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Teachers' and Students' Perceptions on the Use of Computer Simulations in Teaching and Learning Ohm's Law in Physics in Dodoma Secondary Schools, Tanzania

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Abstract: *Computer simulations (CS) are widely used in the field of education as a modern-era method of teaching and learning, but for effective implementation, the main users have to be aware and positive of their capabilities and challenges. This paper explored the perceptions of teachers and students towards the use of CS in teaching and learning Ohm's law in physics subjects in Dodoma secondary schools. The exploration employed a mixed-method approach that integrated both the qualitative and quantitative aspects in writing, presenting, analysing, and interpreting the findings of the computer simulation developed for enhancing students' teaching and learning of Ohm's law in physics. Data was gathered using 120 questionnaires and 18 interviews with students and teachers, respectively, for a total of 138 participants. Collected data was analysed descriptively. The findings from this study provide a compelling insight into the overwhelmingly positive perception held by both students and teachers regarding the integration of computer simulations in teaching Ohm's Law. The results strongly underscored the constructive impact of computer simulations on the teaching and learning experience. Among the noteworthy findings, it became evident that computer simulations were regarded as catalysts for increased student interaction. In conclusion, the study's findings underscore the positive perceptions of both teachers and students regarding the use of CS in teaching Ohm's law. The study's recommendations emphasise the importance of promoting gender equity in science education and integrating visual aids, like CS, to enhance teaching effectiveness and student learning experiences.*

Keywords: Computer Simulation, Ohm's law, Physics, Memory retention, Experimentation, Language barrier.

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1. Introduction

Physics stands out as an indispensable subject, serving as the cornerstone for various career paths. Its significance in the technological progress of a nation, especially in secondary education, cannot be underestimated, given its pivotal role in the scientific and technological advancement of industrialised economies (Benek & Akcay, 2019). It also serves as a gateway to higher education and careers in fields such as science, engineering, and medicine. Despite its importance, physics remains an elective subject, typically chosen by students who possess the confidence to take on a third science subject after chemistry and biology. Unfortunately, performance on this subject has consistently fallen short of expectations (Pingol, Villanueva, & Tapang, 2017). This issue stems from the fact that students often find physics topics challenging, leading to negative attitudes and perceptions about the subject, primarily due to factors like the integration of mathematical language (Sitotaw & Tadele, 2016). To address this challenge, it falls upon

teachers to facilitate inquiry-based learning among students. To nurture knowledge and skills in physics, educators must incorporate diverse teaching strategies and technology into the instructional process (Salame & Makki, 2021). Additionally, by creating motivating classroom experiences, teachers can positively shape students' attitudes towards learning science (Saudelli et al., 2021). In this context, the study goal was to investigate the perceptions of teachers and students towards the use of CS in teaching and learning Ohm's law in physics subjects. Therefore, the study sought to address the following research question: What are the perceptions of teachers and students towards the use of Computer Simulations in teaching and learning Ohm's law in physics in Dodoma secondary schools?

In Portugal, computer simulations (CS) are a highly effective tool for teaching and learning and readily accessible to most science educators (Chowdhury et al., 2019). In South Africa, CS has been utilised in physics education to enhance instruction and foster conceptual understanding. In terms of student performance, Department of Basic Education in South Africa reported an increase in physics education performance from 58.6% to 62% due to the use of CS (DoBE, 2017). Similarly, a study in Nigeria by Simanjuntak (2021) found a statistically significant difference in the performance of the experimental group, which was taught using simulation game strategies, compared to their counterparts in the control group taught using traditional methods. In Kenya, Kanyaru and Maina (2019) reported the use of animated and colourful graphical images in CS as a novel teaching method embraced by physics teachers. Where the study found computer simulations and animations enhanced students process skills. Chafulumira, Mwale and Bahati (2021) examined the effect of simulation on student's understanding of electric current in high school physics in Lilongwe, Malawi. The study revealed the potential of computer simulations in students understanding. Also, Beichumila, Bahati, and Kafanabo, (2022) examined students' acquisition of science process skills in chemistry through computer simulations and animations in secondary schools in Tanzania.

1.2 Statement of the Problem

Çelik (2022) emphasizes teaching with CS for students to acquire science process skills. Despite the importance of CS in teaching and learning, in Tanzania context, the majority of teachers still struggle to use CS to facilitate learners' learning through inquiry activities (Kihoza et al., 2016) where the teaching strategies are mostly dominated by teacher talk, lacking hands-on activities for inquiry learning (Kinyota, 2020). In such a learning context, the persistent issue of poor performance and high dropout rates in science subjects, particularly physics, remains a challenge due to its complexity, abstract nature, and mathematical demands (Jane & Florence, 2022). Nevertheless, limited research is available to signifying the use of technological model in Tanzanian secondary schools to complement traditional teaching methods. Also, the generalizations based on previous scholars' studies are questionable due to social, cultural, and economic differences in the study areas. Therefore, the goal of this study was to explore the perceptions of teachers and students towards the use of CS in teaching and learning. The goal is to provide the answers to the question: What are the teachers and students perceptions on the use of CS in teaching and learning Ohm's law in physics? Answers to the question would equally shed light on the use of CS in the teaching and learning of physics in Tanzanian secondary schools as practicable alternative instructional resources.

2. Literature Review

2.1 Theoretical Framework

The study employed connectivism theory of learning, which is the integration of principles explored by chaos, network, and complexity and self-organization theories. According to this theory, learning is a process that occurs within nebulous environments of shifting core elements not entirely under the control of the individual. A network can simply be defined as connections between entities (Kabigting, 2021). Computer networks, power grids, and social networks all function on the simple principle that people, groups, systems, nodes, entities can be connected to create an integrated whole. Therefore, alterations within the network have ripple effects. Connectivism is driven by the understanding that decisions are based on rapidly altering foundations where the new information is continually being acquire (Kron et al., 2017). The ability to draw distinctions between important and unimportant information is vital and the ability to recognize when new information alters the landscape based on decisions made yesterday is also critical. Thus, the connectivism theory works under the following principles:

i. Learning is a process of connecting specialized nodes or information sources.
ii. Learning may reside in non-human appliances.
iii. Capacity to know more is more critical than what is currently known.
iv. Nurturing and maintaining connections are needed to facilitate continual learning.
v. Ability to see connections between fields, ideas, and concepts is a core skill.
vi. Currency (accurate, up-to-date knowledge) is the intent of all connectivism learning activities.

Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes in what it means to learn. Connectivism provides insight into learning skills and tasks needed for learners to flourish in a digital era where it relies heavily on technology, so the first step to creating a connectivism classroom is to introduce more opportunities for digital learning like online courses, webinars, social networks, and blogs. Simulations engage students in deep learning that empowers understanding and add interest and fun to a classroom setting as opposed to surface learning that only requires memorization. For example, a physics class where students create an electric circuit with an online program, instead of being instructed via a book or classroom lecture, they are learning about physics by simulating an actual physical setup. Therefore, the study used this theory as a guide in constructing conceptual framework by constructing input and output relationship model and use simulation as the input to control students' average score. Also, the theory is tested against study results to see if connectivism theory holds in study area and recommended the need of put much efforts in digital learning, what would be expected relationship and would possibly give what extent of the results.

2.2 Empirical Literature Review

Several studies have explored the use of computer simulations (CS) as a teaching method to enhance learners' performance and understanding in various subjects, particularly in the field of physics and other science subjects. Niyigena and Nzabalirwa (2022) found that using CS in teaching biology concepts, such as plant and animal cells, helps transform abstract content into tangible knowledge, allowing students to connect their learning to real-life situations. This approach demonstrated improved performance compared to traditional teaching methods, highlighting the importance of CS as an alternative for conducting laboratory experiments in natural science subjects.

Abiasen and Reyes (2021) conducted a study on the perceptions of science teachers regarding the integration of CS into their classes. They found a positive perception among teachers, emphasising the potential of CS to bring significant changes to the learning environment. The study also showed that when CS is properly integrated into pedagogy, it positively impacts learners across various domains of knowledge, skills, and attitudes. This integration encourages teachers to become more innovative and effective, although there is still a need to strengthen teachers' technological, pedagogical, and content knowledge.

Salame and Makki (2021) investigated the impact of PhET (Physics Education Technology) interactive simulations on students' attitudes and learning. Their research revealed that simulations promote better understanding of abstract concepts, particularly in subjects like chemistry. Additionally, Hergüner and Son (2020) found that PhET simulations had a positive effect on students' attitudes and perceptions about learning, improving their understanding of chemistry concepts covered in lectures. PhET simulations were noted for providing clear instructions, ease of use, and unique learning opportunities not available in traditional laboratory settings.

Lin (2020) delved into high school students' perceptions of the helpfulness of PhET simulations for learning physics. The study identified two key aspects of helpfulness: visualisation of abstract physics concepts and linking mathematical understanding to physics concepts. The results indicated that interactive simulations like PhET assist students in overcoming challenges related to understanding abstract and invisible physics concepts. Additionally, the mathematical features of these simulations facilitate the connection between mathematical knowledge and physics comprehension.

Overall, these studies collectively highlight the positive impact of using CS in education, underscoring their potential to enhance students' learning experiences, improve performance, and bridge the gap between abstract concepts and real-life understanding. Meanwhile little is known on how teachers and students perceive the use of computer simulation in teaching and learning.

3. Methodology

3.1 Research approach and design

This paper employed mixed-method research approach that combines both the qualitative and quantitative study approaches. The mixed-method research approach allowed researcher to triangulate qualitative and quantitative data to a greater understanding of the phenomena under the study (Creswell & Clark, 2018), the study used this method to provide a well-rounded and contextually rich understanding of the use of CS in teaching Ohm's law. It allows a comprehensive exploration of both quantitative data and qualitative insights, ensuring that the findings are robust and applicable in this specific educational setting. The descriptive research design, particularly convergent design, was used to explore the perceptions of teachers and students towards the use of CS in teaching and learning.

The design allows the collection of qualitative and quantitative data concurrently at an equal weight and analysing of each set of data separately. A descriptive study design was chosen to accurately and comprehensively depict the current perceptions and practices related to the use of CS in teaching Ohm's law. This design allows for a thorough exploration of the existing conditions without attempting to establish causal relationships.

3.2 Location of the Study

The study was conducted in Dodoma Region, particularly in Dodoma City Council, which comprises thirty-eight (38) public secondary schools. Dodoma city was selected purposively because students from public secondary schools perform poorly in science subjects, including physics and the area suffers with the shortage of instructional materials (MoEST, 2019, 2020). Researcher purposively selected three (3) public secondary schools from Dodoma city council with ICT facilities as the source of relevant respondents. The public secondary schools were chosen due to the fact that the performance in science subjects is worse than private schools (URT, 2020). Also, purposive sampling employed in the selection of teachers who responded through interview and form two students during the comparison of the learning outcomes before and after the use of CS. Meanwhile random sampling was employed in the selection of students who responded through questionnaire.

3.3 Computer Simulations Lesson

This study developed lessons of computer simulation in teaching and learning Ohm’s law. In the instructional sessions, students were taught Ohm’s law by using computer simulations whereby PhET simulations were installed in computer laboratory. This instructional approach was employed to teach the same subject matter of which two (2) periods each having a duration of 120 minutes were firstly delivered to each selected schools before exploring the perceptions of using computer simulations in teaching and learning. For the teachers, interview was used whereby questionnaire were given to students to search for the answer to the question; What are teachers’ and students’ perceptions towards the use of Computer simulation in teaching and learning Ohm’s law.

3.4 Research Tools and Data Analysis

The sample size for this study was 138 respondents. The quantitative data was collected from 120 randomly selected students by using student’s questionnaire and qualitative data was collected from 18 teachers by using interview who were selected purposively. Also, descriptive research design was employed to systematically collect, analyse, and interpret data in order to provide a detailed account of the perceptions held by both teachers and students regarding the utilization of CS in the teaching and learning of Ohm's law. The primary aim of this research design was to present a comprehensive snapshot of the participants' attitudes, beliefs, and experiences without manipulating or altering the variables under investigation. To achieve this, various data collection methods were employed, such as questionnaire and interviews to gather a wide range of information from the participants. Through this descriptive research design, the study aimed to offer a detailed and accurate portrayal of the viewpoints and sentiments of both teachers and students, providing valuable insights into the effectiveness and reception of CS in teaching Ohm's law in the context of the physics subject.

In this study, data analysed both quantitatively and qualitatively. Due to having both qualitative and quantitative data, the descriptive were performed through Statistical Package for Social Science (SPSS) v26 and MS excel to obtain frequencies, percentages and means and the results were summarized in tabular forms.

3.5 Reliability and Validity

A pilot study was employed as a crucial preparatory phase before the main data collection. This pilot study involved a smaller-scale, trial version of the research, conducted to test and refine the research instruments, methodologies, and procedures. Initially, a small sample of teachers and students were selected to participate. The researcher administered interviews and questionnaire on a sample to assess the clarity, relevance, and appropriateness of the data collection tools. Feedback from participants was solicited to identify any ambiguities, potential biases, or logistical challenges in the study design. The findings from the pilot study were then used to make necessary adjustments, such as modifying questions and refining interview protocols. This process helped ensure that the final research design and instruments were well-suited for the context of the study, enhancing the reliability and validity of the data collected during the main research phase. Therefore, the pilot study played a crucial role in fine-tuning the research methodology and ensuring that it was effectively tailored to capture the perceptions of teachers and students regarding the use of CS in teaching and learning Ohm's law.

3.6 Ethical Consideration

The study adhered to all relevant ethical standards of conducting research as required by the St John’s University of Tanzania and the ethical clearance letter were obtained

from the office of the Vice Chancellor before embarking on field data collection mission. Again, the researcher was granted permission by the office of the Director of Dodoma City Council accompanied by a letter, which served to introduce the researcher to the schools. All research subjects were free to choose to participate or not to participate without any pressure or coercion. Also, researcher provided participants with a consent note for them to read and ask them if they had any questions. Also, researcher secured all information, took steps to safeguard and prevent any threats to data privacy.

4. Results and Discussion

4.1 Perception of Teachers and Students on the use of Computer Simulations

In this section, the researcher aimed to present findings of the perspectives of both teachers and students regarding the utilization of CS in the educational process. The study involved a total of 138 respondents, comprising 120 students and 18 teachers. Students were provided with questionnaires that included a mix of closed and open-ended questions, while teachers participated in interviews. The section considered various aspects such as student interaction, language barriers, memory retention, and recall from the students' standpoint. It also delved into the perception of CS concerning their ability to facilitate easy experimentation, spark interest in learning, and enhance the acquisition and retention of educational content among learners.

Key: SD=Strongly Disagree, D= Disagree, A= Agree, SA=Strongly Agree

Table 1: Students' Perception on the use of CS in Learning

		SD	D	A	SA	Total
Students Interaction	Frequency	20	18	43	39	**120**
	Percent	16.67	15.00	35.83	32.50	100
Language Barrier	Frequency	6	11	45	58	**120**
	Percent	5.00	9.17	37.50	48.33	100
Memory and remembering	Frequency	5	15	44	56	**120**
	Percent	4.17	12.50	36.67	46.67	100
Easy Experimenting	Frequency	2	25	55	38	**120**
	Percent	1.67	20.83	45.83	31.67	100
Interest in Learning	Frequency	5	27	34	54	**120**
	Percent	4.17	22.50	28.33	45.00	100
Acquisition and Retention of Content	Frequency	11	19	52	38	**120**
	Percent	9.17	15.83	43.33	31.67	100

4.1.1 Students' Interaction

The findings presented in this section provide an in-depth analysis of the results derived from both student questionnaires and teacher interviews. The data collected through surveys involving 120 students aimed to gauge their perceptions regarding the influence of CS on student interaction, and it revealed distinct trends. The evidence from data indicate that a significant portion of students held favourable views regarding the statement: "The use of CS enhances students' interaction in the learning process." Specifically, the majority of students, comprising 82 individuals (68.3%), expressed positive sentiments by either agreeing or strongly agreeing with this statement. Therefore, the findings of this study indicate there is positive perception. This suggests that students are more inclined to engage in interactive learning when using CS, driven not only by the educational content but also by their curiosity about CS itself (Salame & Makki, 2021).

The findings from the teacher interviews parallel those of the students. Out of eighteen (18) teachers interviewed, 14 demonstrated a positive perception of the role of CS in fostering students' interaction. From the teacher's perspective it was obvious that teaching by using CS would increase students' interaction not only in learning Ohm's law but also other topics from other science subjects. One of the teachers said that:

> *"Computer simulation makes everything interesting like a journey for students, it triggers curiosity and thirst to understand even beyond what is taught. This increases interaction and I believe it is what every teacher wants"* (Teacher A, School 1, 18/5/2023).

Southgate et al., (2018) concluded that the use of virtual reality in classrooms during educational lessons will increase interaction and communication. Lin (2020) obtained similar result. Hence, based on the viewpoints of both students and teachers, it is evident that CS have a notable impact on enhancing student interaction. In Tanzanian classrooms, it becomes evident that there is a requirement for the integration of CS, particularly in subjects or topics that students find challenging to grasp through traditional teaching methods.

4.1.2 Language Barrier

Based on the feedback received from 120 students who were asked to share their level of agreement or disagreement regarding the statement asserting that CS help in overcoming language barriers. The evidence from data reveals that, 45 (37.5%) students agreed, while 58 (48.3%) strongly agreed with the statement. These findings suggest that students perceive CS as effective tools for transcending language barriers. They believe that CS can serve as a means for communication and collaboration, allowing individuals to surmount language obstacles and promoting interaction and comprehension. Therefore, the findings of this study indicate there is positive perception. This perspective aligns with Cannon's (2017) which assessed the perceptions of both teachers and students regarding computer-assisted instructional software, including CS. The study revealed that computer-assisted instructional software, such as CS, covers a range of content areas encompassing mathematics, reading, language arts, writing, science, and social studies. Interestingly, thirteen (13) teachers expressed unanimous views regarding the capacity of CS to address language barriers effectively. One of physics teachers said that:

> *"Sometimes physics becomes difficult in learning due to language barrier since some of the phrases used are not very common in real life and it rises questions on what even that thing looks like but through CS it can be demonstrated visually i.e., force, torque, current, surface tension, momentum etc."* (Teacher B, School 2, 22/5/2023)

Overall, the responses indicate a diversity of viewpoints regarding the language barrier aspect of CS. While some respondents perceive limitations in communication, others see simulations as a means to overcome language barriers and foster effective collaboration and understanding. By embracing CS as a language barrier-free educational tool, educators can harness the potential of technology to foster enhanced understanding and engagement among diverse learners especially in Tanzania.

4.1.3 Memory and Remembering

An investigation was conducted to determine whether computer simulations have the potential to improve memory retention. The study involved the participation of 120 students who provided responses through questionnaires and 18 teachers contributed their insights through interviews. The results indicated in Table 1, the evidence from data indicate that a notable number of students 44 (36.7%) agreed that CS indeed aids in keeping memories for a long time. Furthermore, 19 (15.8%) of students strongly agreed with this statement, making a total of 63 (52.5%) students responded positively perception on the fact that CS enhance memory retention. The results imply CS provides a visual aid and mimic interaction that increase capacity of keeping memory and remembering. Therefore, the findings of this study indicate there is positive perception. The results were the same as teachers' interviews, where one of the teachers said:

> *"Visual aid has influence on improving student memory through detail that captured by eyes".* (Teacher B, School 2, 22/5/2023)

Likewise, in a study conducted by Gadzikwa, (2018), which investigated the impact of computer simulations on the development of conceptual understanding among grade 10 learners in direct current circuits, it was observed that the visual images played a significant role in enhancing students' ability to remember. As a result, students were better equipped to recall what they had seen in the simulations along with the entire concepts. Considering the findings of the current study and those of other researchers, it can confidently be concluded that CS assist students in memory retention. In Tanzanian classrooms, it is imperative to prioritize the use of visual aids, not limited to CS but encompassing any available means, in order to enhance students' memory retention.

4.1.4 Easy Experimenting

The study involved the analysis of the perspectives of 120 participants (students) to assess the influence of CS on the ease of conducting physics experiments. Additionally, teachers' interviews were conducted to provide further insights into the findings. As depicted in figure 4.5, the evidence from data indicates that a collective total of 93 (77.5%) students either agreed or strongly agreed with the statement: "CS would make experimenting easier." These findings signify a favourable perception among students regarding the efficacy of computer simulations in simplifying the process of conducting experiments. Therefore, the findings of this study indicate there is positive perception. Also, teachers through interviews expressed a positive perception on the use of CS. One of physics teachers responded that:

> *"Computer simulation does not just make experiment easy but its future of experiment and more advanced and efficient compared to actual experiment"* (Teacher C, School 3, 21/6/2023)

Similarly, a comparable outcome was observed by Ouahi, (2022), wherein students exhibited a strong inclination toward innovative teaching methods, particularly those incorporating visual aids and simulations that closely mimic real-world objects and processes, as opposed to traditional teaching approaches. Consequently, CS have the potential to establish a solid foundation for learning, simplifying the execution of actual experiments. It is advisable for educational authorities in Tanzania to prioritize the integration of CS into teaching methodologies to facilitate ease in conducting experiments.

4.1.5 Interest in Learning

Researcher examined the perception of both students and teachers on CS in increasing interests to learning. By using questionnaires for 120 students and interviews for 18 teachers. The evidence from data indicates that a total of 34 (28.3%) out of 120 (100%) students agreed and 54 (45%) out of 120 (100%) students were strongly agreed with the idea that simulation would increase their interests in learning physics. This implies that 88 (73.3%) out of 120 (100%) students were either agreed or strongly agreed that provides a significant proportion of students expressed a positive perception on the use of CS in teaching so as to increase interest in learning. Also, through interview the perception of teachers towards CS in increasing interest in learning physics was the same to students except for teachers all of them responded positively. For example, one of the teachers from school 3 said:

> *"Yes of course computer simulation increase interest in learning physics its relatively new thing and every student became curious about it, most interesting students can tell each other about what they saw precisely compared to what we can tell them in traditional method of teaching".* (Teacher C, School 3, 21/6/2023)

Also, another teacher added that:

> *"The use of computer simulation in teaching and learning is fun and students seems to enjoy the moment".* (Teacher A, School 1, 18/5/2023)

The feedback provided by teachers suggests that students exhibit curiosity when learning through CS, as it effectively stimulates their interest in the learning process. This observation aligns with the findings of Chafulumira et al. (2021), who noted that simulations have the capacity to capture learners' attention and quench their thirst for knowledge. In a broader context, it becomes evident that CS have the potential to significantly increase students' interest in learning physics. Notably, a considerable number of Tanzanian students have historically shown reluctance to pursue physics in higher levels of education due to their lack of interest in the subject, as indicated by BEST in 2020. In light of this challenge, CS can serve as a valuable tool to ignite and sustain students' interest in learning physics from an early stage (Chowdhury et al., 2019).

4.1.6 Acquisition and Retention of Content

The evidence from data indicates a significant majority of students, around 75%, perceive CS as valuable tools for enhancing the acquisition and retention of content knowledge. This positive perception aligns with the effectiveness of visual aids in helping students understand and build upon concepts. Importantly, teacher interviews also revealed a consistent positive view, with 16 teachers expressing similar beliefs about the beneficial role of CS in content acquisition and retention. Therefore, the findings of this study indicate there is positive perception. One of the noticeable comments was from one of physics teachers from school 2 who said:

> *"CS are even promising in acquisition and retention of content with relative to traditional teaching method and sometimes better than practical"* (Teacher B, School 2, 22/5/2023)

the study's findings strongly support the idea that incorporating CS into the teaching of Ohm's law enhances students' ability to acquire and retain content. These results

provide valuable guidance for educators and researchers, indicating that the integration of CS in physics education can lead to more meaningful content acquisition and retention. Similar positive outcomes were observed in a study by Salame and Makki, (2021), where PhET simulations in general chemistry also significantly improved content acquisition and retention compared to traditional teaching methods. This suggests the potential of CS, particularly in the Tanzanian context, to aid students in comprehending complex concepts by providing visual aids alongside textual explanations.

5. Conclusion and Recommendations

5.1 Conclusion

In conclusion, this study sheds light on the perceptions of both teachers and students regarding the utilization of Computer Simulations in the teaching and learning of Ohm's law in Dodoma secondary schools. The results obtained through questionnaires and interviews consistently confirmed predominantly positive perceptions among both students and teachers on the use of Computer simulations in teaching and learning processes. These results were recognized Computer simulations as valuable tools that enhance student interaction, overcome language barriers, improve memory retention, facilitate experimentation, ignite interest in learning, and boost content acquisition and retention.

5.2 Recommendations

1. Government and all education actors should encourage educators to integrate visual aids, such as computer simulations, into the teaching and learning of science subjects, especially physics. This integration can enhance the effectiveness of teaching and improve students' conceptual understanding.

2. Education actors should implement training programs for teachers to familiarize them with the use of interactive tools, including computer simulations. This training will empower educators to effectively incorporate technology into their teaching methods.

3. Advocating for the early introduction of interactive educational tools, such as computer simulations, in the learning process. Starting at an early stage can stimulate students' interest in subjects like physics and promote a lifelong passion for science.

4. Researcher should engage further research and development efforts in the field of computer simulations in Tanzanian education. These efforts should aim to create customized resources that align with the national curriculum and the specific educational context of Tanzania.

The provided recommendations underscore the potential benefits of technology-enhanced learning and emphasize the importance of teacher preparation and ongoing research to continuously improve the educational experience for students in Tanzania, particularly in the realm of science education.

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