative attitude towards sciences compared to the male learners.

According to Iyamuremye et al. (2022), students attitude affects performance but when chemistry is taught through social interactions, like the use of web-based discussions, it can change the attitude of the learners towards chemistry to love and improve their achievement in the subject. In case of limitations in the access of internet and other ICT requirements, learners can be guided and counselled in the subject. Gong et al. (2020), in a study on peer learning in STEM, a qualitative study of a student oriented active learning intervention programme, puts it clear that learners are put in groups to discuss concepts with their peer learners, they can easily understand the ideas taught in sciences. This will improve the achievement of the learners in science subjects so as to make them join STEM careers. Chen et al. (2020), carried out research on teaching and learning of children: impact of reciprocal peer learning and emotional engagement in which they agree with peer learning having a positive contribution on learners' achievement but added that it should be guided by the teachers. This is because the learners may end up being involved in other non-academic discussions of sports, boy girl relationships, social interactions, and other community related events.

Slade and Griffith (2013), in a study entitled a whole child approach to student success, asserts that learner's achievement in academics focuses attention on all the following: emotional, social, mental, physical, and cognitive aspects of the learners.

According to Hawkins et al. (2022), in a study on individual and collaborative health behaviour and academic achievement of the learners, put it clear that higher achievement of the learners is attributed to more positive and cumulative health behaviour and conditions of the learners. According to Oghuvbu (2010), in a study on attendance and academic achievement of learners in secondary schools, the learners who attend lessons regularly will perform well in class compared to those who dodge lessons. Ancheta et al. (2021), carried out a study on the effect of class attendance on academic performance and found out that one of the key causes of academic failure amongst the students is failure to attend lessons in class.

METHODS

Research approach

The research approach for this study was qualitative which was used to collect, analyze, and present the findings. This is the approach used to have in-depth insights into an identified problem so as to generate new ideas on the issue at hand (Rahman, 2020). In education, qualitative research enables one to have a deep understanding of experiences, phenomena, contexts by asking questions that cannot be easily put into numbers to understand human experience.

Research design

This research adopted case study design to have a deep understanding of the topic and have a variety of evidence to the same effect (Thomas, 2021).

This was because the topic of this study aimed at exploring the factors contributing to low achievement of learners in chemistry focusing on senior three class and some of the students who had already finished ordinary level in this school.

Sample population

The sample population constituted one head teacher, one chemistry teacher, ten S.3 students having five girls and five boys, ten old students having five girls and also five boys. These were selected so as to provide the current state of the school interms of the factors that would lead to low achievement of learners in ordinary secondary chemistry. The old students of the school were selected because they had already the experience of the national exams in chemistry as a subject, UCE, after being prepared by the school for all those years.

Sampling procedures

These are the techniques used by the researcher to come up with the list of participants and get access to them so as to administer the tools to get the expected information from them. The research used three sampling procedures that included: Simple random sampling, snowball sampling, and purposive sampling.

Simple random sampling

The researcher used simple random sampling to select the five girls and five boys from the current senior three class where five papers had the word positive written on them and the rest had the word negative, and the papers were thrown on a table and all the girls were asked to pick them and open to read the word on it. The five girls who picked positive were the ones to participate in the study especially in the focus group interview and the same was repeated for the boys and also five boys were selected but all of them were in class during lesson observations.

Snowball sampling

This sampling technique is also called chain referral sampling. It is a non-probability sampling technique in which the samples have traits that are rare to find (Berndt, 2020). This involves the existing subjects helping to recruit the others which the researcher does not know. In this process, the deputy head teacher helped the researcher to locate one old boy and one old girl of the school who then connected the researcher to the next two, old boy and old girl and the chain continued until the researcher got all the ten old students of the school.

Purposive sampling

This is a sampling procedure in which the researcher selects the participants directly to participate in the study (Campbell et al., 2020). Based on this sampling technique, the number of participants was very low, and in this study, it only applied for the head teacher and one chemistry teacher for senior three class because in a secondary school in Uganda there is only one head teacher and for this particular school there was also one teacher handling chemistry in senior three class.

Demographic information of the participants

The study had a total of twenty-two participants that consisted of ten female respondents and twelve male respondents out of these, ten of them were below eighteen years and the twelve were above eighteen years in terms of their age.

Table 1. Showing the experience of the headteacher and the chemistry teacher for senior three class.

S/no	Participant	Year started serving in the school	Number of years in the school
1	Head teacher	2018	5 years
2	Chemistry teacher	2016	7 years

Source: Field Data (2022)

Old learners

Table 2. Showing the demographic information and the performance of old boys and old girls.

Pseudonym	Sex	Age	Score in chemistry	Year of completion
OGI	F	28	F9	2016
OG2	F	21	P8	2018
OG3	F	21	P8	2019
OG4	F	20	F9	2017
OG5	F	20	P7	2019
OB1	M	22	C5	2017
OB2	M	25	P8	2016
OB3	M	26	C6	2016
OB4	M	25	C6	2016
OB5	M	28	C6	2017

Source: Field Data (2022)

Current senior three learners

Table 3. Showing the demographic information of senior three learners.

Pseudonym	Sex	Age
LI	F	17
L2	F	17
L3	F	16
L4	F	16
L5	F	16

L6	M	17
L7	M	17
L8	M	16
L9	M	16
L10	M	17

Source: Field Data (2022)

Data collection methods

In the process of data collection, the researcher used narrative inquiry interview, document analysis, focus group interviews and lesson observation. All these focused on establishing the factors affecting the performance of learners in chemistry in ordinary secondary level using different tools.

Document analysis

The use of the relevant documents for collecting data in qualitative research is very important (Li et al., 2019). The researcher extracted the performance of the learners in UCE for the last five years and the performance of the learners in senior three for the last two terms using document analysis protocol.

Lesson observation

The researcher observed five different lessons on different days which were all double periods for 80 minutes using observation check list as the tool. According to O'Leary (2013), during lesson observation, the researcher can witness the interaction and behavior of the teachers and the learners in a particular class. The researcher was able to confirm the interaction between the teacher and learners and the interaction amongst learners and also the methods used by the teacher to deliver concepts in chemistry.

Semi structured interview

The researcher conducted a narrative one on one inquiry interview and the choice of this was to make the participants feel free to share their opinions on the factors contributing to low achievement of learners in chemistry. According to Jung (2022), in the narrative interview interaction with participants, no choice answers are provided for the participants, but it allows participants to freely speak without any guidance. The data collection instrument used in this was the interview guide which were three: one interview guide for head teacher, another interview guide for the chemistry teacher, and the third was an interview guide for the old boys and the old girls (old students) of the school.

Focus group interview.

This data collection method was used to collect data from the current senior three class learners which ideally were going to be interviewed one on one but because of the tight programs in the school, they were then conducted in two groups of five members and the tool used was focus group interview guide. In this process the researcher asked a question and the five members responded to the same question at a time before the next question was asked. Transition from one respondent to the next and from one question to the next was moderated by the researcher.

Data analysis

The data obtained from the field was shared and confirmed by some participants after transcription and later was analyzed based on the objectives and subsidiary questions that guided the study. The researcher used thematic data analysis Ravindran (2019), which starts with transcription which involved getting raw data from the recorded responses of the participants, coding process which involved reading through the data and assigning codes to the points based on their similarities and differences which helped the researcher streamline the overall analysis process. This was followed by forming themes and sub themes which informed the research questions and finally the data was presented.

Results

School factors contributing to low achievement of learners in chemistry.

The research findings showed that the school has a school laboratory, with a smaller room space for learners and also smaller classrooms, it is not well equipped some of the apparatuses are not there and the ones that are there are few, some of the reagents have expired which limits practical activities in chemistry. The findings also showed the school has a school library having a small room to accommodate the number of the learners in the school at once for studies, and also has few textbooks for chemistry. The study again found out that there are fewer number of chemistry teachers in the school leading to a high teacher pupil ratio.

The researcher found out that the school does not have a computer laboratory, has fewer computers, does not have a projector and there is no internet connection in the school which leads to limitations of further research and individual work by the learners to understand chemistry concepts more.

Learner factors contributing to low achievement of learners in chemistry.

The study found out that learners have a negative attitude towards chemistry as a science subject. The findings showed that many learners are found of missing classes and some of them come late to school for various reasons, far homes, bad weather, too much work at home and also school fees challenges. The data revealed that peer learners have a negative impact on the concentration of the learners like saying chemistry is difficult, influencing friends to go to play instead of reading, and also boy girl relationships. The researcher established that learners in the school many times have poor health suffering from malaria, typhoid, and worms, this affects lesson attendance in the subject.

Discussion

School factors affecting the performance of learners in chemistry as a science subject.

These are factors mainly concerning the management of the school in areas like administration, school facilities and activities, and also other stake holders including the parents and teachers' association, the board of governors, the District and the Ministry of Education

and Sports, MOES, and the government at large. According to Oginni et al., (2013), the school has to provide a conducive environment for both teachers and learners which includes laboratory, library, provision of ICT services to encourage research, and further reading, classrooms and also ensuring that there is enough human resource in the school for the subject.

School laboratory

School laboratory service is a key determinant of the achievement of learners in chemistry as one of the core Science subjects that needs to be delivered practically (Olubu, 2015a). It was established that the school has a chemistry laboratory that did not have enough space, few apparatuses, and limited reagents some of which had expired as confirmed by most of respondents including the head teacher of the school.

School Library

According to Mahwasane (2017a), the school library resources have a great impact on the learners' achievement in academics and it provides relevant, current, and timely information to the learners so as to progress in their academic work. This study found that the library at the school did not have enough space and also had fewer textbooks for chemistry as a subject.

All the participants confirmed that the school library room is small and has a limited number of chemistry textbooks compared to the enrolment of learners in the school. According to Shintia et al. (2021) having a spacious library and enough books in the library ensures easy access and comfortability in the use of the services hence encouraging research and getting more knowledge amongst the learners and the teachers thus will improve the achievement of learners.

Number of Chemistry Teachers

The number of teachers for a given subject and the total number of learners in a school determines the teacher-pupil ratio. The nationally accepted teacher-pupil ratio is 1 teacher to 40 learners (Evarist, 2018). This has a greater impact on the teachers' attention to the learners he or she teaches because the teacher will attend to the individual needs of these learners in the subject adequately. This study established that there were only five chemistry teachers for the 520 learners in the school.

Almost all the participants mentioned that the school had over the years very few chemistry teachers, which directly affects the performance of the learners in the subject. This means the teacher-pupil ratio is high for the school resulting to low achievement of learners which is in line with this study: according to Mary (2020), the teacher-pupil ratio plays a vital role in the achievement of the learners at the end of a particular education cycle. If the teacher-pupil ratio is small the teachers will have adequate time to attend to the individual challenges facing the learners and appropriate solutions can be devised to help the learner to improve in academics.

ICT services

Several topics in chemistry require the use of ICT to learn ideally and the use of ICT would enhance the learning capacity of learners as well as teachers' efficiency in teaching, the use of ICT in chemistry would overcome the routine chalk-and-talk method used by the teachers (Ojha, 2016). Many of the respondents testified that the school does not have an internet connection, and this affects research and self-study in the subject. According to Opateye and Ewim (2021), the use of ICT tools in the assessment and learning of chemistry helps learners to pick courage and interest in the subject.

The school environment and the family environment of the children are not made use of in the learning of chemistry as a science subject. From all the discussions above, it is clear that the school laboratory and school library services, the number of teachers, and ICT services are not adequate to support the learning of the learners in chemistry and teachers are not making use of the environment to teach chemistry.

Learner factors affecting the achievement of learners in chemistry as a science subject.

Attitude of learners

The low performance of learners in chemistry in most countries in the world is attributed to the negative attitude towards learning and teaching of chemistry which makes learners switch off in chemistry very early (Musengimana et al., 2021).

All the participants mentioned that learners, especially in the ordinary secondary section, have negative attitudes towards the subject with exception of a few who will excel in the subject, this agrees with this study conducted by Lovelace and Brickman (2013), that says development of students' attitudes towards chemistry is one of the most critical components of science education as students' attitudes significantly impact on learning and eventually learner achievement in chemistry.

Lesson Attendance

According to Oghuvbu (2010), lesson attendance by learners is one important aspects of a learner doing well in chemistry, the level of passing the subject by a student has a direct link to the class attendance of the learner.

From this study, it was found that the students are missing chemistry lessons sometimes because of school fees and other home-related challenges. According to Ancheta et al. (2021) learners who miss lessons do not perform well in class.

Peer influence

According to Gong et al. (2020) when learners are made to work in groups, they can grasp the ideas more easily. From the ground, in the data collected many of the learners expressed that their peer learners have a negative feeling that chemistry is a difficult subject, which to a greater extent affects their performance in chemistry. Actually, many of the learners had a mention of peer learners having a negative contribution as far as chemistry is considered mostly in terms of scaring them that it's a tough subject which eventually demoralizes them in the subject. This is not in line with Chen et al. (2020) who says learners learn quickly through group interactions.

Health of the learners

According to Slade and Griffith (2013), the health of students is a key factor that determines success in academics. That means a healthier learner will progress with education better than one who is always affected by infections. The study showed that to a greater extent, the health status of the learners in the school affects their lesson attendance as such a good number of them miss lessons due to poor health and end up not doing well in chemistry as a science subject, this agrees with a research study done by Hawkins et al. (2022), which shows that higher academic grades are associated

with more positive individual and cumulative health behaviors among high school students.

Conclusion

As per the research findings of this study in which the major purpose was to explore the factors contributing to low achievement of learners in chemistry, it is reasonably important to conclude that several factors contribute to low achievement of learners in chemistry in the ordinary secondary section. poor laboratory and library facilities, few teachers and inadequate ICT services, negative attitude towards chemistry, missing of lessons, negative peer influence and poor health, inadequate preparation of teachers and failure to select the most appropriate pedagogy in teaching and learning of chemistry, failure to use the environment in teaching and learning of chemistry. The factors, if addressed by the various stakeholders of education, can improve the teaching and learning of chemistry in the school and the achievement of learners in the subject at ordinary level will improve. The study recommends further research on the same topic for the Advanced level. The researcher also recommends that similar studies need to be done on other science subjects like Biology, Physics, and Agriculture so that performance in the subjects can improve if the challenges facing their teaching and learning are established and addressed by the concerned stakeholders.

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