Experiences of Physics Teachers with integration of Real-life Contexts in their Teaching and Learning Processes.

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Abstract

The integration of real-life context in physics instruction is one of the effective strategies that can improve students' learning. To be successful, this strategy requires the physics teachers to be competent and students have to be actively engaged in the instructional process. This study explored physics teachers' perspectives in integrating real-life context in physics instruction. The following research questions were employed to orient this study: How do teachers incorporate real-life examples and applications of physics in the process of teaching and learning? What are teachers' opinions about the integration of real-life examples in teaching physics? Qualitative methods such as purposive sampling, interviews, and thematic analysis were applied. The sample of 6 physics teachers, who worked in Kayonza District, was purposively selected as the respondents for this study. The findings revealed that physics teachers have a good understanding of this instruction, and they possibly integrate real life examples and applications in their instructional activities.

Keywords

Physics education, physics in a real-life situation, interest, and motivation in physics learning,

Introduction

The nature of physics as a natural science and its importance in different domains of life explain the extent to which physics education can be linked to the everyday life of students. Teaching physics using real-life context enhances students' scientific literacy (Whitelegg & Edwards, 2001). The integration of real-life context in teaching and learning physics increases the scientific curiosity among students and improves students' interest and motivation in learning (Mackinnon, 2010). The teachers help students by connecting physics concepts to phenomena found in everyday life or to some possible future scientific career, by discussing technological applications of physics laws and principles, or by describing the historical context of physics and its impact on society. Therefore, physics teachers must be aware of the instructional strategies regarding integration of real-life context and how that strategy can work in the classroom environment (Liu & Sun, 2020).

For many teachers, the lack of awareness of teaching physics in a real-life context makes it a challenge to the effectiveness of instruction. The traditional strategies of teaching physics failed to help students achieve higher learning outcomes for instance critical thinking, higher reasoning skills, problem-solving skills, and other important key competencies (Kantar, 2016). Improvement in students' interest and motivation, as well as the achievement in learning outcomes, are the significant benefits from the integration of real-life context in physics instruction. This instructional strategy helps students to construct an accurate understanding of the scientific nature of physics, and in

connecting physics concepts to their everyday situation; they gain illumination about how to choose their scientific future career and technological use of physics laws and principles.

When there is a need for any positive change in the educational system, implementing the new instructional strategy is the important solution. Teaching with the new strategy brings improvements in all aspects of students, and the teacher must adjust her/his activities with the new instruction. For a competent teacher, developing the knowledge, attitudes, and skills of students is the main goal, and the teacher benefits from increasing the students' competencies. The effective achievement of teachers' objectives in implementing the new instructional strategy faces the size of physics content to cover, time restrictions, management of students from different backgrounds, and the lack of awareness of the new instruction and difficulties in the content to be delivered.

Statement of the research problem

Most of the teachers prefer to teach in the way they were taught and they resist the change that can bring any improvement in the instructional system. Some teachers apply the instructional methods which can't allow students to acquire the appropriate knowledge and skills for this era (Gutulo & Tekello, 2015). The studies conducted by (Ndihokubwayo et al., 2020) revealed that physics teachers still use teacher-centered approaches which are dominated by lecturing method, demonstrating and computing while students are passive followers, and chalk and blackboard method. Also, some of them use a single method that is group discussion as learner-centered method that can't work for all topics (Venuste, 2020), So, this is in contrast to the intended outcomes from the new Rwandan Curriculum and that will affect science students where they may leave school with poor conceptual development and they may lack critical thinking skills and motivation in the sciences.

Research questions

This research was conducted to answer the following questions:

1. How do teachers incorporate real-life examples and applications of physics in the process of teaching and learning?

2. What are teachers' opinions about the integration of real-life examples in teaching physics?

3. What are teachers' challenges about the integration of real-life examples in teaching physics?

Review of literature

Context-based education

In education, context-based learning as an instructional approach consists of using real-life situations and tangible examples and applications in instruction settings to help students to acquire through the real, the authentic, and the

applied knowledge of the topic instead of concentrating all efforts on its theoretical parts (Seel, 2012). In these innovative teaching and learning strategies, the students gain not only the opportunity to critically analyze the phenomena which they face in their way of life but also develop further awareness of linking physics knowledge and their real-world situations.

Context-based learning as an approach to teaching and learning inspires educators to confidently have innovative and creative thoughts in their instruction activities to respond to the current needs in teaching contexts. Gilbert (2006) defines real-world context as a learning environment that intends to allow students to perform tasks and solve problems using methods that reflect the nature of such tasks in their everyday life. Though such instruction allows the students to improve their interest and motivation stimulate them in becoming actively engaged in their learning.

Context-based learning is quite described to be a varied structure. While implementing this instructional structure, different methods of context-based learning can be combined having the central purpose to put scientific perceptions, patterns or themes, and phenomena in a situation that approximately links science subject to everyday life, social or cultural issues, or technological revolutions (Podschuweit & Bernholt, 2018). About this instructional structure, the context to be applied in the teaching and learning process must be familiar for students and consider students' learning differences like students' gender and their background.

The real-life context in teaching physics

This is a process that has the potential to encourage the effectiveness of learning environments and improve learning experiences for both student and teacher, for instance, such instruction can improve academic achievement (Bennett et al., 2007). In addition, it can be explained as an instruction structure that allows the teachers to contextualize what they teach by emphasizing the learning circumstances of all students to improve attitudes towards learning and enhance academic achievement (Podschuweit & Bernholt, 2018). Based on these thoughts, teachers who implement such instruction could have the appropriate understanding and competencies on the instructional strategy. Teaching physics in a real-life context has the aim to connect everyday phenomena and the systematic knowledge from physics instruction (Podschuweit & Bernholt, 2018).

The integration of real-life context has the aim of making physics to be concrete and relevant to students by linking physics concepts with their everyday life experiences. The school environment must facilitate the implementation of that strategy in one way or another. In different situations, teachers face challenges while integrating real-life context in teaching such as the lack of the environment that is conducive for this instructional strategy. Physics literacy for students encompasses many aspects, conceptual understanding, interest and motivation in learning physics, and other different benefits from physics education. To integrate a context that is

familiar to students in teaching physics content that has an important outcome in maintaining and increasing students' interest and motivation in learning physics.

Adequate motivation and active engagement are one of the important aspects of effective physics instruction which allow the students to retain the theory and to try in understanding its applications (Cahyadi, 2007). For this reason, the real-life context for teaching physics like examples, applications, and other phenomena comes before teaching a concept and helps in stimulating students' interest and motivation in learning physics and facilitates them to construct meaningful knowledge of the concept to be taught. While contextualizing the subject, introducing an example of an application of any physics law or concept after teaching the theory may not be the active approach aimed at all students.

Increasing students' interest and motivation for learning physics are one of the reasons for using real-life context as the instructional approach. However, to implement this approach students' learning differences must be recognized and consequently, some contexts when selected unintentionally can be more suitable for some groups of students than others. An understandable example or application would be the choice of contexts that will consider students' learning differences like the context that can interest and motivate all students due to their learning differences and from different backgrounds.

Karweit, (1998) describes real-life context as a learning environment that intends to help students think about the current issues and solve problems in a manner that reproduces the nature of those activities in their actual reality. The real world is the condition in which students, teachers, and the school really live and the situations they really deal with (Karweit, 1993). A good example of a real-life situation is the circumstances you are experiencing exactly in the present day, as opposed to the situation you expect to live in sooner or later. Fundamentally, “authentic learning is a multi-disciplinary, skills-based learning in a real-life context, demonstrating to students that their learning is connected, relevant, and can have an impact upon the world around them, as well as their future personalities” (Mackinnon, 2010).

Teachers' challenges in contextualizing physics

Even though the physics teachers recognized their position in performing contextual courses and identified its benefits for them and their students, they also expressed their concerns that there are some problems or challenges which can hinder their competence in implementing it effectively, commonly the short time for program completion and inadequate school conditions. In some classes, teachers show the problem of insufficient time for preparation, where the total volume of physics content to cover, and then to satisfy individual student’s learning difference as the challenges that anticipate the efficacy of the integration of real-life context in teaching and learning physics. The integration of real-life context in teaching physics focuses on higher reasoning and critical analysis that reduces the

emphasis on memorization of formulas and mathematical rigor; moreover, this strategy allows students that are not genius in mathematics to learn physics at a deep level.

There is tension in guaranteeing the symmetry between the results expected after teaching and the procedure, the time constraint, learned material and outcomes, then what has to be essential to enhance instructive evolutions and attain successfully academic outcomes (Gutulo & Tekello, (2015); Wulandari, (2015); and Sassi & Michelini, (2014)). Thus, it appears that the current physics syllabus for senior secondary in Rwanda contains the overloaded content to be covered in only one year. Apart from that, some teachers face several other constraints like students' attitudes towards learning physics, lack of instructional materials, and students' poor background in science subjects when they want to apply physics in a real-life context in their classrooms. To appropriately teach the entire physics syllabus, teachers and students require sufficient time to apply physics knowledge in their real-life situations.

Teaching using a real-life context (Development & Panek, (2012); Ültay, N. & Çalıka, (2012); and Ulusoy & Onen, (2014)) is of the view that it has the potential to increase students' interest and self-engagement, when the context used, is conveniently selected. In the everyday life of people, there are some phenomena and problems that are built upon the laws and principles of physics. Teaching physics using a factual or actual framework help student (people) to explain those laws, principles, and phenomena and to solve those problems scientifically based on formal knowledge (Monica, 2013). Moreover, integrating an everyday or familiar context in teaching and learning physics helps to fill the gap between physics theory and the applications of physics.

Linking the lessons to real-life examples and applications reduce classroom management challenges because students' self-engagement increase (Sunar, 2013). Besides, students' interest and motivation towards learning a subject reduce descriptive behaviors of students, and the improvement in students' attitudes towards learning affect academic achievement in terms of knowledge and skills attainment.

Instructional approaches with the integration of real-life context

Teaching and learning approach that involves the integration of real-life context is called Contextual Approach to teaching or Context-Based Approach that is accepted widely in teaching sciences (Bennett, Sylvia, & Lubben, 2005). The context-based approach provides useful instructional methods of including science, technology, and society material in any course (Wilkinson, 1999). In physics education research, many studies were conducted in this area to examine the level at which physics teachers employ hands-on activities and context-based approaches into their teaching process. Such studies had the purpose to examine physics teachers' opinions and insights about context-based approaches, and to explore how, what, and why they do it.

The integration of real-life context in teaching requires the use of active strategies in all activities. The traditional methods of teaching physics which emphasize the memorization of physics laws, principles, formulas, and a lot of mathematics applications, can't be helped by the integration of real-life context in teaching and learning physics. To contextualize physics, the teacher must be aware of teaching using active teaching and learning methods. If the physics teacher doesn't present adequate competencies in active teaching and learning strategies, his/her adaptation to using real-life context is complicated.

Research methodology

This research had the objective of exploring physics teachers' experience, their perceptions, and their challenges in integrating the real-life context in the teaching and learning process. In the interpretivism perspective, the researcher chose phenomenology as a research design where the qualitative approach helped the researcher to understand the commonality of lived experiences within a particular group of physics teachers. By using phenomenology design, the investigator intended to deeply understand the lived experience of the respondents and to get an in-depth insight into the phenomenon of the respondents' situation. All physics teachers from purposively selected five secondary schools were considered as the participants for this study. Data was collected through interviews, classroom observations, and open-ended questionnaires. Inductive thematic analysis was employed in analyzing data.

According to the paradigm adopted in this research, an open-ended view obeyed the notion of data triangulation by permitting research participants to assist the researcher in the research question as well as with the data collection. Implementing multiple methods of data collection, such as observation, interviews, and recordings determined the validity, reliability, and diversity construction of realities. The tools for data collection were selected to answer to the following research questions: 1. How do teachers incorporate real-life examples and applications of physics in the process of teaching and learning?

2. What are teachers' opinions on the integration of real-life examples in teaching physics?

3. What are teachers' challenges about the integration of real-life examples in teaching physics?

Interviews

Semi-structured interview guide was utilized in this research as one of the methods of collecting qualitative data. All participants answered the same questions classified in three parts: integration of real-life context in teaching and learning physics, and each participant had the right of asking any question for clarification. The interviews were audio-recorded and transformed into written notes. This interview was conducted in Kinyarwanda-the mother tongue and the translation was made later. Key themes were identified from this data.

Classroom observations

Classroom observations were also conducted while teachers were teaching physics. As some teachers participated in the study as two or more teaching in the same school, for this case, the researcher worked with one of them who accepted voluntarily to participate in lesson observations. Three physics teachers were considered for classroom lesson observations and two lesson observations were provided for each teacher. The participants assigned for the observations indicated a particular day and time for the researcher to observe. This helped the participants to plan for an active classroom so that the researcher could observe the real-life context incorporated into the instructional process. Teachers, who were observed, signed an observation agreement. This helped the participants to plan for an active classroom so that the researcher could observe the extent of teachers' capacity to apply the real-life context in their teaching. The majority of the observations for most of the participants indicated the employment of students-centered approaches which in their entirety facilitate the integration of real-life context in the process.

Open-ended questionnaire

The open-ended questionnaire was administered to every participant of this study, where they were asked to respond to all provided questions that were classified into two sections: integration of real-life context in teaching and learning of physics; personal views and opinions of what they think about teaching physics by integration of real-life context in teaching and learning physics. Also, key themes were identified for analysis. Due to the nature of information needed to be collected, a standardized questionnaire is adopted. Adopting such questionnaire increased the reliability as all participants were asked precisely the same questions which were in an identical format and their responses were recorded in a uniform manner. The total number of six physics teachers was targeted while administering questionnaires and all of them provided the responded questionnaires to the researcher.

Data analysis

In this research, the inductive thematic analysis was applied in analyzing data from the collected data. The meaning and explanations of the identified themes were analyzed. To analyze data from collected information in the form of text from the open-ended questionnaire, media from the semi-structured interviews, and information from notes taken during classroom observation, the following steps guided the plan for data analysis:

1. The researcher carefully reads repeatedly the recorded interviews to classify and to obtain the meaning attributed to the background and experiences of each participant individually.
2. After the records the researcher classifies important descriptions which relate straight to the planned phenomenon.
3. The researcher advances the explanatory senses of each statement individually. The researcher repeatedly reads the study procedures to guarantee that the original description is obvious in the explanatory senses.
4. The explanatory senses are organized into groups, which allow themes to arise. The researcher sought authentication, avoided boring themes, and noted any inconsistencies during this procedure.

5. The themes were then combined into a complete description. The researcher also mentioned the theme groups back to the procedures to validate them.

6. The researcher shaped a brief declaration of the comprehensive description and provided an important declaration of identification also referred to as the complete core of the knowledge.

7. The summary of the declaration of the comprehensive description was accessible to the study's participants to prove the conclusions and the expansion of the core statement (Colaizzi, 1978)

The participants' profile

The sample was well represented by involving teachers with a diverse range of experience in teaching Physics at different levels and female teachers. A total of six 6 physics teachers were considered as the participants of this study.

Table1: Participants' overview

Participant	Code of the participant	Subject taught	Level taught	Experience	Qualification	Gender
Participant one	T.P.C-RF	Physics	Ordinary level	seven (7) years	Bachelor's degree in teaching Physics (BDTP)	male
Participant two	T.P.C-MN	Physics	Ordinary level	One (1) year	Bachelor's degree in teaching physics (BDTP)	Male
Participant three	T.P.C-EN	Physics	Ordinary level	One (1) year	Bachelor's degree in teaching physics (BDTP)	Male
Participant four	T.P.C-JG	Physics	Advanced le	Six (6) years	Bachelor's degree in teaching physics (BDTP)	Male
Participant five	T.P.C-NN	Physics	Advanced level	Ten (10) years	Bachelor's degree in teaching physics (BDTP)	Male
Participant six	T.P.C-ZR	Physics	Ordinary level	Six (6) years	Bachelor's degree in teaching physics (BDTP)	Female

Findings

During the interview process, classroom observations, and open-ended questionnaires several ideas emerged. The objective of the phenomenological research was to explore physics teachers' experiences in integrating real-life context in the teaching and learning processes of students. The emergent ideas from the interviews, classroom observations, and open-ended questions provided six (6) important key findings:

1: Teacher's professionalism, motivation, and job enjoyment: facilitating students' use of higher level of thinking skills, demonstrating the skills relevant to the subject area utilizing the best and the appropriate context, examples, and the applications, and demonstrating the ability to link the present subject with the other subjects and real-life context.

2: Teaching physics in real-life context: how the teacher can choose a real-life context to integrate into the lesson, the benefits of incorporating real-life context in teaching physics for learners and teachers, and challenges of integrating real-life context in teaching physics.

3: Students' interest, motivation, and self-engagement in learning physics: how students are engaged in physics instruction, how they build knowledge on their prior knowledge and the real-world situation, and how the individual differences are addressed in the classroom.

4: Instructional planning, delivery, and assessment: is the teaching students centered? Is the assessment for learning based on pedagogical strategies?

5: School conditions: how does the school environment facilitate the integration of real-life context in teaching and learning physics, the exploitation of school facilities like physics laboratory and ICT laboratory is adequate, and the promotion of teaching Physics according to its nature and its applicability in real-life situations is possible.

6: Teachers' perceptions and challenges: the effects of integrating real-life context in teaching Physics, the intended objectives when teaching physics, and the challenges faced by physics teachers while teaching physics.

By assessing the above codes, perceptions, thoughts, experiences and challenges concerning the real-life context in teaching and learning of physics, the following themes came up:

Theme1: Teachers' professional development

In the participant's words "Choosing a context to use in teaching requires mastery of the content to link the lesson and real life. It also needs to increase your teaching skills in Physics to help your learners make things concrete rather than being abstract'. Most of the participants appreciated the incorporation of real-life context in teaching and learning physics. They argued that, using real life experience concurs with student-centered learning approach and it increases students' interest and motivation for academic achievement and competencies.

Theme2: Instructional structure and school conditions

This theme gave new thoughts and feelings of empowerment and knowledge to physics teachers who needed positive change or the significant innovation in an actual instructional setting that valued the integration of real-life context. It was found out that physics teachers are very eager, interested, and appreciative of acquiring new

strategies that would help them integrating real-life context in their teaching and learning physics. One teacher stated that, "*teachers need practical training and necessary materials and environment to teach and apply physics in real-life context".* Most participants agreed that the school environment and some teaching and learning facilities like science laboratories and ICT tools is still lacking in their schools and yet if provided, it can influence the effectiveness of the real-life integration in teaching physics.

Theme3: Student and teacher effects

Applying active instructional strategies and using real-life context brings a positive experience for both teachers and students. It also brings the improvement in students' self-engagement with studying physics and science in general. This gives a positive experience to both teachers and students for long-life learners. One teacher stated that, 'the integration of real-life context allows the teacher to know and use students' day to day life'. Another teacher said that, "when students are sharing and discussing their individual experiences concerning science subjects, they get excited because they learn from each other and realize how practical science can be". This actually motivates students in their learning and it builds both the teachers' and students' experience. Another teacher stated that, "like any other science, physics is real and it must be learnt using real-life experiences not abstract. Everything we teach in physics is found within the society. When students are not able to see in real life, they cannot apply it after their studies because most of them study theoretically'.

Conclusion

This study has revealed that, connection of physics with real-life context is remarkable for all physics teachers and it is highly necessary for students' in-depth knowledge and application of physics and any other natural science. In spite of low training in practical physics teaching and lack of teaching materials, majority of the participants appreciated the integration of real-life context in teaching and learning physics. It has been re-iterated that, physics concepts must be contextualized in a real-life situation. This study has revealed that, even students are interested in self-engagement in learning physics. Both teachers and students feel happy to share their life experiences in order to learn physics and see it in real life. This helps physics teachers to fill the gap between theories and practices in their teaching and learning of physics. Furthermore, this motivates students and increases their self-confidence, performance and interest in learning physics.

Recommendations

1. Student-centered pedagogy which is desperately needed for real-life teaching approach, must be well supervised and monitored for effective implementation by teachers;

2. Policymakers should facilitate the training of science teachers by providing enabling laboratories;

3. In-service training for physics teachers also has to be regular to facilitate knowledge development and therefore enhancing students' and teachers' practice of physics in real life;

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ANNEXE:

Open-ended questionnaire for physics teachers

SECTION I

1. Does the school environment facilitate the integration of real-life context in teaching Physics? Why? or why not?

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2. Have you been trained during your teaching experience? If yes, explain what you have benefited from those training. If not, state the challenges you have come across

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3. Do you have adequate physical conditions (laboratory opportunities and ICT) for teaching physics? If yes, how those conditions are exploited in your school? If no, explain the cause and propose what can be done to overcome that problem?
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4. Is the time allocated for teaching Physics sufficient according to the curriculum? If yes, explain your side. If not, explain how you work out to cover all contents in the syllabus.

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5. Have you faced any concept of Physics that you do not understand very well in your teaching experience? If yes, what do you do once you meet that challenge? If not, what is your judgment about Physics?

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6. Can the contents that you teach in Physics be contextualized in real-life situations? If yes, explain briefly what you do to contextualize your lesson. If not, discuss the barriers that you face while contextualizing your lesson.

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7. Have you ever participated in the preparation of the Physics curriculum? If yes, what were your contributions to curriculum designing? If not, explain why you did not participate.

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8. Do students participate actively in their learning? If yes, explain how students try to bring their contribution to teaching and learning. If no, explain what does it limit them in that participation?

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9. Are you interested in Teaching Physics? Yes or No

Explain your motivation on teaching physics if yes, and disappointment if "No". (One sentence)

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10. During your teaching sessions, are students interested in learning physics? If yes, explain their contribution to teaching and learning.

If not, explain why do many students not like learning physics?

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……..

SECTION II

1. What do you understand by incorporating real-life context in teaching and learning Physics?

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2. Is there an appropriate link between physics, other subjects, and real-life context? If yes, explain how you help students to benefit from that link. If no, propose what can be done to improve teaching and learning physics in a real-life context

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3. How to promote the teaching of Physics since the applicability of the nature of Physics in real-life situations?

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4. Explain your contribution when the integration of real-life context is accepted to be implemented in our high schools.

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5. What can you recommend to curricula designers about the integration of real-life context in teaching Physics at the high school level?

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Final comment

Thank you for taking the time to consider your opinions and completing this questionnaire. Please feel free to make any comments about any other matters in the space below.

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