

**EXPLORING HOW SCIENCE TEACHERS USE MANIPULATIVE
TEACHING MATERIALS IN THE CLASSROOM: A CASE OF
SCHOOLS IN MANZINI REGION**

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ABSTRACT

This study sought to explore how science teachers use manipulative teaching material in the classroom. The study was based on the following objectives: establish the benefits of using manipulative teaching materials, determine the challenges faced by science teachers towards using manipulative teaching materials and suggest how science teachers may overcome the challenges faced in using manipulative teaching materials. Underpinned by the constructivism learning theory, a qualitative research approach was adopted where a case study research design was employed with a purposely selected sample of twelve (12) primary school science teachers who were randomly selected from four schools. Data were analyzed using thematic analysis. The findings of the study revealed that there are benefits of using manipulative teaching materials. These were that, learners make sense of the theory and have a clear understanding of the concepts taught, learners also acquired scientific skills and manipulative teaching materials motivate learners to participate in the lesson, therefore this makes it hard for learners to lose attention. The study also revealed the challenges faced by teachers in using manipulative teaching materials were lack of resources needed in the science lessons, failure to meet the demands of the subject, and the number of learners in the classroom. The study further revealed that all these challenges could be minimized by the government building science laboratories in the schools and that teachers should improvise the manipulative teaching materials. Based on the findings, the study concludes that manipulative teaching materials play an important role in the teaching and learning of science.

Keywords: manipulative, teaching, materials, science teacher, academic performance

1.0 INTRODUCTION

Manipulative teaching materials are concrete learning resources that help students understand abstract topics by putting them into context (Boggan & Whitemire, 2010). By providing actual experiences, manipulative teaching materials assist learners in establishing a link between the materials and abstract scientific concepts (Holmes, 2013), resulting in long-term retention of scientific skills. They've been identified as a potent method for achieving excellent teaching and learning (John, 2016). The value of high-quality, appropriate manipulative materials in teaching and learning may be shown in their effective use in the classroom. Manipulative teaching materials are structured items that are utilized by the teacher to assist learning and by the students to better grasp and interpret the subject matter (Mkpa, 2005). The manipulative materials are all the instruments that teachers can use to

make learning more engaging and memorable, and they are designed to depict abstract scientific/mathematical ideas explicitly and concretely. The use of manipulative teaching tools guarantees that the teaching and learning process is successful.

The use of manipulative teaching and learning materials has a significant impact on science instruction. When manipulative teaching materials are employed instead of just a simple lecture style, learners tend to grasp more. In the teaching of science, learners have a tendency to receive and absorb information in a variety of ways (Weinstein et al, 2018). The use of manipulative teaching and learning tools makes it easier for students to comprehend what is being taught to them and to acquire the scientific skills that the teacher wants them to have. Effective scientific learning occurs when the teacher creates a learning environment in which students learn through their natural reactions to the instructional material (Katherine, 2009). During the learning process, the teacher must create a learning environment that satisfies the learner's natural reaction, which is accomplished through the use of manipulative learning materials.

Manipulative teaching materials, no matter their nature and composition, are vital and relevant components for achieving success in the process of teaching and learning. Manipulative learning materials develop the continuity of thought as they provide an experience that is not easily attained traditionally. Langley (2013), observed that school quality and manipulative learning materials have an impact on learners' learning achievements. Moreover, learning materials help the learners to develop a concrete grip on the subject matter and cognitive development is observed. Buluma, (2013) equally established a link between performance and instructional resources. Saroyan et al (2009) linked the lack of instructional resources to poor academic performance. This makes the use of manipulative learning materials directly related to students' acquisition of skills, and knowledge and to their success.

The relevance and appropriateness of the manipulatives and learning materials utilized have a significant impact on student participation in scientific classes (Rose & Kurtz, 2008). Learning materials must be relevant to the topic being taught in order for classroom instruction to be effective. Manipulative materials encourage students to love their science classes to the point where they will repeat the activity in their spare time. This aids learners in retaining newly acquired skills and knowledge in long-term memory (Wambui, 2013). Learners' participation in science lessons is thought to supply them with knowledge and satisfy their learning needs. According to Onche (2014), a major issue in classroom instruction is a lack of instructional tools for participation. Educators must select and plan carefully the materials they are expected to use during the teaching and learning process

1.1 Benefits of using manipulative teaching materials

The review of the literature reveals that manipulative teaching materials have a number of benefits in the teaching and learning of science. A study done by Arop et al (2015), the study reveals that manipulative teaching materials help the teacher to teach well as to make her lesson clear and understandable to the students and that they are designed to develop the learner to achieve desires, goals, and objectives of the teacher in a learning situation. Manipulative materials bring science to reality in the classroom. Eya (2004) adds that manipulative teaching materials also give the teacher the air of guidance, coordination,

supervision and more time for correction, brighten the classroom and bring variety to the class lesson. A qualitative study done in Nigeria by Usman and Adewumi (2006) observed that manipulative teaching materials have been found to improve the quality of the learning experience in the classroom as they improve multi-sensory and multi-image factors responsible for the teaching and learning in science. Without the use of manipulative teaching materials, it becomes very difficult for learners to understand the abstract concepts of science.

Manipulative teaching materials are very important for the process of teaching and learning teaching, especially for inexperienced teachers. The teachers rely on manipulative teaching materials in every aspect of teaching (Crist 2014). The manipulative teaching materials are important to the teachers for background information on the science subject they are teaching. Teachers who are new in the teaching field find it difficult to express themselves when they enter the classroom. Therefore they need manipulative materials to help them, especially when teaching abstract concepts in science. A study was done by Clark (2009) in the United Kingdom also supported that these manipulative teaching materials are also needed by teachers to assess the knowledge of their students. John (2016) also adds that manipulative teaching materials are important because teachers are able to express themselves so that learners will have a clear view of what is being taught and also helps in getting the attention of the students. With instructional materials, the class is more realistic and it gives a viewpoint on the topic. Thus manipulative teaching materials cannot be left outside in the teaching and learning process, especially in the learning of science, which is the bedrock of scientific and technological development.

1.2 Challenges faced by teachers in the use of manipulative teaching materials

Teachers encounter a number of challenges in the use of manipulative teaching materials and these challenges affect the teaching and learning of science. A study done in Tanzania by Makunja (2016), reveals that even though the manipulative materials can be available in schools overcrowded classrooms are a challenge that hinders the process of teaching and learning. The number of students in classrooms is sometimes too big for the available limited manipulative teaching materials. Classrooms are overcrowded in such a way that a teacher cannot move around even if he wants to help students for demonstration purposes. Overcrowded classrooms tend to affect classroom teacher- students and students-students interaction during group discussions. Overcrowding classes also increase the workload of teachers. Another study done in Finland by Eshiet (2013) adds that a large number of students in one class in schools becomes a challenge for the teacher to use manipulative teaching materials, which are essential in the learning process and implement certain class activities. Large classrooms make a teacher avoid using manipulative teaching materials as it becomes a headache and hence most teachers prefer a lecture method. A study conducted by Blatchford et al (2003) found that in larger classrooms, students are less engaged and in most cases, those who are disengaged are those who are struggling in performance. Only the bright students dominate the classrooms. A large number of learners in the classroom negatively affect the successful process of teaching and learning.

Another challenge that science teachers face is the lack of training about the requirements of the subject. Some teachers turn to teaching the science subject in which they are not well versed due to the lack of teachers in the schools. The performance of a subject requires that each member of a team is well versed in skills, expertise, and knowledge of the subject

(Liber, 2010). A study by Nsibande (2002) argues that lack of curriculum knowledge, and not being clear about terminology, leads to poor lesson planning and lack of confidence when teachers are teaching. Therefore, it is important that teachers are knowledgeable in the field of the subject so as to minimize the challenges and the demands of the subject. Clark (2009) in unison agrees that teachers should constantly update their knowledge on issues relating to the subjects they are teaching. In other words, they should have a thorough understanding of contemporary approaches to effective teaching and learning so that they can effectively convey, provide and coordinate information about the latest ideas and approaches to different subjects and strategies to staff members.

Another challenge faced by teachers in science lessons is the lack of manipulative teaching materials. Cop (2015) reported in his studies that manipulative materials were inadequate in most schools in Nigeria. They further stated that the available ones are not usually in good condition. A professionally qualified science teacher no matter how competent and how well trained would be unable to put his ideas into practice if the school setting lacks the equipment and materials necessary for him or her to translate one's competence into reality. Thus, science is resource-intensive, and in a period of economic recession, it may be very difficult to find some the electronic gadgets and equipment for the teaching and learning of basic science in schools (Ebuwa, 2010). Thus simple manipulative teaching materials are needed for scientific instructions.

2.0 THEORETICAL FRAMEWORK

This study was guided by the constructivism learning theory by Jean Piaget. The theory of Constructivism states that learners learn by creating their own knowledge based on what they are presented with (Bada & Olusegun, 2015). Educators cannot simply transmit knowledge to learners but learners have to create their own knowledge through the manipulation of materials. Craig (2019), further states that learning is a result of mental construction. In constructivism, learners are not passive but they are actively involved in the teaching and learning process. Constructivism boosts learners' logical and conceptual growth (Driscoll, 2005). Learners must be exposed to the material being taught or studied. Learning is affected by the context in which concepts are taught as well as students' beliefs and attitudes (Bada & Olusegun, 2015). When using manipulative teaching materials, learners are able to rationalize, conceptualize and understand the concepts being taught and acquire intended skills when manipulating the teaching and learning materials. As they do this, they create their own knowledge and understanding. Using teaching and learning materials when teaching scientific concepts helps learners to construct more meaningful and clear knowledge.

3.0 PROBLEM STATEMENT

In the Kingdom of Eswatini learner performance in the Eswatini Primary Certificate (EPC) Science national examinations have not been satisfactory in performance in Science as it has remained low as compared to the other subjects (Mnisi, 2020). About half of the learners who are sitting for the EPC perform below average. This shows that there is a problem in the teaching and learning of science in primary schools. According to Arop et al (2014), manipulative materials make learning more permanent and also encourage participation especially if students are allowed to manipulate the materials used and thus, improve

performances. The poor performance in the science subject could be ascribed to the non-use of manipulative teaching materials in the classrooms which enhances the process of teaching and learning. Therefore, the researchers have found it important to conduct a study on how science teachers use manipulative materials in the teaching and learning of science.

4.0 OBJECTIVES OF THE STUDY

The objectives of the study are to:

1. Establish the benefits of using manipulative teaching materials.
2. Determine the challenges faced by science teachers towards using manipulative teaching materials
3. Suggest how science teachers may overcome the challenges faced in using manipulative teaching materials.

5.0 RESEARCH METHODOLOGY

According to Creswell (2014), research methodologies comprise the strategies and methods for research that extend the decisions from general assumptions to thorough methods of data gathering and reasoning. It comprises the joint of theoretical assumptions, strategies, and exact methods. The study adopted a qualitative research approach. Wiersma and Jurs (2009) revealed that in a qualitative approach phenomena should be viewed holistically, and complex phenomena should not be reduced to a few factors or partitioned into independent and dependent variables. Maree (2007) also posits that the purpose of qualitative research is to understand the current situations from the participants' perspective and that the researchers do not attempt to manipulate the phenomenon of interest. In this study, the phenomenon was the science teachers in the schools and the challenges they faced with the use of manipulative teaching materials.

5.1 Research design

A case study was the research design used in the study. Robson (2011) acknowledges that the defining feature of case studies is that they are concerned with particular cases within their settings or contexts. Case studies take place within their social and physical settings as opposed to studying phenomena devoid of their context and that is the reason it was adopted in the study.

5.2 Data collection

Data was collected from a purposely selected sample of 12 science teachers who were randomly selected from 4 schools. Purposive sampling is a strategy to choose small groups or individuals likely to be knowledgeable and informative about the phenomenon of interest (Leedy & Ormrod, 2005). Benard (2014) also adds that in the purposive sampling method, the researchers made a deliberate choice of an informant quality the informant possesses. In this study, the researchers purposely chose teachers who teach science in each school from grade 1 to 7. Interviews were used as the main data collection technique in this research. One-on-one interviews were used to solicit information from the teachers.

5.3 Data analysis

Thematic analysis was adopted and used in the study. Thematic analysis is a process of identifying patterns or themes within a data set (Clarke & Braun, 2013). The researchers used the thematic analysis approach as alluded to by Clarke and Braun (2013) that it provides a highly flexible approach that could be modified for the needs of many studies providing a rich and detailed yet the complex account of data. The goal of thematic analysis is to identify themes such as patterns in data that are important or interesting and use these themes to address the research or say something about an issue.

6.0 RESULTS

The results of this study were presented according to the themes that emerged from the data that was collected based on the objectives of the study. The researchers used direct quotations from the respondents. The themes that emerged from the study were, the benefits of using manipulative teaching materials challenges faced by teachers towards the use of manipulative teaching materials, and the possible solutions for the challenges faced by the teachers in the teaching of science.

6.1 Benefits of using manipulative teaching materials

In this study, it was found that the use of manipulative teaching and learning materials in science helps learners in a number of ways. It helps learners to make sense of the theory and have a clear understanding of the content as they manipulate the materials. Teacher 4 from school B stated that:

The use of manipulative teaching and learning materials helps the learners to have a clear understanding of what they are learning. It helps in motivating learners to participate in the lesson. Some concepts in science are difficult to understand, so the use of manipulative materials helps the learners to easily grasp concepts.

Learners tend to be interested in lessons where they will be hands-on in the learning process. When learners manipulate teaching and learning materials they are hands-on, the chances of them losing concentration or attention are very slim as they will be eager to see the outcome of the experiment. In addition, scientific activities do not just end at school, they extend to our home environment. There are some activities at home that students do without realizing that they are being scientific. On the same note teacher 1 from school, A concurred by stating that:

When manipulating teaching and learning materials learners are able to relate home experiences to the classroom situation. In classrooms, learners bring their own prior experiences. Teaching and learning materials are related to what the learners bring to class and what is taught.

Furthermore, it was made clear in this study that teaching and learning materials are key to improving learners' scientific skills and knowledge. Teaching and learning materials allow learners to be hands-on and therefore, as they manipulate the teaching materials, they acquire the scientific skills that they are supposed to learn other than the learner only hearing the teacher saying it.

Teacher number 3 revealed that "A student will better learn how to handle a test tube only if the teacher demonstrates how it is handled then allow the learner to handle it him or herself." As learners are manipulating the materials, they create their knowledge which lasts longer in their cognitive structures. Likewise, teacher number 5 from school B concurred by stating that "...manipulative teaching and learning materials reinforce scientific skills and concepts. They help make the learning environment interesting and engaging. They bring abstract concepts into reality". It becomes easy for learners to conceptualize what they are learning if it is brought to their real world. Similarly, teacher 8 from school C stated that:

Learners who are taught using manipulative teaching and learning materials acquire skills and knowledge efficiently because they do not forget what they have seen or done other than hearing. It gives learners a holistic understanding of the concepts being taught. Learners turn to develop a deeper understanding through personal experience and it becomes difficult to forget such concepts when they have done them practically.

This shows that learners prefer lessons where they will be able to manipulate the teaching and learning materials. This is due to the fact that such lessons are fun for the learners.

The teachers also commented on learners' behavior when they use manipulative teaching and learning in their lessons, all teachers concurred that using manipulative teaching and learning materials makes learners to be very interested in the lesson, therefore this makes it hard for learners to lose attention during the lesson which increases the level of understanding concepts and learning of the necessary skills. Teacher 3 from school B reflected that:

Learners get too excited when they are to manipulate teaching and learning materials. In some instances, if not most, they are very active in the classroom when they manipulate learning materials.

Similarly, in school, A teacher 2 maintained that:

Learners become vibrant in class; learning becomes easier and learners become actively involved in the learning process which means that the acquisition level of skills and concepts will be high

6.2 Challenges faced by teachers towards manipulative teaching materials

In this theme, the teachers started a number of challenges they encounter with the use of manipulative teaching materials. The responses of the teachers revealed challenges such as lack of resources needed in the science lessons and failure to meet the demands of the subject. Teachers believe in the use of manipulative teaching and learning materials in science classrooms. However, they revealed that they lack enough instructional equipment to teach in a science classroom. Teacher 7 from school D stated that "we always cry about the shortage of teaching materials here at school schools, there are few or no teaching materials available in teaching science and the principals always give an excuse of lack of funds.

Teacher 4 from school B also concurs with teacher 1 and stated that "We are not getting enough teaching materials, especially from the office since the administration always complains about lack of money due to delays from the free primary education" Teacher 3

from school A also reflected that, "...my school lack money to buy the materials teachers need for the education, for examples, test tube, litmus papers, and other materials are not available in the school." However, teacher 2 disagreed with teachers 1 and 4, he state that "Administration always find it difficult to provide manipulative teaching materials in science subjects, however as teachers as teachers we must improvise be creative enough to make our own teaching materials for effectively teaching"

The teacher's responses also revealed that they are not well versed in the demands of the science subject. They have limited expertise in the teaching of science. Teacher 9 from school C stated that "I do not have the knowledge and skills for teaching science let alone the manipulative materials associated with science. I did sciences only in the first year of college and when I got into the field I was forced to teach science due to a lack of teachers and the norm of teaching all subjects at the primary school level.

Among other challenges that affect the use of manipulative teaching materials in science is the number of learners in each classroom. The number of learners in the classes affects the teachers in a way that the teaching materials are limited and the teacher is forced to demonstrate. Teacher 2 from school A revealed that "We are disadvantaged by the number of learners we have in the classes, while the resources are limited. Similarly, Teacher 10 from school D material, "Our classes are overcrowded. This has been a norm due to the free primary education implemented in our country. We cannot work properly for that reason. We find ourselves self-using the lecture method when teaching and never using the manipulative teaching materials.

The teacher's responses indicated that a large number of learners in the school is a big problem. Teacher 1 also argues that, in this school, there are so many students per class. The class can have up to 70 students. This situation essentially reduces the use of teaching materials and teacher-learner interactions. It was a time in which there was a substantial increment in enrolments. All in all, I think this poses a problem in fulfilling the science subject.

6.3 How to overcome the challenges faced by the teachers towards the use of manipulative teaching materials

The teachers were asked to suggest a way out of the challenges they encounter in the use of manipulative teaching materials in science. Most of them were attuned to the suggestion that the government must build science laboratories in primary schools in the country. This could help because you find that even if some materials are available, it is difficult to store them and the classrooms were not built for conducting scientific experiments.

Teacher 3 and teacher 2 from school A had a different opinions. They suggested that the National Curriculum Centre (NCC) should try by all means to relate the syllabus to the seasons of the year. The point they were driving home was that the topics in the syllabus should relate to the current environment. It can be difficult for science teachers to teach about flowers in winter since there will be no flowers in the environment to show the learners, teachers would rely on charts and posters which can prove to be not as effective as the real flowers. Teachers 2 from school A revealed that:

The syllabus should work hand in hand with the seasons of the year like summer-related topics or lessons should be first and those that require winter teaching and learning materials should be able to be taught in winter.

Likewise, teacher 4 from school C suggested that "Teachers should be work-shopped on the important use of teaching and learning materials since some science teachers may rely on the lecture method which may prove not to be as effective". Teachers could also be equipped by inspectors on how to improvise the teaching materials to produce the same desired learning outcomes.

The manipulative teaching materials used by teachers in schools is provided by the government a lot but it is not enough, not in good condition, or not in line with the 21st-century standard. This means that schools in Eswatini can't solely rely on the government to provide sufficient manipulative teaching and learning materials but they have to find other ways of having these manipulative resources since they are important in the teaching and learning process in the science subject. So teachers suggested the improvisation of the manipulative materials.

On the same note teacher 11 from school D responded by saying:

Our school gets assistance from the Ministry of Education and most of the time the assistance is delayed so we improvise as teachers and source our own manipulative teaching materials. We sometimes ask the learners to bring their own from home. If I want to teach about teeth in Grade 3, I have to go to our health center and borrow a teeth model and posters instead of using charts only because our school doesn't have teeth models and posters.

The teachers also indicated that the learners themselves are key in assisting with the teaching and learning materials because sometimes the teachers ask them to bring some materials from home to use in lessons as teaching and learning materials. As much as this helps the teachers in their teaching but it also helps the learners feel valuable and vital participants in their learning.

7.0 DISCUSSION OF FINDINGS

The findings of the study were that learners benefit a lot from the use of manipulative teaching and learning materials in science as it helps learners to make sense of the theory and they have a better and clear understanding when manipulative teaching and learning materials are used. According to the findings of the study, some concepts are very difficult to be understood in science, so the use of manipulative teaching materials makes understanding easy. This is in line with a study done by Eshiet (2013), which mentioned that learners who are taught using manipulative teaching and learning materials acquire skills and knowledge efficiently because they do not forget what they have seen or done other than hearing. It gives learners a holistic understanding of the concepts being taught. It also helps in capturing learners' concentration during lessons. Arop et al (2015), agree with this assertion as he revealed in their study manipulative materials help the teacher to teach well and to make her lesson clear and understandable to the students.

In addition, the findings also revealed that the learners tend to be interested in lessons where they will be hands-on in the learning process. The chances of losing concentration and attention are very small because they are zealous about the outcome of the experiment. This is similar to what Eshiet (2013) notes as she agrees that manipulative teaching materials in science help in the motivation and development of interest in the learner. Ojoso (2009), in his study, asserts that manipulative teaching materials brighten up the classroom and bring more variety and interest to the lessons.

Among the challenges the teachers face in the use of manipulative teaching materials, the study revealed that teachers lack enough teaching materials for successful teaching and learning in science. The administration finds it difficult to support the teachers with the manipulative materials and they indicate that there are limited funds. This challenge is found to be parallel with a study by Richard (2014) which highlighted and emphasized that manipulative teaching materials play a crucial role in the classroom in the process of teaching and learning science.

The number of learners in the classroom was another challenge the teachers faced in the use of manipulative teaching materials in the classroom. The number of learners in the classes affects the teachers in a way that the manipulative teaching materials are limited and the teacher is forced to demonstrate since the classes are overcrowded. This is similar to what Eya (2004) as he contends that overcrowding in the classroom negatively affects the process of teaching and learning in the sense that the teacher cannot equally give attention to the learners. The teachers find themselves teaching using lecture methods due to a large number of learners in the classrooms.

The research findings are also concerned with how the challenges can be mitigated. The analyses revealed that most teachers suggested that the government through the Ministry of Education should build science laboratories in primary schools in the country. This could help because you find that even if some materials are available, it is difficult to store them and the classrooms were not built for conducting scientific experiments. Science laboratory allows learners to perform experiments rather than read about them (Kwok, 2015). Sari (2011) also agrees with this solution as in his study he mentioned that science laboratories allow learners to engage with the subject matter and thus improving the process of teaching and learning. Another solution suggested by the teachers was that the National Curriculum Centre (NCC) should try by all means to relate the syllabus to the seasons of the year. The point they were driving home was that the topics in the syllabus should relate to the current environment.

8.0 RECOMMENDATIONS

Based on the findings from this study the following recommendations were made:

- The government through the Ministry of Education should provide teachers and schools with adequate and relevant manipulative teaching materials and learning materials in time so that they teach successfully.
- Teachers should be appropriately equipped in the use and importance of manipulative teaching materials through staff development, in-service training, and workshops so

that they can effectively teach. The number of workshops for the science subject should be frequently done since it is a demanding subject.

- The study also recommends that the Ministry of Education should do frequent supervision and inspection in all the schools in Eswatini, so that they help teachers whenever there is a need to do so, especially in the use of manipulative teaching materials.

9.0 CONCLUSIONS

The study concludes that manipulative teaching materials in science play a very important role in the teaching and learning process as it promotes learners' academic performances. Teachers should improvise and source manipulative teaching materials for teaching effectively if they are not available. However, despite the positive impacts of manipulative teaching materials, there are some challenges teachers face in the use of manipulative teaching materials which include the number of learners in the classroom.

REFERENCES

- Arop.B.A, Umanah.F.I and Effiong.O.E. (2015). Effects of instructional materials on the teaching and learning of basic science in Junior Secondary Schools In Cross River State, Nigeria. *Journal of education research*. vol 14
- Bada, D. & Olusegun, S. Constructivism Learning Theory: A Paradigm for teaching and learning. *Journal of research and methods in Education*. Vol 5
- Bernard, H. R. (2014). *Research methods in anthropology: qualitative and quantitative approach* (3rd ed.0Thousand Oaks,CA: Sage
- Blatchford, P., Edmonds, S., & Marin, C. (2003). Class size, pupil attentiveness and peer relations. *British Journal of Educational Psychology*, 73, 15–36.
- Buluma, A. (2013). Utilization of open educational resources in teacher education programmes of Makerere University. Phd project.
- Boggan, M., Harper, S., & Whitmire, A. (2010). Using manipulatives to teach elementary mathematics. *Journal of Instructional Pedagogies*, 3(1), 1-6.
- Clark, T. Cavanaugh, C.,& Barbour, M. K. (2009). Research and practice in K-12 online learning: A review of literature. *International Review of Research in Open and Distance Learning*, 10(1).
- Clarke, V., & Braun, V. (2013). Teaching Thematic Analysis: Overcoming Challenges and Developing Strategies for Effective Learning. *Psychologist*, 26, 120-123. <https://thepsychologist.bps.org.uk>
- Clark, L. M. (2009) *Teaching tools teaching in the secondary school* new York: Macmillan publishing co. Inc [5]
- Cop, L. (2015). Math manipulatives: Making the abstract tangible. *Delta Journal of education*, 5(1).10-19

- Craig, H. (2019). The theories of emotional intelligence explained. Positive psychology. Com
- Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches (3rd ed.). Thousand Oaks, CA: Sage Publications.
- Crist, M. (2014). What are the Importance of Instructional Materials in Teaching for Employment blurit. Com /2247194
- Douglas, H. (2016). Teaching by Principles. An Interactive Approach to Language Pedagogy. Prentice Hall Regents Englewood Cliffs, New Jersey 076321
- Driscoll, M.P.(2005). Psychology of learning for instruction (pp.384-407;Ch,11-constructivism). Toronto, ON: Pearson.
- Ebuwa, S. E. (2010). strees on the use of teaching aids Nigeria observer, June 9, 4
- Eshiet, L. T (2013). The use of instructional materials in the teaching of science” (ed) in fundamental of education technology Unicross
- Eya, P. E., 2004. Instructional material procedures in a challenge Education system. Paper presented at the Annual natural conference organized by curriculum Development and Instructional material Centre (CUDIMAS). University of Nigeria, Nsukka
- Holmes, A. B. (2013). Effects of manipulative use on PK-12 mathematics achievement: A meta-analysis. Poster presented at the meeting of Society for Research in Educational Effectiveness, Washington, DC.
- Ibanga, E (2012 instructional materials and educational out comes secondary school books Ibadan: Nigeria
- John, T. (2016). Role of instructional materials in academic performance in community secondary schools in Rombo District. Med project. University of Tanzania.
- Katherine, M. (2009). Audio-Visual Materials: Collection Development Policy, Rod Library University of Northern Iowa.
- Kwok, P.W.(2015). Science laboratory learning environments in junior secondary schools. Asia –Pacific Forum on science learning and teaching. 16(1),1-28
- Langley, D. (2013) Division with Dienes. Primary Mathematics 17(2) p 13 - 15. Leicester: Mathematical Association
- Leedy, P. D. & Ormrod, J. E. (2005). Practical Research: Planning and Design (8th Ed). Pearson: Merrill Prentice Hall.
- Liber, T. F. (2010) Aids for teaching and learner London: George Allen
- Makunja, G. (2016). Challenges facing teachers in implementing competence-based curriculum in Tanzania: the case of community secondary schools in Morogoro municipality. International Journal of Education and Social Science, 3(5), 30-37.
- Maree, K. (2007). First Steps In Research (1st Ed). Pretoria: Van Schaik.

- Mkpa, M.A. (2005). Challenges of implementing the school curriculum in Nigeria journal of curriculum studies 12 (1), 9 –17.
- Mnisi, T. (2021). Effects of inquiry based learning on learner’s academic performance in science at primary school in Eswatini. A Thesis Submitted in Partial Fulfilment of the Requirement for the Degree of Master of education University of Eswatini.
- Nsiband, N. (2002). Teachers’ implementation of Continuous Assessment and challenges to curriculum literacy. University of South Africa. Pretoria
- Ojose, B., & Sexton, L. (2009). The effect of manipulative materials on mathematics achievement of first grade students. *The Mathematics Educator*, 12(1), 3-14.
- Onche, A. (2014). Meeting the Challenge of Accessibility and Utilization of Modern Instructional Materials in Rural Secondary Schools in Nigeria. *International Journal of Multidisciplinary Studies*. I,(2): 1 – 13.
- Petro, M. (2016) Department of Early Childhood Education and Development, School of Teacher Education, University of South Africa, South Africa maraip@unisa.ac.za
- Richard, A. A. (2014). Teachers’ Perception on the importance of teaching aids in Nigerian Secondary Schools. *Mediterranean Journal of Social Sciences*, 3(1), 99-109
- Robson, C. (2011). *Real world research* (3rd ed.). Oxford, UK: Blackwell.
- Ross, R., & Kurtz, R. (2008). Making manipulatives work: A strategy for success. *The Arithmetic Teacher*, 40(5), 254-257.
- Sari, M. (2011). The importance of Laboratories Courses in science and technology teaching In primary education and the ideas of simple tools and instruments to evaluate teacher Candidates on science experiments. April. Antalya. Turkey
- Saroyan, A., Dangenais, J., & Zhou, Y. (2009). Graduate students’ conceptions of university teaching and learning: Formation for change. *Instructional Science: An International Journal of the Learning Sciences*, 37, 579-600.
- Usman, K.O. & Adewumi, A.O. (2006). Factors responsible for inability of teachers to improvise instructional materials for the teaching of mathematics. *Journal of Science Teachers Association of Nigeria*, 41(1&2), 51-56.
- Wambui S.E. (2013). Effect of use of Instructional Materials on learner participation In Science Classroom in Preschool in Kiine zone Kirinyaga County Kenya. Master of Education Unpublished Dissertation, University of Nairobi.
- Wiersma, W., & Jurs, S. (2009). *Research methods in education: An introduction*. MA: Pearson.
- Weinstein, Y., Madan, C.R. & Sumeracki, M.A. Teaching the science of learning. *Cogn. Research* 3, 2 (2018). <https://doi.org/10.1186/s41235-017-0087-y>