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An examination of manifestation of Bloom's taxonomy in biology school-based assessment in selected school

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ABSTRACT

This study investigates the utilization of Bloom's Taxonomy in school-based biology assessment tasks in selected secondary schools in the Meru district of Tanzania. Despite the emphasis on Bloom's Taxonomy in teaching and assessment, examination results in biology have been consistently underwhelming. The study aims to examine the manifestation of Bloom's Taxonomy in the cognitive, affective, and psychomotor domains within school-based biology assessments. Qualitative research methods were employed to gather data, including interviews, observations, and document analysis. Findings reveal that while some teachers demonstrate an understanding of Bloom's Taxonomy and its application in assessment, others lack clarity on its principles. Teachers acknowledge the importance of progressing from lower to higher cognitive complexity levels in teaching and assessment. However, observations indicate a tendency to assign assessment tasks predominantly at lower cognitive levels, neglecting higher-order thinking skills. Similarly, the affective and psychomotor domains are addressed to varying degrees. Teachers incorporate aspects of the affective domain by observing student attitudes, behaviors, and values, although this aspect is often less structured. The psychomotor domain is assessed through practical activities and demonstrations, with some teachers effectively integrating it into assessment tasks. Recommendations include curriculum review to ensure alignment between syllabi and teaching materials, increased budget allocation for biology resources, and addressing teacher workload through recruitment initiatives. These measures aim to enhance the quality of biology education and improve student assessment performance. Overall, this study highlights the need for greater alignment between teaching practices, assessment methods, and educational objectives.

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INTRODUCTION

Bloom's Taxonomy (BT) stands as a foundational framework for evaluating students' cognitive abilities, essential for enhancing teaching and learning outcomes. Developed by Benjamin Bloom and colleagues in 1956, this taxonomy categorizes cognitive processes into six levels: knowledge, understanding, application, analysis, synthesis, and evaluation (Akinboboye & Ayanwale, 2021). Its inception aimed to refine curriculum discussions and communication of course objectives among educators and students (Sagala & Adriani, 2019). However, contemporary education standards demand a comprehensive approach beyond cognitive domains, integrating emotional and psychomotor skills into teaching and assessment practices (Nascimento, et al., 2021).

In a cumulative hierarchy, categories should not overlap. Akinboboye & Ayanwale (2021) state that cumulative hierarchy demands mastering a more sophisticated type that needs knowledge of all the more straightforward kinds below it, a strict norm. Avsec & Ferk Savec (2022) found inversions of goals and duties. Knowledge needs are more complicated than Analysis or Evaluation. Synthesis necessitates Evaluation simplifying Evaluation. Most critics of the taxonomy argue that cognition and emotion are neurologically and phenomenological diffused processes that may take various forms.

Statement of the problem

Bloom's taxonomic domain is a skill that all teachers should use in school-based assessment tasks. This is meaningful when teachers use cognitive, affective, and psychomotor skills in assessment tasks designed by teachers during assessment (Ramlawati et al., 2020). Unsworth & Posner (2022) argued that when using BT in school-based assessment tasks, such as oral questions during instruction and homework, the mid-term test helps to improve learners' performance. The school-based assessment shapes teaching and learning processes (Nascimento, et al., 2021).

Assessment reform theorists assert that teachers can improve the achievement levels of students by implementing sound, consistent, and reliable assessment practices (Ramlawati et al., 2020). Unfortunately, there has been a disconnection between the method used by different measurement specialists and the day-to-day classroom assessments and grading practices. For example, researchers have shown that teachers' classroom assessments sometimes lack meaning because they are not always based on information indicative of achievement. Many teachers' classroom assessments are unreliable, inconsistent, and often based on non-achievement factors (Avsec & Ferk Savec, 2022).

In Tanzania, performance in biology subjects has become a history. In the Meru district, it has been customary for the learner to perform exceptionally well on classroom-based assessment tasks in biology while having poor national examination results. Therefore, the study examines the utilization of Bloom's Taxonomy in school-based biology assessment tasks in selected secondary schools in the Meru district.

Main objective

To examine the extent to which the taxonomic domain of Bloom manifested of Bloom's in biology school-based assessment in selected school.

Specific objective

1. To identify how the psychomotor domain manifested in school-based assessment.
2. To identify how the cognitive domain manifested in school-based assessment.
3. To identify how the manifestation of the affective domain in school-based assessment.

RESEARCH METHODOLOGY

The study utilizes a qualitative approach, which allows researchers to gain insights into complex phenomena by exploring participants' perspectives and experiences in depth. Qualitative research is well-suited for understanding the complexities of educational practices and processes(Nowell et al., 2017). Using the qualitative method, the researchers conducted interviews with teachers to gather their perspectives, experiences, and practices related to Bloom's Taxonomy and its manifestation in school-based biology assessment tasks.

Classroom observations were conducted to directly observe how teachers implement Bloom's Taxonomy in their teaching practices and how students engage with assessment tasks.

Also, the researchers analyzed documents such as curriculum documents, syllabi, textbooks, and any other relevant materials to understand how Bloom's Taxonomy is integrated into educational policies and materials.

FINDINGS

The extent to which the taxonomic domain of Bloom manifested of Bloom's in biology school-based assessment in selected school.

How psychomotor domain manifested in school-based assessment

The psychomotor domain can be used in the school-based assessment to evaluate students' psychomotor skills, which refer to their ability to use their bodies to perform different tasks or solve problems (Nascimento, et al., 2021). This domain includes skills related to physical coordination, agility, balance, and speed. Educators can use methods, such as direct observation, performance tests, or portfolios, to assess the psychomotor domain. By incorporating the psychomotor domain in assessments, educators can gain a more holistic understanding of a student's strengths, weaknesses, and potential, which can help tailor learning experiences that align with their unique learning needs (Unsworth & Posner 2022). The researcher asked the respondents if they applied psychomotor Bloom's Taxonomy**.** Is there any topic in biology lessons where the student can demonstrate skills? The responses were;

Teacher A in school Y said,

> *The student should take action. I can tell the student to go to the board and explain or demonstrate on the board (biology teacher interview on 17th October 2022).*

Teachers B and C in schools W and X said;

> *I observe students' fine motor skills and coordination while performing active ties such as microscopy or preparing laboratory samples. And sometimes through Peer evaluations and students' collaborative ability during lab activities (biology teacher interview on 18th October 2022).*

The interview findings matched the results from classroom observation that the teachers asked the students to demonstrate. Among the questions given were;

Draw the following cycles and explain their significance;

a. Water cycle
b. Nitrogen cycle

The representatives were able to draw water and nitrogen cycle. Also, four students demonstrated their skills in school while experimenting on food tests.

Figure 1: A picture showing the biology practical on food test

The above data is pinpointed with the studies (Saido et al., 2018), who emphasize that when assessing students reflects Bloom's taxonomy, students are evaluated from all levels, from low to high, hence improving innovation in the science discipline. The cognitive domain is hierarchized into six classes: remembering, understanding, and applying. Analyzing, evaluating, and creating these levels are arranged from simplest to complex (Barari et al., 2022; Hadzhikoleva et al., 2019). However, the literature depicted that when the school-based assessment tasks are based on low levels of BT without considering synthesis and evaluation levels of cognitive domain deteriorate, creativity in science among students (Saido et al., 2018).

According to Endo (2019), Bloom's Taxonomy goes hand in hand with assessment tasks, and biology teachers need to use all levels of Bloom's Taxonomy in each category to ensure students demonstrate the skills required to be acquired per the implemented curriculum. The literature shows that when biology teachers utilize Bloom's Taxonomy well, it enhances learners' performance. The study shows that learners remember more when they have learned to hold the subject matter at the higher levels of the BT (Huitt, 2011). Nevertheless, when they are not well utilized in biology classroom assessment tasks, it affects the performance and skills of learners as students will not be able to acquire high cognition ability (Insani et al., 2019). Thus, the students must grasp high cognitive BT to attain greater-order thinking.

This part is guided by research question 2: How Bloom's Taxonomic Levels are utilized in biology classroom assessment practices. The findings from the interview, classroom observation, and document analysis on responding Indicate that many biology teachers assign students questions at lower levels than higher levels. Overall, incorporating the psychomotor domain in biology assessments can help students develop the necessary skills and competencies to succeed in the field of science.

How cognitive domain manifested in school-based assessment

The cognitive domain is associated with Benjamin Bloom's categorization of cognitive abilities; Knowledge, understanding, application, analysis, synthesis, and evaluation are the six cognitive stages of complexity (Sobral, 2021).

Teacher D in school X said,

> *The student must understand the concept as we move from simple to complex levels. (Biology head of department interview on 17 October 2022).*

Putri (2019) pointed out this point, emphasizing that teachers and students benefit from an awareness of the cognitive domain's skill hierarchy. This helps both parties recognize the importance of developing foundational competencies before moving on to more advanced concepts in a given field. Lower-level process skills should be introduced in introductory courses and further developed in intermediate courses (Sagala & Adriani, 2019).

Teacher D in school X again said

> *The syllabus itself is linked to Bloom's taxonomy; in the syllabus, I find the specific objectives, but also, in the general goal, there is the cognitive domain, the knowledge between low-level to a higher level (biology head of department interview on 19th October 2022).*

The literature shows that teachers implement Bloom's taxonomy, which is set in the curriculum; therefore, if the curriculum is mainly developed in low levels of BT, the assessment tasks will also be based on low levels of BT. A comparative study of Turkey, Singapore, Hong Kong, and Canada on the revised Bloom's taxonomy revealed that Canada and Singapore apply the curriculum at higher instructional objectives (Koc & Ontas, 2020). The curriculum in the utilization of BT helps the instructors to plan better, in addition to assisting in the appropriate choice of strategies (Sobral, 2021). Nonetheless, when biology teachers do not prepare the lesson before the classroom, it affects students' skills acquisition.

Teacher A from school U said,

> *I use the scheme of work I developed from the syllabus where specific objectives are arranged from low level of knowledge to higher level, and I must write them down in the lesson plan. For example, the topic of gaseous exchange now I teach 40 minutes. I will write during the session, and students will be able to explain the features of the gaseous exchange. From that sentence, I think it measures my understanding of how I feel. (biology head of department interview on 18 October 2022).*

Teacher B in school Z said,

> *I usually provide room for discovering students' level of understanding by allowing them to demonstrate what we learn in theory.*
>
> *Usually, the syllabus is the guideline for all curriculum instructions, and it reflects Bloom's cognitive domain because the knowledge is arranged from row level to higher level. These help me in teaching as well as helping my students to understand the concepts from a low level to a higher level (biology head of department interview on 22 October 2022).*

This point has been concurred by Putri, (2019), who emphasizes that an effective curriculum provides a quantifiable plan and framework for providing high-quality learning to learners. The curricula specify the instructional objectives, criteria, and essential competencies students must achieve before progressing to the next level. The instruction materials provide Bloom's Taxonomy actions that encompass the skills a learner should master after the topic completion. Learning outcomes are critical components of every school curriculum and must be unambiguous, observable, and quantifiable (Meda & Swart, 2018).

The involved ranks and sub-domains in the cognitive domain, such as knowledge, aim at enabling the learners to recall the information but also understand, which assists the student in getting a clear image of the discussed matter in their way. Furthermore, the application is vital as a learner can move from the paperwork to the real-life example with the same acquired knowledge (Nascimento, et al., 2021).

Teacher C in school U

> *I manifest the cognitive domain by providing low-level questions and higher-level questions. Low-level questions focus on the recall of universal concepts and processes. In contrast, higher-level questions require the student to develop more profound analytical skills (biology head of department interview on 19 October 2022).*

Also, the observation researcher observed that the three schools were low. The classwork given to students on classroom observation in School Z on Introduction to Biology, school Y on Balance of Nature, and School U on Balance of Nature demonstrated that teachers offer students classwork that is in low order. Most questions were about remembering and understanding, in contrast to Schools Z and Y. School U, where the biology teacher assigned practical questions of high levels to the students. Therefore, the ratio of one school to provide a high level of Bloom's Taxonomy class work to three schools showed that most teachers assign common questions.

The findings from the three schools all were at low levels. The class work given to students on classroom observation in School One on Introduction to Biology, School Two on Balance of Nature, and School Three on Balance of Nature demonstrated that teachers offer students class work that is in low order. Most questions were about remembering and understanding. In contrast to Schools 1, 2 and 3. School 4, where the biology teacher assigned students practical questions of high levels. Therefore, the ratio of one school to provide a high level of Bloom's Taxonomy class work to three schools showed that most teachers assign common questions.

Thus, this implies that biology teachers do not assign questions that need higher levels of cognitive. The findings from this study revealed that most biology teachers use low levels of Bloom's Taxonomy while assessing their students. Therefore, the response to subsidiary question two showed that most of the school-based assessment tasks provided in the classroom are in low levels of BT. In addition, there is a limitation of school-based assessment tasks assigned as homework. As a result, it affects the acquisition of demonstration skills by applying higher-order BT among

students. Nascimento, et al., (2021) insisted that, in determining how much a student has learned, tests should concentrate on key curriculum elements to observe critically BT covered per instructional objectives**.**

Teacher A in school Y

> *In my class, other specific objective cognitive domains manifested by allowing students to devise approaches to design experimentations and test hypotheses. In most cases, I ask them to compose a paper and a report in which thoughts are synthesized (biology head of department interview on 17 October 2022).*

Correspondingly, the study conducted by Sagala & Adriani (2019) added that the first two components, fundamental knowledge and secondary comprehension, do not necessitate critical thinking abilities. Still, the latter four-application, analysis, synthesis, and evaluation necessitate critical-thinking skills. On the other hand, the study found that teachers encountered the challenge of generating specification tables and classifying and arranging items according to Bloom's taxonomy of instructional purposes for test creation (Jalos et al., 2019).

The study done by Gichuhi (2014) in Kenya on teachers' competence in student assessment within Bloom's taxonomy for practical learning assessment indicated that secondary school teachers do not sufficiently use Bloom's cognitive level objectives when creating assessment tasks. Gichuhi's study further contended that teachers set low order of Bloom's Taxonomy in test construction supported by Akinboboye & Ayanwale (2021) in their research investigating Bloom taxonomy usage and psychometric analysis of classroom teachers made a test in Nigeria. It was noted that around 80% of the teachers who scored mathematics topics that addressed remembering and understanding were harmed while applying, analyzing, evaluating, and creating were overlooked.

The manifestation of the affective domain in school-based assessment

The affective domain refers to the emotional and psychological factors influencing learning and behavior, such as attitudes, values, beliefs, and motivation. Assessing the affective domain in the classroom can be a valuable tool for teachers to gain insight into their student's learning experiences and help them adjust their teaching strategies accordingly. The affective domain can be assessed through surveys or questionnaires asking students to reflect on their attitudes and feelings about a particular subject or topic (Meda & Swart, 2018). Stages in this domain are not as sequential as the cognitive domain but have been described as the following: Receiving, Responding, Valuing, Organizing, and Characterization.

How do you manifest affective domain in school-based assessment? The response was

Teacher B in school Z said,

> *Affective: I don't know the effectiveness. I only know how to assess the student (biology head of department interview on 17 October 2022).*

Teacher A in school Y said,

> *I observe the practical domain by watching how learners respond to my oral questions in the classroom using surveys or questionnaires that ask students to reflect on their attitudes and feelings related to a particular topic. (biology head of department interview on 18 October 2022).*

Teacher C in school U said,

> *For some specific objectives, I observe the affective domain by arranging students in the group, celebrating their facial explanations, and observing how they work together to master the skill. I also keep their behavior and interactions during class activities, such as group work or classroom discussions. (biology head of department interview on 20 October 2022).*

Teacher D in school X said,

> *I usually assess the practical domain by observing student attention and interest in doing practicals. (biology head of department interview on 22 October 2022).*

Meda & Swart, (2018) argued that learning biology necessitates active engagement and group participation in observation. The findings need participants who are good at observing what they receive during teaching and learning. At the response level, this is followed during the conversation when teaching and learning. This is demonstrated well through group discussions and presentations. The story of valuing enables learners to link with the importance. In the learning environment, it is undertaken when learners want to improve skills; usually, the verbs contribute, suggest, or react. In organizing, which is the final stage, learners earn the ability to air out their views consistently. This level enables the learners with values to guide their behaviors, mostly in defending, negotiating, influencing, volunteering, and committing. Overall, assessing the affective domain can help teachers better understand their students' needs and provide a more personalized and practical learning experience.

DISCUSSION

Now that the teachers understand Bloom's Taxonomy together with a clear understanding of how it manifested, the study wanted to know how the teachers use Bloom's taxonomy domain in school-based assessment.

Study reveals some teachers do not understand what Bloom's taxonomy domain entails, and those who understand and demonstrate Bloom's taxonomy domain cognitively realize the student's interest, providing room for student demonstration and shaping the level of instruction knowledge from a low-level to a high level. Also, they reveal the cognitive domain, even in the syllabus, the way it is arranged from the low level to the higher level, which reflects school-based assessment; the study shows that teachers implement Bloom's taxonomy, which is set in the curriculum. The findings from the interview, classroom observation, and document analysis on responding Indicate that many biology teachers assign students questions at lower levels than higher levels.

RECOMMENDATION FOR ACTION

Through the Ministry of Education and Vocational Training, the government reviews the curriculum as early as possible since there seems to be a contradiction between the reference books and the syllabus, which guides the teacher and learners. The syllabus has yet to be reviewed, while the textbooks have already been reviewed and put into the circle for use, hence a contradiction. Having done so, the load and the excuses to be raised by the teachers will have no space, and accountability will be enhanced.

The government and the education stakeholders should look for a means to adjust the budget since biology needs extra practice, which costs money. According to the findings from the study, the costs seem to be lowering the implementation of some of the work in teaching and learning biology. With the big load that the government has to provide to all the schools, I believe with the help of the stakeholders being summoned by the government, they will see the need and hence assist in providing tools such as models, textbooks, and valuable equipment to the laboratories.

Due to the significant workload that the teachers seem to have, which affects their efficiency at work, the government should look for a means to increase the number of teachers, especially on the science side where the deficit seems more significant, particularly in Biology. By doing so, the teachers will get enough space to prepare the lesson through the lesson plan, engage the learners, and ensure the best productivity.

CONCLUSION

Many have been observed in this study. The study's findings have shown what has always been missing in the learning environment, which might even be the image of most schools. Generally, suppose the study findings and the suggested recommendations will be upheld. In that case, the academic sector at large in Tanzania will be highly improved, and it will ensure the production of graduates with the skills to think, analyze, and create as the application of the knowledge obtained.

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