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The Interplay between Practical Activities and Students' Performance in Tropism, Case of Musanze District Secondary Schools

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Abstract: *This study examined the interplay between practical activities and students' performance in tropism, in Musanze district secondary schools, Rwanda. It identified a dominating teaching approach in teaching tropism and the impact of practical activities on students' performance in tropism. As a quantitative study, it used purposive and stratified sampling to recruit a population of 19 Biology teachers and 177 students. For the teaching approaches used in teaching and learning of tropism, chalk and talk has a mean score of 2.80 compared to other approaches. "Laboratory method" is sometimes used also as it has a mean score of 2.60. About the effect of the practical activities on the students' performance, the experimental group had significantly higher marks than the control group during the pre-test with a significant level of $p < 0.05$. Barriers that hinder the use of practical activities in teaching tropism include inadequate or lack of training/workshops in practical activities (SD: 1.069), lack of appropriate laboratory materials and equipment for tropism (SD: 1.759), and few hours provided by Rwandan curriculum in studying this lesson of tropism in advanced levels (1.457). The increase of the use of practical and laboratory activities in teaching biology, training or workshops of the teachers about practical activities, provision of the laboratory materials and equipment about tropism, and extension of the period time for teaching tropism on a curriculum will boost the understanding of the unit and performance of the students in biology.*

Keywords: *Tropism, Practical activities, Students performance, Secondary schools, Musanze district.*

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1. Introduction

Biology study in secondary school can provide students with useful concepts, principles, and theories to help them face challenges before and after school completion. Biology practical activities allow students to do science rather than just learn about it.

According to Nzewi (2008), practical activities can be viewed as a strategy that can be used to make a teacher's task (teaching) more real to students as opposed to abstract or theoretical presentation of facts, principles, and concepts of subject matter. Nzewi maintained that practical activities should engage students in hands-on, mind-on activities that make use of a variety of instructional materials/equipment to drive home the lesson. Teaching and learning through practical activities is one instructional strategy that

unquestionably aids in the transmission of knowledge and competence (Nzewi, 2008).

According to (Akinwumi, 2020), the use of practical activities (approach) to the teaching of biological concepts should be a rule rather than an option for biology teachers if we hope to produce students who can acquire the necessary knowledge, skills, and competence to meet the nation's scientific and technological demands. The search for a more effective approach to teaching and learning biology that will improve the development of intellectual skills and attitudes required to learn concepts has been ongoing for many years.

Plant tropisms play a fundamental role in shaping the growth form of plants, including in plant development, governing organ position, growth from the germination of a seed to the positioning of flowers for pollinators, and seed dispersal. Inquiry into plant tropistic responses is not new; Darwin studied them in the mid-1800s. Although his work has now been recognized as an important contribution to plant biology, it was resoundingly rejected by his peers as discussed by Whippo and Hangarter. Even though plant movement has fascinated school children, been the subject of books for the public and featured whimsically in TV commercials (Windex), the essence of the phenomenon and mechanisms that control plant movements are hardly understood by many students (Whippo & Hangarter, 2009).

Problems with understanding concepts and mechanisms connected with the movement of plants have been identified among biology students at the Faculty of Adam Mickiewicz University in Poznan, Poland for several years. Studies on alternative concepts in understanding these phenomena are still marginally treated in analyses available in the literature, which is why we embarked on this study. Movement, reaction to stimuli, and growth are some of the basic characteristics of living organisms that include both plants and animals. However, students tend to attribute these characteristics only to animals and perceive plants as organisms that are less alive. Thus, teachers should be able enhance students' knowledge of plants as being animate as well (Lin, 2004).

In Rwanda, research carried out by (Ndihokubwayo, 2017) on barriers to science laboratory activities in teacher training centers in revealed that most of schools do not have laboratories and teachers lack skills to conduct the experiments in the labs. Similarly, (Nsengimana., 2020)revealed the lack of resources and facilities. Therefore, there is a need to be aware of challenges that are encountered while teaching Biology.

This is why this study assessed the interplay between practical activities and students' performance in tropism in Musanze district secondary schools, Rwanda, as research about plant tropism and students' conceptions about plant tropism are very limited.

2. Literature Review

Practical activities in Biology

Practical activities may be defined as activities in which scientific students participate and equip themselves with practical knowledge (Olufemi A. & Ibukun V., 2013). According to (Clara & Carmen, 2021) practical activities are crucial because they give students the chance to engage in a variety of hands-on activities. These hands-on activities also provide children lots of chances to utilize their minds to figure out broad scientific rules and principles. Practical activities encourage conceptual growth, motivation, and excitement for enhancing scientific skills. Also, practical tasks help students develop their manipulative abilities, a positive outlook, and an interest in science. Via a variety of activities using sourced science resources to enhance science learning experiences, it makes challenging and abstract topics concrete, clears up misconceptions, and piques, boosts, and sustains students' enthusiasm in science. This has made creativity and information more accessible while aiming to prepare students to be successful workers in the workplace (Clara & Carmen, 2021)

Practical work teaching methods

Biology lessons have different teaching and learning approaches that are used by the teachers while delivering their biology lessons.

Slavin (2011) examined the methodologies used in teaching Biology and claimed that while there are several approaches, none of them can be deemed to be the most successful one. Therefore, it is necessary to look for more efficient methods that are likely to boost secondary school Biology students' performance. Cooperative learning and instructional techniques fall under this category and have been shown to enhance Biology learning results (Robert, 2011).

Organization of practical activities in teaching and learning of Biology

Across the whole world, teachers are known to connect learning to the personal world of their students by making learning tasks more relevant by relating instructions to

students' experiences. (Wrenn & Wrenn, 2009) suggest that teachers' three broad aims in terms of practical work can be categorised into three domains: procedural, conceptual, and affective. They discovered that educators should promote precise observation and thorough recording, encourage straightforward, logical, and scientific ways of thinking, sharpen manipulating abilities, getting students ready for assessed practical work, arouse and keep interest in the topic, enhance the reality of biological, chemical, and physical phenomena through practical applications (Wrenn & Wrenn, 2009)

Interplay between practical activities and students' performance in Biology

(Ngwenya & Arek-Bawa, 2022) claims that the majority of classrooms' usage of practical exercises confuses students and is ineffective for learning. They draw attention to the fact that learners are still far from understanding the laboratory techniques employed, practical activities, and the nature of learner interaction in practical work. Abrahams and Millar (2008) expressed a similar worry, arguing that many children, the activities, and what happens in the lab frequently contribute nothing to their learning of science.

The same authors emphasize that natural science teachers lack the skills necessary to effectively integrate practical activities into their lessons. According to (Abrahams, 2008), the ineffective methods that science and practical activities are planned and taught in schools may be the cause of learners' low success in science education. For teaching science, the "chalk and talk" method predominates and is frequently employed.

Teachers of natural science hold the view that students can engage in group work to demonstrate perceptions that are unpredictable with an inquiry-oriented and constructivist approach in which students participate in real-world investigations to provide experiences from which conceptual understanding is developed. As a result, according to the same author, practical activities do not promote the best manner for students to study natural science. To communicate scientific findings that are relevant to actual life rather than just science activities, teachers should encourage students to raise questions and voice their thoughts about science (Abrahams, 2008).

Most of the time, student responses are theoretical and devoid of actual scenarios, which makes it challenging for students to connect science to contexts outside of the textbook.

According to (Eylem Yıldız & Niymet Demirci, 2021), students should create their own problems of inquiry to learn more about the world around them. Through active participation in scientific research, learners can gain a wide knowledge and understanding of the nature and processes of science. Yet, due to not achieving its intended goals in terms of science teaching and learning, these activities are underdeveloped and not in line with actual laboratory work.

The use of practical activities in teaching Biology

(Daba & Anbesaw, 2016) discovered that the Ethiopian biology teachers who were the subject of the investigation did not employ the laboratory practical method. Among other things, the lack of equipment, the absence of labs, and the absence of a distinct Biology laboratory were the reasons why they were unable to implement the method. This failure to employ the suggested methods ultimately had a negative effect on the learner's achievement, interest, and attitude toward biology.

According to (Wrenn & Wrenn, 2009,) it is crucial for biology instruction that students are involved in the preparation and execution of improvisation of instructional material. Students ought to take part in the improvisation of science materials. The learners' participation in this important process has a tendency to explore and expose them to certain knowledge and skills required in the active learning process. There are frequent differences between what teachers believe to be the results and what students think they are. To determine the obstacles preventing its proper implementation, studies on practical work in secondary schools in Ethiopia have been carried out.

The usefulness of the practical activity as a learning event must be reduced since the ideas needed to make meaning of the activity or observation are not available. There is a discrepancy between what teachers declare as their outcomes before lessons and the ones their students perceive (Olufemi & Ibukun, 2013).

3. Methodology

3.1. Research design

A quasi-experimental research design was employed. When evaluating the efficacy of a treatment or educational intervention, quasi-experiment research is frequently carried out in contexts where random assignment is either impossible or not present. Students from selected schools were grouped into control and experimental groups for

biology subjects. A pre-test and post-test instrument was adopted to assess the effect of practical activities on student performance in tropism.
This design was selected because it provides a thorough analysis of the topic under consideration. The design was therefore helpful in answering how and why questions about students' performance in Biology, specifically in tropism, in 4 chosen secondary schools in the Musanze district.

3.2. Target Population

The target population comprised of 19 Biology teachers and 544 students from all secondary schools of Musanze district that have Biology in their science combinations. These are students who study in one of the following combinations: ANP, PCB, MCB at the following schools :(Ecole des Science de Musanze, Ecole des Sciences de Ruhengeri, Ecole de St Vincent Muhoza and Groupe Scolaire Muhoza I, Groupe scholaire Marie Reine de Rwaza,Sonrise secondary School,Groupe scholaire Notre Dame des Apotres de Rwaza,). The teachers gave their views on their most preferred teaching method they often use while they are teaching Biology—the topic of tropism in particular and the reasons behind their preference. On top of that, the pre and post-tests were done by students from selected schools to know the impact of practical activities to students' performance.

3.3. Sampling Technique

Sampling is the process of choosing a few individuals for a study in such a way that the selected individuals represent the entire population (Jeovany, 2016)**.** The researcher used purposive and stratified sampling technique when sampling teachers to take part in this research. According to (Lawrence, 2015), purposive sampling techniques are handpicking the cases to be included in the sample on the basis of one's judgment of their typicality. The goal is to choose cases that are likely to be "information rich" in terms of the study's purpose. Because the study's sample size was minimal depending on the research design chosen, purposive sampling was mostly used to sample teachers. On the other hand, the term "stratified random sampling" is used to describe a sampling technique in which a population group is split into one or more different units, or "strata," based on shared traits or behaviors. These techniques were employed to select a sample size of 177 learners. The schools had various options of sciences namely MCB (Mathematics-Chemistry and Biology), PCB (Physics, Chemistry and Biology), ANP (Associate Nursing Program) So, not more than 60 students were picked from each school from different science options to participate in the current research.

3.4. Sample size

The sample size consisted of 177 students, 15 Biology teachers making a total sample of 192 participants.

3.5. Data collection methods and instruments

This study used primary data obtained from the respondents. One of the instruments for data collection was used is the Biology Measuring Test (BMT). The BMT was developed by the researcher based on the learning objectives on the topic tropism.

The current study used questionnaire to collect data from teachers in order to know which dominant teaching method they like using while teaching tropism in Biology. This was used to answer the first research objective which aimed at investigating the dominant teaching approach used while teaching Biology particularly tropism concept. The questionnaire consisted of two sections: Section one sought to answer information on personal data while the second section contained 4 questions and each with its items structured to provide answers to the research questions. Five-point scale rating of Strongly Agree (SD), Agree (A), Strongly Disagree (SD) and Disagree (D) with values of 5,4, 3, 2, and 1 respectively. 15 teachers of selected schools filled the interview guide forms and their lesson plans were collected to check the quality of delivered lessons on the topic tropism.

Moreover, the researcher developed a set of questions to be given to learners from the 4 selected secondary schools of Musanze District in order to investigate the impact of practical activities on the students' academic performance in Biology especially in tropism. The developed Biology measuring test consisted of two sections: The first section consisted of 10 multiple choice questions while the second section was made up of one open questions. The test was administered twice. The pre-test was administered before teaching while the post-test was administered after having been taught the topic of tropism to both control and experimental groups. This was done to test the impact of practical activities on students' performance of two groups**.** The control groups were made up of students who had been taught using chalk and talk approach while the experimental group had been taught using a practical-based lesson approach and some experiments were carried out.

3.6 Data analysis

The triangulation method has been used to assess the teaching approaches used in the teaching and learning of tropism in Musanze secondary schools as it was a mixed method of the interview guide results for the teachers and

quantitative data were presented using the table. An unpaired t-test has been used to compare the effect of practical-based activities on the performance of students in the control and experimental groups.

This part gives key information relating to the specific objectives of the current study which seeks to investigate the interplay between practical activities and the student's performance in Biology, case study of the selected secondary school of.Musanze district.

4. Results and Discussion

Table 1: Biology teaching approaches used in tropism teaching and learning in the selected secondary schools of MUSANZE District

SN	The teaching approaches used in teaching and learning of tropism in Musanze secondary schools	Never	Not sure	Strongly Agree	Often	Total	Mean	Std. Deviation
1	Chalk and talk approach	4	1	4	6	15	2.8	1.2
2	Laboratory methods	5	2	7	1	15	2.27	1.0
3	Cooperative learning approach	3	4	5	3	15	2.6	0.9
4	Project based learning	9	1	4	1	15	1.8	1.0
5	Inquiry-based learning	3	9	3	0	15	2	0.6

(Source: Primary data)

Data shown in table 1 clearly shows that the teaching approach mostly used in the teaching and learning of Biology particularly the tropism concept in selected secondary schools of Musanze district is "chalk and talk". The average number of teachers who confirmed to use them sometimes has a mean score of 2.80 compared to other approaches.

This is in line with the study conducted by (Ogunniyi, 1977) stating that because of lack of science apparatus, practical work becomes difficult to organize. In Rwanda, laboratory activities are not fully performed because of scarcity of laboratory as well as improvising skills (Ndihokubwayo, 2017)

The effect of the practical activities approaches on students' performance in tropism

Table 2: Scores of students in tropism course during pre- and post-test for both control and experimental groups

		Maximum (/20)	Minimum (/20)	Mean (/20)	SD
Pre-test	Control group	14	1	7	±3
	Experimental group	17	3	10	±3
Post-test	Control group	16	3	9	±3
	Experimental group	20	9	15	±3

(Source: Primary data)

As it appears in the figure above, the control group scored 7 out of 20 marks while the experimental group scored 10 out of 20 marks in the pre-test. Then, in the post-test, the control group scored the average marks of 9 out of 20 while the experimental group scored 15 out of 20 marks.

The results obtained from the test which was administered to learners of Biology showed that the experimental group had significantly higher marks than the control group during the pre-test (which test did you use, sample size, $p < 0.05$). The post-test results showed highly significantly increased marks in experimental groups compared to the control ones. A pretest-posttest ratio of approximately 1e-5 in significance has been noted.

The performance difference between the two groups was due to the fact that each instructional material provided

different learning experiences and that one instructional material may provide more learning experiences than another instructional material, for example real objects provide more learning experiences than videos and charts. Making a classroom interesting is a fundamental way for teacher to encourage and make students learn without forcing them. Different lab materials and devices enable students to be more creative and active in learning. This agrees with findings of Gambari and (Clara & Carmen, 2021) who found that students taught with technological devices acquired better knowledge, and improved comprehension skills than other groups. They also introduced the cone of experiences as a "pictorial device" for showing the progression of learning experiences from direct firsthand participation to pictorial representation and on to purely abstract, symbolic expression. He arranged the learning experiences from the point of view of learners in order of increasing abstractness or decreasing concreteness.

Barriers that hinder the use of practical activities in teaching tropism in secondary schools

According to the results of the study, major barriers that hinder the use of practical activities in teaching tropism include inadequate or lack of training/workshops in practical activities, lack of appropriate laboratory materials and equipment for tropism practical activities, few hours provided by Rwandan curriculum in studying this lesson of tropism in advanced levels. However, the majority of respondents reject some challenges like practical activities in tropism which can be distracting and unproductive or even confusing to students.

Table 3: Barriers which hinder the use of practical activities. SD: Strongly disagree, D: disagree, NS: not sure, A: agree: strongly agree

SN	The barriers that hinder the use of practical activities	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree	Total	Mean	Std. Deviation
1	Inadequate or lack of training/workshops in practicals	0	2	2	5	6	15	4	1.069
2	Lack of appropriate laboratory materials and equipment for tropism practical activities	3	1	2	2	7	15	3.67	1.759
3	It is time consuming to prepare it	2	2	3	6	2	15	3.33	1.291
4	Short period of time by Rwandan curriculum to study tropism in advanced levels	2	2	2	4	5	15	3.53	1.457
5	Ignorance of contribution of practical activities in teaching and learning tropism	6	3	2	3	1	15	2.2	1.32
6	Practical activities in tropism delay lessons about tropism	6	2	4	2	1	15	2.6	1.456
7	Practical activities in tropism cannot represent scientific inquiry properly	6	4	2	2	1	15	2.2	1.32
8	Practical activities in tropism can be distracting and unproductive or even confusing from students	10	1	1	2	1	15	1.87	1.407
9	Practical activities in tropism require technical support	1	2	6	4	2	15	3.27	1.1
10	Teachers' inexperience about practical activities in tropism	0	2	1	9	3	15	3.87	0.915
11	Practical activities don't provide opportunities for open-ended or enquiry-based learning	4	6	2	3	0	15	2.27	1.1
12	Teachers do not have enough enthusiasm in doing experiments	5	3	2	3	2	15	26	1.502

Data from the table above shows that a lack of appropriate laboratory materials and equipment for tropism practical activities, inadequate or lack of training/workshops in practical activities, a short period of time by Rwandan curriculum to study tropism in advanced levels and Teachers' attitude play a significant role as the major factors affecting the use of practical activities in teaching the concept of tropism in Biology Ordinary level.

5. Conclusion and Recommendations

5.1. Conclusion

The study was carried out to assess the interplay between practical activities and student's performance in Biology topic of tropism. Even if some teachers mentioned some barriers encountered in practical activities of tropism as a lesson such as inadequate or lack of training, lack of appropriate laboratory material and equipment for the required experiment and the fact that there are few hours provided by Rwandan curriculum in studying this lesson, the post-test which was administered to learners indicated that practical-based activities are more effective in terms of students' achievement compared to other Biology teaching approaches.. A great number of the respondents agreed to the benefits of practical activities which include students' motivation, attraction, participation and ability to put in actions what they have learnt in abstract way to practical reality which help them in increasing their understanding and academic performance in tropism. This was shown by the significant difference in performance between experimental group and controlled group in pre and post-test.

5.2. Recommendations

After finding the benefit of practical activities to the performance of the student and considering the barriers that different teachers face, the following are the recommendations from this study:

1. The Ministry of education should provide laboratory material to schools since science lessons need to be practically learned in order to grasp the meaning of what they learned in classes.

2. As the teachers are core individuals to every student learning, they should increase their knowledge, which will go back to the student they teach. This will go with the allocation of enough time to do practical activities and this will help students to grasp the lesson learned.

3. Since practical activities sharpen students' ability to develop a critical attitude in tropism, the research suggests that teachers should also use student-centered method by giving them practical assignments which will not only develop good relationships among themselves but also will help them in being motivated. It will increase their active participation, which will boost their research spirit.

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