Original Research Article

Teachers' Pedagogical Competence in Dealing with Teaching Aids in Tanzania: A case of a Few Finalist Pre-service Science-Teachers

ABSTRACT

The value of teaching aids in the process of teaching sciences cannot be overstated. The capacity of finalist university pre-service science teachers to incorporate teaching aids into their science classrooms to open up the potential of bringing about the critical features of an intended object into realisation is evaluated in this study. Observations and document reviews were used as data collecting techniques in this qualitative study, and they were used to investigate only 25 student-teachers during their final teaching practice placement. The study findings indicated significant difficulties among finalist university student-teachers regarding the selection and handling of instructional materials during the science lessons. The study recommended various measures for policy and practice regarding both science teacher-education and science teaching process.

Keywords: Tanzania, science pedagogy, teaching Aids, student-teachers.

1. INTRODUCTION

Modern education should attempt to develop critical skills and competences in learners to enable them to flourish in life beyond the classroom. Therefore, the current schooling process is not designed to provide children with ready-made knowledge, but rather to teach them to interact with their environment. In view of this, Academics [e.g., 1, 2, 3, 4] recommend science instructors to innovate teaching processes particularly by abandoning traditional, dogmatic, bookish, and chalk-talk procedures, in favour of active, learner-engaging educational strategies.

One of the instructional aspects that is currently garnering more attention to ensure that students participate actively and deliberately in the teaching and learning processes is the use of teaching aids. There is enough evidence [e.g., 3, 4, 5, 6, 7, 8, 9] to suggest that teaching aids improve students' academic performance. When instruction particularly of sciences is accompanied with the use of authentic teaching aids, students' academic performance is improved because learning processes become less abstract and more concrete [3, 5, 6]. Teaching aids, however, is a broad concept as it refers to a variety of textual, audio, visual, and audio-visual materials the teachers use to enhance students' learning [10, 11]. In this study, this term, that is, teaching aids, is used to refer to such things as models, graphs, charts, illustrations, pictures, maps, cartoons, slides, and electronic media such as animations. While there has been many studies on the use of teaching aids in the developed countries, little has been written from the developed world about the ways in

which teachers unpack visual representations. Knowing these and connecting them to key pedagogical aspects brings about a new useful thread of pedagogical awareness that educational stakeholders in the developing countries can use to enhance teacher education and more generally professional development. This study aimed at filling this gap. It aimed at checking whether, or not, teachers could integrate teaching aids into their didactic aspects. The goal was to see how well teachers could choose and employ appropriate teaching resources. To this end, the study was guided by the following research questions:

- What is the level of validity of the teaching aids that science teachers use?
- Is there effective utilisation of the instructional materials during science lessons?

2. THEORETICAL UNDERPINNING

Teaching aids are an important part of today's educational processes, and their proper integration into science education opens a world of possibilities for teachers and students [6]. Whenever teachers use some of the learning aids while teaching, their students get more stimulated because the learning aids help them (students) to become more attentive. Teaching aids are particularly essential because they help teachers deal with the problem of knowledge-reality isolation [2, 3, 6]. Due to spatial distance, complexity or other reasons, access to immediate reality is not always possible for students; therefore, teaching aids are used as a substitution for it [3, 5, 6]. Importantly, teaching aids not only compensate for the lack of true reality, but also serve as a key source of evidence in the learning process [6], avoiding the overemphasis on rote learning and recitation that often characterises the educational process. Scholars call for the use of teaching aids to engage students and promote their learning because abstract explanations are insufficient for most learners [7, 9]. The call to employ teaching aids is especially significant because the concrete sensory experience and 'touch of reality' that teaching aids bring to the learning scenario help to combat misconceptions and reference confusion among students [3, 5, 8], leading to the development of not only accurate images in students' minds, but also their mental faculties. That is to say, the development of students' imaginative and reasoning power brought about by the appropriate use of teaching aids allows students to easily learn and grip complex science concepts. Furthermore, [5] and [6] point out that the use of teaching aids promotes student-teacher-knowledge interactions, bringing learning to life and making lessons more interesting and exciting for students. On these grounds, it is beyond doubts that teaching aids are critical ingredients in the implementation of science curricula, and that teachers who use them are more confident, effective, and likely to be more productive.

Academic success is achieved through the utilisation of diverse instructional media. Researchers such as [4] and [8] backed up this claim by looking at how teaching aids contributed to numeracy skills. These studies revealed improvements in pupils' ability to grasp key concepts due to the proper use of teaching aids. Similarly, the studies by [5], [7], [9] and [10] revealed that students taught using a variety of instructional aids attain exceptional results compared to those who are not.

2.1. FACTORS INFLUENCING TEACHERS' USE OF TEACHING AIDS

While instructional materials make the learning process more engaging, previous reports by [10], [11], [17], and [18] show that most teachers do not use them; and if they do, they do so in a less professional manner [18, 19, 20]. There are numerous reasons for this issue, including teachers' incompetence, which ranges from the failure to select and prepare (or improvise) relevant resources [18, 19] to their use in the classroom [20, 21, 22]. Pacing of teaching aids, for example, is widely reported to be a problem that most teachers face when teaching science subjects [20, 22].

Additionally, there has been a challenge with obtaining appropriate human resources, tools, and facilities for successful teaching and learning. Governments, particularly in developing countries [4], fail to provide teachers with instructional resources, making lessons more abstract. Improvisation, according to [19], is one possible solution to the problem of insufficient material resources. However, reports by [10] and [19] indicate that many teachers are lacking the necessary competence to improvise teaching aids, leading to the use of teaching aids that do not provide concrete presentation of the reality.

Another factor that seems to influence the use of instructional aids is the value placed on them by teachers [17, 19]. This is the case with the teachers in the study by [10] who claimed that they chose not to use teaching aids for doing so could slow them from covering their syllabuses. Others, such as those in the study by [11], suggest that instructional aids cause classroom management issues. According to the study by [10] and [17], teachers experienced difficulties to promote academic achievement because of the lack of models, wall charts, and other traditional media to supplement the usage of chalkboards. Therefore, being able to select acceptable instructional aids and follow proper methodological principles when using them is critical. If found necessary to employ instructional aids, then the use of realistic materials is most recommended.

2.2. FACTORS INFLUENCING IMPACTS OF TEACHING AIDS

One of the most typical features of teaching aids is their illustrative role. Visibility, engagement, accessibility, and usefulness are, therefore, among the factors for selecting instructional aids [3, 23]. Scholars [e.g., 24, 25] agree that for an instructional material to be effective, it must be able to stimulate more of the learner's senses. Many resources can be used to accomplish this goal, and they include models, graphs, charts, illustrations, photos, maps, cartoons, slides, and electronic media such as animations [3, 10, 12]. This is not, however, a call for teachers to use many teaching aids during a single lesson session as this practice may cause students to become distracted [13]. Researchers such as [13], [14], [15], and [16] warn us that humans can only process a limited amount of information a time. Thus, teaching aids that simultaneously overload learners with multiple information is not recommended.

Another issue worthy considering is the degree to which a teaching material accurately represents reality, that is, realism. The influence of realism has been a prominent topic of study in the field of education for decades, and it has resurfaced owing to contemporary concerns about the design of virtual reality in educational settings. Despite the fact that realistic details of a teaching aid have beneficial effects, such as helping learners to retrieve information, studies [e.g., 23, 24] reveal that teachers often tend to develop and use materials that do not provide accurate representation of the reality, leading to misconceptions among students.

3. METHODOLOGY

This study was purely descriptive. The observation method, specifically the direct observation, and reviews of lesson planning documents were the only data collection techniques. Observations helped the researcher to study the behaviour of teachers as they occurred in their natural settings without introducing any influence on both people investigated and their context. The lesson plan reviews helped to check the range of instructional aids the teachers employed during the two-month period of their teaching practice placement. The researcher did not opt to use other data collection methods because they often introduce artificiality into the research environment. During the

observation, the researcher was guided by the observation schedule with a list of guiding questions, a checklist of teaching aids employed, and a diagram to picture patterns of teachers' movements and their interactions with students during the presentation. Additionally, the researcher took rich verbatim notes related to teachers' verbal statements in dealing with the teaching aids and the length of time students interacted with them.

Researchers agree that the efficiency of teaching aids depends on, among others, the quality of raining the teachers attended. The teaching practice, therefore, provides student-teachers with the best opportunity to practice both art and science of teaching before entering the real world of teaching [25]. Likewise, the teaching practice placements provided the best opportunity for the researcher to test the soup he cooked, that is, to examine the degree to which the student-teachers mastered the training. This study involved 25 finalist University student-teachers from Sokoine University of Agriculture in Tanzania, all of which were the researchers' students of science pedagogy course. The researcher collected the data during the last two weeks of their teaching practice in October 2021. To observe research ethics, the researcher obtained the consent from each of the study participants but after informing them the goal of this study.

4. FINDINGS AND DISCUSSION

4.1. TYPE AND RELEVANCE OF TEACHING AIDS EMPLOYED

The researcher checked whether all, or not, of the 25 Finalist university teacher-education students employed the instructional aids (visual, audio, and audio-visual) recommended by the Tanzanian secondary school curriculum. The researcher did it using the checklist he previously prepared. As Figure 1 depicts, the participant teachers employed mainly five types of teaching Aids in teaching. These included illustrations or sketches, photographs, real things from the nature, and electronic audio-visuals.

As figure 1 depicts, the use of real things, however, was remarkably occasional, and was observed from only three student-teachers. Teachers predominantly use illustrations they drew on manila sheets despite the fact that real materials to reinforce their lessons were readily available in the surroundings. For example, two of the 25 student-teachers used illustrations as their teaching aids when teaching about taxonomy of insects and the reproductive parts of angiosperms (i.e., sections of the flower). From a didactic standpoint, it is recommended that teacher's lecture be accompanied with at least one visual aid. While the use of photographs and sketches is permitted, teachers and students might find it challenging to meet their lesson objectives. Given the advances in technology, it was alarming to find out that the teachers rarely employed modern electronic resources to demonstrate science concepts, organisms, or processes, all of which could be easily accessed through the internet. On these grounds, it is reasonable to conclude that some of the stated goals were not met.

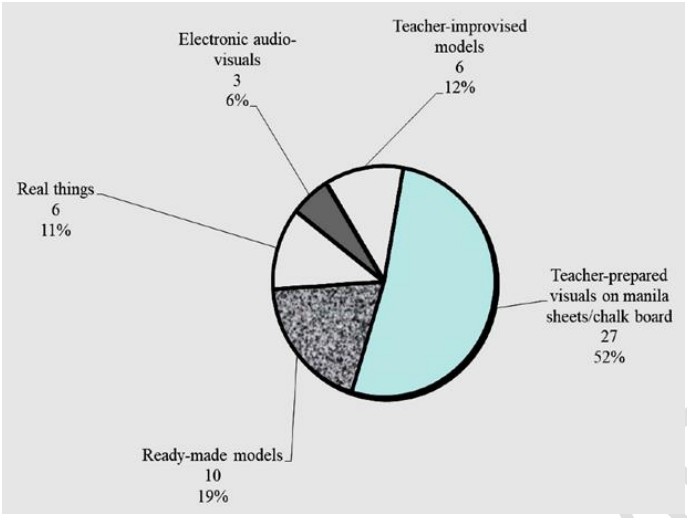

Figure 1. *Type of teaching aids employed*

4.2. QUALITY AND RELEVANCE OF THE TEACHING AIDS

The quality of teaching aids is gauged by looking its validity, determined by the didactic, construct, and technical aspects [15]. Table 1 provides a summary of validity-related issues revealed while Figure 2 exemplifies construct and technical aspects of the teaching aids. As stated previously, a few student teachers used real things to demonstrate various science concepts and processes. As illustrated on Figure 2-A, one teacher, for example, demonstrated simple distillation processes using local materials. Most likely, students' understanding and grasping of the lesson was maximized because of this realism. Most of the student teachers used illustrations (drawn on manila papers or on the chalkboard) as teaching aids. There was a problem, however, with the construction and technical components of the illustrations they used. Most of the visualisations they used (see Figure 2-C) had unnecessary labelling, a practice not recommended. Presenting nonessential information, according to Mayer and Johnson (2008) is a construct problem that backfires the learning process. If the instructional aid includes such information, learners divide their cognitive processes to concurrently manage both the nonessential and central information. When teaching aids such as these are employed, for example, the students engage in three tasks: reading such rich texts on the teaching aids, observing the teaching aid itself, and listening to the teachers' description of the teaching aid. Simply put, the redundant information creates unnecessary cognitive load on learners as it interferes with their processing of the critical information [13]. That is to say, if the sketches had not been accompanied by such length-described labels, students may focus entirely on the diagram, optimising their information processing. Teachers are, therefore, advised to label their instructional materials with only essential information. If such level of detail is required, [14] and [15] recommend that teachers 'signal' essential information (e.g., by colour-coding, blurring or highlighting).

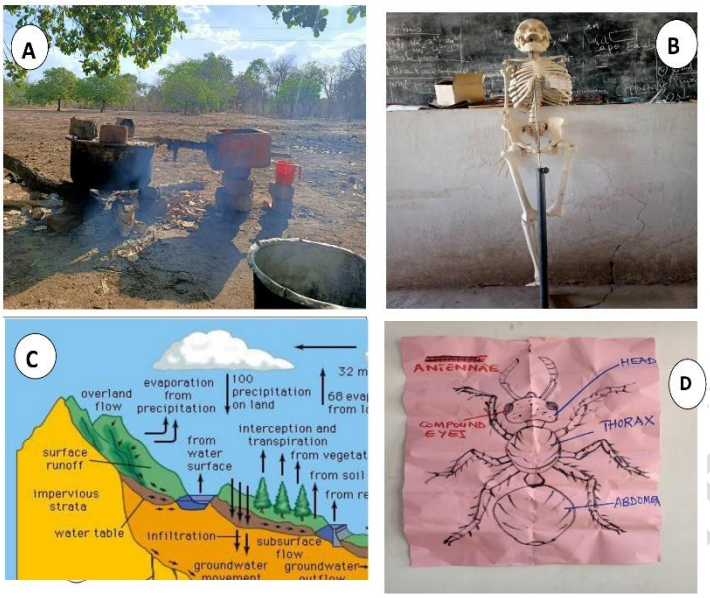

Figure 2. **Quality and relevance of teaching aids**

The quality of the illustrations, sketches, and photos was a worth mentioning concern. When planning to use pictures and sketches to facilitate the delivery of a particular lesson, it is advised to sketch realistic, and therefore, "perceptually rich" visualisations [23], which is referred to by [14] as mechanical validity. "Realism according to [12] refers to the degree to which a visual representation truly reflects the reality. As Figure 1 illustrates, there were 27 (51%) instances of teachers using pictures, charts, and sketches they drew on the manila sheets or on the chalkboards. Most of these visuals, however, were not professionally prepared. Some, for example, were poorly coloured, lacking faithful depictions of the reality. Figure 2-D exemplifies such visualisations. Given that not all teachers have the drawing skill, the most recommended option is to capture the original-coloured photographs using advanced cameras. Such real photographs convey accurate information, allowing the students to not only process it easily, but also construct mental images that are a true reflection of the reality [23]. For the drawing-skilled teachers, providing appropriate colour-cues to foster students' mental operations is indispensable [24]. It should be overemphasised, however, that using realistic instructional visualisations does not automatically guarantee better performance, as it may happen when the teaching aid bombards learners with information that is irrelevant to their specific learning goal and needs. Children, according to [3], do not often create mental representations of minute details that a visual representation may have. Possibly, this is why the student-teachers eschewed higher level of realism when constructing their teaching aids. Another issue could be that student-teachers were not aware of the repercussions of the lack of substance in their teaching aids.

Another issue identified during the research was the size and condition of teaching aids. Most of the student-teachers appeared to use materials that were too small that pupils at the rear of the classroom struggled to see them. That is to say, the finalist student-teachers did not consider the class-size factor when selecting and deploying the instructional aids. Findings such as these are also reported by [10] and [4]. Furthermore, certain teaching aids, particularly the ready-made models, were in extremely poor condition. As Figure 2-B typifies, some instructional models lacked important parts, leading to the presentation of incomplete information. During this study, the teachers had to describe verbally the features and roles of

the missing parts, and this made some parts of their lessons to be somewhat abstract. As a result, students found it difficult to comprehend the information intended by the teachers. It is unprofessional to teach using such resources [13].

Table 1. *Quality and relevance of teaching aids*

Quality and relevance issue	The frequency observed
Illustration has less important information	13
Use of smaller visualisations	9
Overdependence on ready-made teaching aids	10
Lack of students' participation in preparing teaching aids	23
Use of damaged, incomplete, non-functional materials	5

The disengagement of learners in the preparation and unpacking of instructional aids was also revealed. Even when teachers taught lessons about things that were within the surroundings, they did not engage students in the collection of relevant learning materials. The possible drawback of this practice is that students may not process the information in the instructional aids deeply [14]. Importantly, [3] is of the opinion that teacher-provided real materials or visualisations such as sketches and charts run the risk of causing students overestimating their level of comprehension for the provided images oftentimes elicit feelings of familiarity. The students' conception of science is better improved when they are engaged in the generation of visual representations of the reality [14] or in the collection of real things from the environment for their learning. Thus, to get the most out of the teaching resources, involving students in activities such as (i) creating illustration during the lesson and (ii) collecting relevant resources (e.g., flowers, organisms, and different types of sand) from the environment and bringing them into the classroom for the lesson is recommended. Allowing students to participate in activities such as these encourages them to assume ownership of the lesson. In comparison to pupils who solely study teacher-provided resources as observed during the data collection process, students who participate in such activities improve self-regulated learning skills. It is worth noting, however, that drawing is time consuming and cognitively demanding, and that proper teachers' guidance is vital to prevent students from developing inaccurate illustrations [14].

4.3. STRENGTH AND WEAKNESS IN UNPACKING TEACHING AIDS

The researcher observed several issues regarding the use of teaching aids among the participant university student-teachers during their final teaching-practice placement. One of the problems was the unprofessional demonstration of the teaching aids, and this transpired in three ways: (i) demonstrating while standing in front of the classroom; (ii) employing the teaching aids at a fast pace; and, (iii) the timing issue. Findings such as these are also reported by [17] and [25].

Figure 3 summarises the main teachers' positions within the classrooms during the presentation of teaching aids. Nearly every teacher observed spent a significant amount of time in front of the classroom presenting teaching aids. In comparison to students who occupied the front seats, those at the real of the classroom had little opportunity to investigate the instructional aids more closely. As a result of this practice, many students lacked the opportunity to interact with the instructional aids, and therefore, lessons became more teacher centred. To solve this problem, student-teachers had to prepare many teaching aids and distribute them throughout their classrooms so that students may study in groups as suggested by [15] and [18] or walk around the classroom displaying and describing the materials.

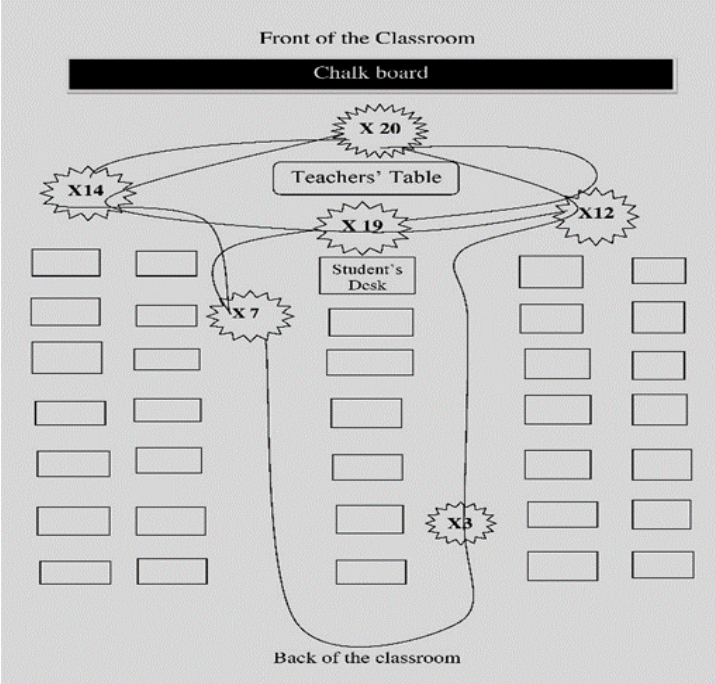

Figure 3. Teachers' main positions while presenting teaching aids

Stars indicate teachers' locations while displaying teaching aids and numbers they in-house indicate the frequency at which they moved to each location. Lines connecting starts shows the teachers' pathways during the presentation.

The pace of presentation of teaching aids was another worth noting issue. The reviewed literature [20, 21, 22] informed us about a positive correlation between good pacing and high levels of student engagement. Rushing through the stages of the lesson may cause learners to get disengaged, resulting in students missing critical details [14, 21]. Teachers are advised to consider the momentum of the lesson and how fast they deliver different sections of the lesson. While a sluggish pace of presentation of teaching aids bores and disengages pupils, a quick one prevents students from grasping what is being taught. The true science of pacing lies in creating a sense of urgency while simultaneously ensuring that students are not left behind [14, 20, 21]. As they tended to spend relatively little time displaying instructional aids and offering succinct descriptions for the students, most of the finalist student-teachers observed had likely little understanding of this principle. The transition from displaying to describing information presented in the instructional aids among the finalist student-teachers observed was rapid, such that students on some occasions were lost wandering about. Researchers such as [22] present a nice example of the benefits accrued through lesson-pace management. These investigated children who used a multimedia model to explore the structure of an eye. Their findings inform us that the experimental group outperformed the control group on a subsequent post-test. Findings such as these are a reminder to teachers that rushing teaching aids demonstrations is not a smart practice. Allowing a few minutes of think time for the learners to reflect and practice a concept before proceeding with the presentation is one technique to ensure adequate lesson momentum.

As previously stated, the researcher noticed that "timing" of the presentation of the teaching aid was another critical issue. It is widely agreed that teaching aids should exactly reflect the course objectives and their role is to illustrate or reinforce complex concepts that could otherwise be taught very abstractly. For this reason, the timely display of the teaching aid is

mandatory. Some of the teachers in this study exhibited the lack of this competence and as Table 2 indicates, this problem was recorded 9 times. Even before they began presenting their lessons, many of them hung illustrations on the front wall of the classroom. This concern was also detected when the teachers brought into their classrooms ready-made models such as those shown on Figure 2 to facilitate their lessons. The students' attention is divided when they see, hear, smell, and or touch the teaching aids outside of the teacher's planned time. The poor teaching planning appeared to be the reason for the teachers' failure to display the teaching in a timely manner. The stage of the lesson at which the teaching aids were to be employed was not indicated in many of the finalist student-teachers' lesson plans.

5. CONCLUSION, RECOMMENDATIONS, AND LIMITATIONS

The teaching aids bring novelty to the teaching activity by breaking verbosity, stimulating learners' interests and attentions, and allowing them to understand the causal-relationship between theory and the reality. The ability of the finalist university teacher-education students to deal with teaching aids was examined in the actual classroom setting to gauge their mastery of the Educational Media and Technology course they attended during their training. Based on the findings, the finalist university student-teachers' ability to select, design, and professionally unpack teaching aids was limited as most of the materials they employed had didactic, structural, and technical concerns. Thus, the attainment of their lesson objectives was questionable.

Many factors possibly contributed to these mistakes. One of these could be the student-teachers' lack of adequate pedagogical preparation. Several techniques to improve the effectiveness of teaching aids and other instructional materials have been recommended by researchers working on cognitive theories of multimedia learning. University teacher-education instructors should consider such guidelines when teaching student-teachers concerning instructional materials. Though the study's participants were Finalist University student-teachers, the findings could be similar if in-service instructors were included. Thus, there is a need to organise professional development opportunities for all science teachers in Tanzania.

These findings were obtained after investigating only 15 finalist university student-teachers of sciences studying at one university. Therefore, care must be taken in using them. It is advised that further research be conducted involving many finalist university student-teachers, including those from several universities for comparative purposes.

REFERENCES

1. Chaudian SS. Innovation in Teaching Learning Process, Visnas Publishing Pvt. Limited, Amsoni road, India. 2009.

2. Marzano RJ. The Art and Science of Teaching: A Comprehensive Framework for Effective Instruction. Alexandria, MA: Association for Supervision & Curriculum Development. 2007.

3. Wiley J. Picture this! Effects of photographs, diagrams, animations, and sketching on learning and beliefs about learning from a geoscience text. Applied Cognitive Psychology. 2019; 33, 9–19.

4. Mkonyi SJ. The contribution of teaching aids (counting objects) in numeracy skills performance for standard two pupils: a case of Kiteto district. Doctoral dissertation, The University of Dodoma, Tanzania. 2017.

5. Višnić T, Bibić LI, Vučković SĐ, Ivkov-Džigurski A, Kotnik EK. The evaluation of the role of teaching aids in stimulating pupils' activation in Geography. Journal of the Geographical Institute "Jovan Cvijić" SASA. 2017; 67(2), 179-194.

6. Ainsworth S, Scheiter, K. Learning by drawing visual representations: Potential, purposes, and practical implications. Current Directions in Psychological Science. 2021; 30(1), 61–67. https://doi.org/10.1177/0963721420979582.

7. Guo D, McTigue EM, Matthews SD, Zimmer W. The impact of visual displays on learning across the disciplines: A systematic review. Educational Psychology Review. 2020; 32(3), 627–656. https://doi.org/10.1007/s10648-020-09523-3

8. Geiger V, Goos M, Dole S. The role of digital technologies in numeracy teaching and learning. International Journal of Science and Mathematics Education. 2015; 13(5), 1115-1137.

9. Okoye CN, Nwobodo R, Donatus F, Osuji GE. Impact of the use of teaching aids on secondary school students' achievement and retention in business studies in awka education zone of Anambra State, Nigeria. Advance journal of education and social sciences. 2019; 4(11), 1-7.

10. Kija B, Msangya BW. The Role of Teaching and Learning Aids in Learning Science Subjects: A Case Study of Morogoro Municipality. Tanzania. International Journal of Novel Research in Education and Learning. 2019; 6(1), 65-69).

11. Ahmad AS, Garba S. Instructional Resources in Teaching Basic Science Subjects in Secondary Schools. Kaduna journal of educational studies. 2021; 1(20): 83-93.

12. Dwyer FM. The relative effectiveness of varied visual illustrations in complementing programed instruction. The Journal of Experimental Education. 1967; 36, 34–42.

13. Mayer RE, Johnson CI. Revising the redundancy principle in multimedia learning. Journal of Educational Psychology. 2008; 100(2), 380–386. https://doi.org/10.1037/0022-0663.100.2.380

14. Castro-Alonso JC, de Koning BB, Fiorella L, Paas F. Five Strategies for Optimising Instructional Materials: Instructor-and Learner-Managed Cognitive Load. Educational Psychology Review. 2021; 1-29.

15. Patron, E., Linder, C., & Wikman, S. (2021). Qualitatively different ways of unpacking visual representations when teaching intermolecular forces in upper secondary school. Science Education. 2021; 105 (): 1173 – 2101.

16. Akhmetshin EM, Ibatullin RR, Gapsalamov AR, Vasilev VL, Bakhvalov SY, "Audiovisual aids application in the secondary-level vocational education establishments: Efficiency analysis and assessment", International Journal of Educational Management. 2019; 33 (2): 374-392. https://doi.org/10.1108/IJEM-02-2018-0082.

17. Ehirim, AI, Paschal I, Blessing EO. "Availability and utilization of instructional materials in the teaching and learning of chemistry in secondary schools in a council area of Imo State, Nigeria." Asian Journal of Education and Social Studies. 2020; 9(3), 26-38.

18. Bukoye RO. Utilization of Instruction Materials as Tools for Effective Academic Performance of Students: Implications for Counselling. In Multidisciplinary Digital Publishing Institute Proceedings. 2019; 2(21):1395.

19. Okori OA, Jerry O. Improvisation and utilization of resources in the teaching and learning of science and mathematics in secondary schools in Cross River state. Global Journal of Educational Research. 2017; 16(1):21-8.

20. Lignugaris/Kraft B, Rousseau MK. Instructional pacing: Definition and research needs. Journal of Special Education Technology. 1982; 5(3), 5-10.

21. Alber R. Instructional Pacing: How Do Your Lessons Flow? [Blog post]. 2012. Edutopia. Accessed on 29 November 2021 from https://www.edutopia.org/profile/rebecca-alber

22. Stiller KD, Freitag A, Zinnbauer P, Freitag C. How pacing of multimedia instructions can influence modality effects: A case of superiority of visual texts. Australasian Journal of Educational Technology. 2009; 25(2), 184–203. https://doi.org/10.14742/ajet.1149

23. Skulmowski A, Nebel S, Remmele M, Rey GD. Is a Preference for Realism Really Naive After All? A Cognitive Model of Learning with Realistic Visualisations. Educational Psychology Review. 2021; 1-27.

24. Skulmowski A, Rey GD. Realistic details in visualisations require colour cues to foster retention. Computers & Education. 2018; 122, 23–31.

25. Unamba EC, John DA, Nwaneri O M. Assessment of pre-service teachers' skills of improvisation and management of instructional materials for effective mathematics instruction during teaching practice. International Journal of Advanced Academic Research. 2020; 6(9), 24-35.