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RESEARCH ARTICLE

TEACHING PHYSICAL SCIENCES THROUGH RESEARCH AND DEVELOPMENT: A CASE STUDY OF THE DOSSO MUNICIPALITY

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ABSTRACT

In summary, this case study conducted in the Dosso municipality has highlighted the importance of engaging teaching of physical sciences through research and development. The objective was to assess how this innovative approach can generate students' interest and enhance their learning in this field. The results have shown that the integration of pedagogical methods based on research and development has a positive impact on students' engagement and their understanding of scientific concepts. The study emphasized the significance of implementing stimulating pedagogical approaches to promote learning in physical sciences. These findings provide valuable insights for improving teaching practices in this crucial domain.

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INTRODUCTION

The teaching of physical sciences holds crucial importance in the education of students as it enables them to develop a deep understanding of the fundamental scientific principles that govern the world around them. However, it is often observed that traditional teaching methods in physical sciences can be perceived as boring and disconnected from students' daily reality, leading to disinterest and low motivation among them. In this regard, it is essential to establish innovative and engaging pedagogical approaches to spark students' interest and facilitate their learning in the field of physical sciences. Interesting teaching of physical sciences plays a key role in promoting students' engagement and constructing their understanding of scientific concepts. This study aims to explore the effectiveness of engaging teaching of physical sciences through research and development, focusing on a case study conducted in the Dosso municipality. The primary objective of this research is to evaluate how the integration of pedagogical methods based on research and development can influence students' interest in physical sciences and enhance their learning in this discipline.

LITERATURE REVIEW

Teaching physical sciences is a research area that has garnered the interest of numerous education researchers.

Several previous studies have explored the use of research and development (R&D) as a pedagogical approach to enhance the learning of physical sciences. According to Smith et al. (2018), integrating R&D into the teaching of physical sciences allows students to actively engage in hands-on projects and develop practical and analytical skills. This approach promotes active learning and exploration of scientific concepts, leading to a better understanding of physical phenomena. Studies have also highlighted the benefits of R&D-based teaching in terms of student motivation. According to Johnson and Smith (2017), involving students in stimulating and relevant research and development projects improves their intrinsic motivation and interest in physical sciences. This approach also fosters the development of cross-cutting skills such as problem-solving, collaboration, and critical thinking. Another study conducted by Brown and Jones (2019) demonstrated that R&D-based teaching enables students to develop a more realistic and concrete view of science. By working on tangible projects, students can explore the practical applications of scientific concepts and understand their relevance in everyday life. This promotes a stronger connection between theory and practice, enhancing the understanding and learning of physical sciences. Overall, the existing literature highlights the advantages and benefits of R&D-based teaching in the learning of physical sciences. This approach allows students to actively engage, develop practical and analytical skills, enhance their motivation, and strengthen the connection between theory and practice. These findings suggest that integrating R&D into the teaching of physical sciences

can be a promising strategy to make learning more interesting and effective in this field.

Analysis of Engaging Teaching Approaches in Several Countries:

1. ***Finland:*** Finland is often cited as a success story in terms of engaging teaching. The Finnish education system emphasizes student autonomy, discovery-based learning, and collaboration. Studies show that Finnish teachers use interactive and stimulating pedagogical methods, which foster students' interest in sciences (Sahlberg, 2011).
2. ***Singapore:*** The Singaporean education system focuses on problem-based and real-world applications in teaching sciences. Students are encouraged to engage in scientific research activities and experimental projects, which sparks their interest and motivation for sciences (Lee, 2013).
3. ***Canada:*** In Canada, studies have been conducted to examine student engagement in classrooms. The results have shown that students' interest in sciences can be enhanced by creating a stimulating learning environment, providing hands-on activities, and promoting active student participation (Pekrun & Linnenbrink-Garcia, 2012).
4. ***United States:*** In the United States, researchers have explored the concept of student engagement, which is closely tied to interest in learning. Studies have demonstrated that interactive and motivating pedagogical practices foster students' engagement and interest in sciences (Fredricks, Blumenfeld & Paris, 2004).
5. ***South Korea:*** In South Korea, research has been conducted to understand students' interest in sciences. The results have shown that students are more likely to be interested in sciences when exposed to hands-on activities, demonstrations, and concrete experiments (Park & Oliver, 2008).
6. ***Australia:*** In Australia, students' interest in sciences is closely linked to their enjoyment of learning. Studies have shown that students who find pleasure in learning sciences tend to maintain their interest in the long term (Ainley & Ainley, 2011).

Overall, these analyses highlight the importance of adopting innovative and stimulating pedagogical approaches to spark students' interest in sciences. The integration of hands-on activities, real-world problems, and interactive methods seems to play a key role in promoting students' engagement and interest in sciences. These approaches can serve as models for improving teaching practices in other countries.

METHODOLOGY

The methodology used in the case study of Dosso municipality is based on a research and development approach. This type of research aims to develop and improve existing practices by proposing innovative solutions or approaches tailored to the specific context. The first step of our methodology involved a pilot survey with the target population. This pilot survey collected data and information from Physical Sciences advisors in the Dosso municipality (DOSSO1), laboratory technicians, technicians from the Dosso region, education administrators, teachers, and students. These interviews helped understand the needs, challenges, and opportunities related to the teaching of physical sciences in the Dosso municipality. Next, a critical review of the literature was conducted to gather existing knowledge on teaching physical sciences through research and development. This literature review relied on previous works and identified best practices in this field. Based on the results of the pilot survey and the literature review, two schools were selected to participate in the case study: Dosso General Education College1 (CEG_1/Dosso) and Dosso General Education College 2 (CEG_2/Dosso). These schools were chosen based on their willingness to participate in the implementation of new pedagogical approaches and their active collaboration with the researchers. The methodology also involves providing robust training to the teachers in the selected schools. This training aims to enhance their capacity to implement research and development activities in their physical sciences classes. Additionally, experimental materials have been developed and made available to teachers and students to facilitate the practical exploration and discovery of scientific concepts. In summary, the methodology adopted in this case study of Dosso municipality is based on a research and development approach. It includes a pilot survey, a literature review, the selection of participating schools, teacher training, and the provision of experimental materials. This methodology aims to improve the teaching of physical sciences in the selected schools and enhance students' interest in these subjects.

DISCUSSION AND RESULTS

Presentation, Analysis, and Discussion of Results: Tables 1 and 2 present information on the student enrollment at CEG_1 or CEG_2 in Dosso, indicating the number of students per class and gender. These data provide an overview of the distribution of students by grade level and the total student population of the college.

Table 1. Student Enrollment at CEG_1/Dosso (School Year 2022-2023)

Classes		6th Grade	5th Grade	4th Grade	3rd Grade
Number of Students	Boys	494	263	224	223
	Girls	496	286	296	277
Total Enrollment		990	549	520	500
Number of Classes		11	6	6	7

Source: Obtained from school administration.

Table 2. Student Enrollment at CEG_2/Dosso (School Year 2022-2023)

Classes		6th Grade	5th Grade	4th Grade	3rd Grade
Number of Students	Boys	330	146	112	91
	Girls	263	175	147	124
Total Enrollment		593	321	259	215
Number of Classes		7	4	4	4

Source: Obtained from school administration

The tables provide an overview of the student enrollment at CEG_1 and CEG_2 in Dosso for the 2022-2023 school year. It shows the number of students per class and their gender distribution. In Table 1, for CEG_1, the highest enrollment is in the 6th grade, with 990 students in total. The number of students gradually decreases as the grade level increases. There are 11 classes in the 6th grade, 6 classes in the 5th and 4th grades, and 7 classes in the 3rd grade. Table 2 presents the student enrollment at CEG_2. The highest enrollment is also in the 6th grade, with a total of 593 students. Similar to CEG_1, the number of students decreases in the higher grade levels. There are 7 classes in the 6th grade, 4 classes in the 5th and 4th grades, and 4 classes in the 3rd grade.

Analysis of the advantages and challenges of R&D-based teaching in the context of Dosso municipality: Due to some constraints, we decided to work only with the 3rd grade level. We selected one 3rd grade class from each school, making a total of 10 classes. We developed didactic experiments in the field of Physical Sciences to conduct our research and contribute to the Nigerien education system. However, we are facing challenges, including a lack of adequate materials. It is not possible for us to work with all grade levels, such as the 6th, 5th, and 4th grades, to carry out practical work on electrical circuits in all CEGs. Additionally, we are facing a context of tensions between teacher unions and the government. Due to this situation, teachers have expressed some distrust towards researchers. Despite these tensions, it was essential to mobilize all necessary resources to successfully complete our project and be able to work with other grade levels.

Analysis of R&D-based Pedagogical Practices Used in the Teaching of Physical Sciences

Practical Activities 1: By observing Figure 1, we can see a teacher moving among the students to check the measurement of resistance using the multimeter.

The teacher plays a crucial role in students' learning. By moving among the students, they supervise and closely observe their resistance measurements with the multimeter. Their objective is to ensure that students are correctly carrying out the measurement and understanding the associated fundamental concepts.

Figure 1. Student Practical Work 1

By circulating, the teacher can provide individual assistance to students who need it. They can answer their questions, guide them in using the multimeter, and help them interpret the results of their measurements. The teacher can also observe the different approaches used by students to measure resistance and provide guidance to improve their technical skills. They can encourage good practices, such as careful handling of the multimeter and taking accurate measurements. The presence of the teacher moving among the students creates a reassuring learning environment and promotes active engagement of the students. Students feel supported and encouraged to ask questions, share their discoveries, and seek help when needed. Furthermore, the presence of the teacher signifies the importance given to this learning activity. Students understand that it is a privileged moment to develop their electronics skills and deepen their understanding of concepts related to resistors and electrical measurements.

Practical Activities 2

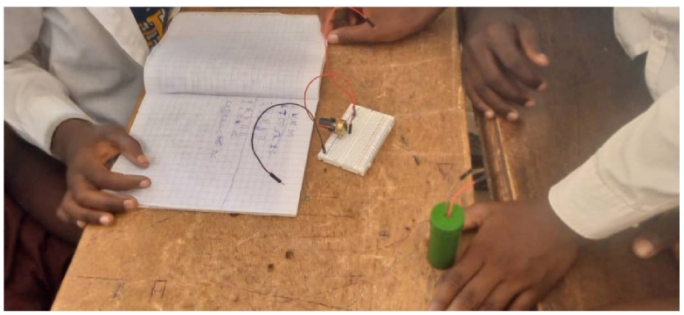

Figure 2. Student Practical Work 2

When observing Figure 2, we can see students engaging in the construction of an electrical circuit during a class led by the teacher. The students are actively involved in a hands-on activity where their task is to build an electrical circuit. The teacher has likely provided instructions on how to construct the circuit, and the students are following these guidelines to attach a potentiometer to a breadboard using male and female wires. The potentiometer is an adjustable electronic component that allows for the regulation of electric current in a circuit. By attaching it to the breadboard, the students can experiment with electrical resistance and observe how it affects the current in the circuit. In the photo, we can also see that the battery is not yet connected to the breadboard. This may indicate that the students are in the process of preparing the circuit before making the final connection. They may be using their notebooks to follow the assembly steps and take notes on observations or results obtained. The presence of notebooks suggests that the students are encouraged to document their work and discoveries throughout the activity. This allows them to keep a record of their experiments, any errors encountered, and their progress. Additionally, it promotes deeper reflection on the concepts being addressed and encourages the development of note-taking and organizational skills. This hands-on activity enables students to apply the theoretical knowledge acquired in class. By constructing the electrical circuit, they can experiment, test hypotheses, and observe results. This reinforces their understanding of electrical concepts and allows them to develop problem-solving skills and proficiency in handling electronic components. In summary, in this photo, the students are constructing an electrical circuit during a class led by the teacher. They are attaching a potentiometer to a breadboard using male and female wires. The battery is not yet connected to the breadboard. The students are using their notebooks to follow the assembly steps and document their observations. This hands-on activity enables them to apply their theoretical knowledge, experiment, and develop their skills in electronics.

The integration of research and development and understanding of scientific concepts by students in the field of physical sciences: The integration of research and development can indeed enhance students' understanding of scientific concepts in the field of physical sciences. By encouraging students to actively engage in research, experimentation, and development activities, this pedagogical approach promotes a deeper comprehension of scientific concepts. When students are involved in research and development projects, they are motivated to explore, ask questions, formulate hypotheses, and conduct hands-on experiments. This allows them to develop a more comprehensive understanding of scientific principles by applying them in real-world contexts. Moreover, the integration of research and development provides students with an opportunity to develop skills such as critical thinking, problem-solving, collaboration, and creativity. These skills are crucial for a thorough understanding of scientific concepts and their application in practical situations.

CONCLUSION

In conclusion, this study has highlighted the importance of implementing innovative and engaging pedagogical approaches to stimulate students' interest and promote their learning in the field of physical sciences. Traditional teaching methods are often perceived as boring and disconnected from students' daily realities, leading to disinterest and low motivation. However, the integration of research and development-based pedagogical methods can have a significant impact on students' engagement and understanding of scientific concepts. The case study conducted in the Dosso municipality assessed the effectiveness of interesting teaching of physical sciences through research and development. The results demonstrated that this approach has a positive effect on students' engagement by encouraging them to actively participate in hands-on projects and develop their practical and analytical skills. Furthermore, the integration of research and development fostered a better understanding of scientific concepts by emphasizing practical applications and strengthening the connection between theory and practice. The research questions addressed in this study have contributed to a better understanding of the advantages and opportunities offered by interesting teaching of physical sciences through research and development. These findings provide valuable insights for improving teaching practices in this field, with a focus on student engagement and building a deep understanding

of scientific principles. In conclusion, it is crucial to continue exploring and promoting innovative and engaging pedagogical approaches for teaching physical sciences. Interesting teaching of physical sciences through research and development offers exciting possibilities to enhance students' engagement and learning in this crucial field.

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