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Teachers' Perceptions of Digital Game Utilisation in Teaching and Learning Physics Concepts in Secondary Schools of Murang'a County, Kenya

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Abstract

This study investigated physics teachers' perceptions regarding the utilisation of Digital Game-Based Learning in secondary schools within Murang'a County, Kenya. The research specifically examined teachers' comfort levels with digital games, perceived usefulness, implementation intentions, and specific attitudes toward game-based instruction in physics education. Employing a mixed-methods approach through a descriptive survey design, the study collected data from 11 purposively selected physics teachers using structured questionnaires and semi-structured interviews. The findings revealed that while 45.5% of teachers expressed comfort with DGBL, significant barriers to adoption persisted. Teachers strongly recognized DGBL's potential benefits, particularly in visualization (M=4.18) and student engagement (M=4.27), but expressed concerns about technical issues (M=3.73) and classroom management challenges (M=3.45). The study identified a notable gap between perceived usefulness and implementation intentions, with moderate confidence levels (M=3.18) in game integration abilities suggesting a need for enhanced technological pedagogical content knowledge. Qualitative data illuminated how teachers negotiate between perceived benefits and practical constraints, highlighting the critical role of institutional support and professional development in successful DGBL implementation. The research concludes that while teachers generally maintain positive dispositions toward DGBL, addressing technical infrastructure, providing targeted professional development, and ensuring curriculum alignment are essential for effective integration.

Keywords: *Digital Game-Based Learning (DGBL), Physics Education, Teacher Perceptions, Technology Integration, Educational Technology, Teaching Innovation*

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1. Introduction

The integration of Digital Game-Based Learning (DGBL) into educational practices has gained considerable attention in recent years. DGBL involves utilising digital games as pedagogical tools to enhance student engagement and comprehension across various subjects (Lameras et al., 2017; Vlachopoulos & Makri, 2017). Research has demonstrated that DGBL significantly increases student motivation and engagement, particularly in learning physics concepts. The interactive nature of digital games captures students' attention and fosters a positive learning environment, which is crucial for physics, a subject that often requires abstract thinking and problem-solving skills (Hussein et al., 2019).

Studies indicate that DGBL can lead to improved learning outcomes in physics education. For example, students learning Newton's laws of motion through DGBL have exhibited higher academic achievement compared to those taught utilising traditional methods. This improvement is attributed to the enhanced cognitive engagement and emotional involvement that games provide (Wu et al., 2014, 2020). Interactive simulations and game-based problem-solving facilitate the visualization and manipulation of physical phenomena, promoting active learning and critical thinking (Pranata, 2024). Additionally, research has shown that implementing DGBL can increase students' self-efficacy, learning motivation, and overall academic performance (Chen & Tu, 2021).

Teachers play a pivotal role in the successful utilisation of DGBL, as their perceptions and attitudes significantly influence its adoption and effectiveness in the classroom (Saal et al., 2024). Teachers' willingness to integrate DGBL is shaped by their perceptions of its benefits, such as increased student engagement and improved learning outcomes, as well as concerns regarding potential distractions and alignment with curriculum objectives (Leonardou et al., 2021). These perceptions may vary based on career stage, with early-career teachers facing different challenges and motivations compared to their more experienced counterparts. Career stage thus serves as a differentiating factor in teachers' attitudes and approaches toward DGBL integration (Malik et al., 2024). Furthermore, familiarity with technology, institutional support, and access to appropriate training programs significantly influence teachers' attitudes toward DGBL (Villa et al., 2023).

Teachers encounter both barriers and motivators when implementing DGBL. Common barriers include concerns about maintaining focus on subject content, adapting games to fit curriculum requirements, and managing classroom dynamics. Conversely, motivators include the potential for increased student engagement and the opportunity to provide diverse learning experiences (Palha & Matić, 2023). Selecting suitable educational games that align with learning objectives and assessing their effectiveness in enhancing students' conceptual understanding are additional challenges (Hayak & Avidov-Ungar, 2020). Moreover, institutional constraints, such as rigid school structures and insufficient professional development opportunities, further hinder the widespread adoption of DGBL (Ragni et al., 2023).

The Technology Acceptance Model (TAM) framework provides valuable insights into teachers' acceptance of DGBL. According to TAM, teachers' perceptions of DGBL's ease of use and usefulness significantly influence their intention to integrate digital games into instruction. However, frequent use of DGBL can negatively moderate perceived ease of use, indicating a complex relationship between familiarity and acceptance (Kuang et al., 2023; Scherer & Teo, 2019). Studies utilizing the TAM framework have effectively explained a significant portion of the variance in teachers' intentions to use DGBL, demonstrating its applicability in understanding technology acceptance among educators. Nevertheless, the

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extent of this explanatory power varies across different contexts and populations (Gumbi et al., 2024).

In Murang'a County, Kenya, the integration of DGBL into physics instruction remains limited, presenting both challenges and opportunities for teachers and learners. While digital games have the potential to enhance engagement and interactivity in teaching, the extent to which physics teachers adopt this approach depends on their comfort levels with instructional digital games, perceived usefulness, and willingness to incorporate them into their teaching practices. Understanding teachers' perspectives on DGBL is essential for identifying both enabling factors and barriers to its utilisation.

This study investigates physics teachers' perceptions of digital game utilisation by examining their comfort with its use, perceived benefits, influencing factors for adoption, and specific viewpoints on its role in physics education. Successful integration of DGBL in physics instruction relies on addressing diverse perceptions and challenges. By gaining insights into these aspects, this research aims to inform strategies that can foster the effective use of digital games in physics instruction, ultimately enhancing learning experiences and educational outcomes in Murang'a County and beyond.

1.1 Research Objective

To investigate physics teachers' perceptions of digital game utilisation in teaching and learning physics concepts in secondary schools.

1.2 Research Questions

i. What are secondary school physics teachers' comfort levels with utilising instructional digital games in their teaching?
ii. How do physics teachers perceive the usefulness of instructional digital games in enhancing teaching and learning?
iii. What factors influence physics teachers' intentions to incorporate instructional digital games into their instructional practices?
iv. What specific perceptions do physics teachers hold regarding the use of instructional digital games in physics education?

2. Literature Review

2.1 Teachers' Perceptions of Digital Games Utilisation in Teaching Physics Concepts

Digital Game-Based Learning (DGBL) has gained recognition as an effective approach for enhancing student engagement and comprehension in science education, particularly in physics. Studies have highlighted its potential to facilitate the understanding of abstract physics concepts by providing interactive and visual representations of physical phenomena (Virk et al., 2015). Despite this potential, the extent to which secondary school physics teachers integrate digital games into their teaching remains varied. Their comfort levels, perceptions of usefulness, and influencing factors play a crucial role in determining how DGBL is utilized in teaching physics concepts.

Teachers' perspectives on DGBL are shaped by several factors, including their familiarity with educational technology, their pedagogical approaches, and institutional support (Akkaya et al., 2021; Kaimara et al., 2021). While some teachers view digital games as valuable tools for reinforcing conceptual understanding in physics, others hesitate due to concerns about curriculum alignment, classroom management, and time constraints. Understanding these perceptions is essential for addressing potential barriers and promoting the effective utilisation of DGBL in physics instruction.

Physics as a subject often presents challenges due to its abstract and mathematical nature. Concepts such as Newton's laws of motion, electromagnetism, and wave-particle duality can be difficult for students to grasp through traditional instruction alone (Anupam et al., 2020). DGBL offers an alternative approach by allowing students to engage in simulated experiments, manipulate virtual objects, and observe cause-and-effect relationships in real-time. Research indicates that digital simulations and interactive games can enhance students' conceptual understanding by making learning more experiential and visually intuitive (Wu et al., 2020). However, the effectiveness of this approach largely depends on teachers' willingness and ability to incorporate such games into their lessons.

The decision to utilise digital games for teaching physics concepts is influenced by various factors. Some teachers may embrace DGBL due to its potential to increase student motivation and engagement, particularly in topics that students often find abstract or challenging (Kaimara et al., 2021). However, even technologically competent teachers may struggle with finding digital games that align with physics curricula and assessment requirements. Tomczyk et al. (2021) propose a framework categorizing teachers based on their attitudes toward technology: techno-optimists (who fully embrace DGBL), techno-realists (who use it selectively based on pedagogical fit), techno-pessimists (who are skeptical of its effectiveness), and techno-ignorants (who lack awareness or exposure to DGBL). These categories help explain variations in how teachers utilise digital games for teaching specific physics concepts.

The Technology Acceptance Model (TAM) provides further insights into teachers' decisions to use technological tools and resources for instruction. According to TAM, perceived usefulness and ease of use are key determinants of whether teachers adopt educational video games (Sánchez-Mena et al., 2017). If teachers perceive digital games as effective in enhancing students' comprehension of physics principles - such as energy conservation or projectile motion - they are more likely to integrate them into their lessons (Yochum, 2013). However, teachers' attitudes toward DGBL are also shaped by factors such as professional training, institutional support, and access to digital resources (Hébert et al., 2021).

Despite its potential, the integration of DGBL into physics instruction faces multiple barriers. A key challenge is the limited availability of physics-specific educational games that align with the curriculum (Takeuchi & Vaala, 2014). Many available digital games focus on general scientific concepts rather than specific physics topics, making it difficult for teachers to find appropriate resources. Additionally, time constraints and rigid academic schedules limit teachers' ability to incorporate game-based learning within the allotted lesson periods (An & Cao, 2017; Baek, 2008). Schools may also face financial constraints, making it difficult to acquire high-quality physics games and the necessary technological infrastructure for their utilisation (Matić et al., 2023). While many students own smartphones, not all digital physics games are compatible with these devices, further limiting accessibility.

Teachers' personal beliefs and past experiences with technology also influence their willingness to integrate digital games for teaching physics concepts. Some teachers express concerns about students developing an excessive attachment to gaming or being distracted from core learning objectives (Baek, 2008; Easterling, 2021; Ince & Demirbilek, 2013). There are also concerns about how competition within games might affect classroom dynamics, with some teachers fearing that weaker students may feel discouraged. These challenges highlight the need for structured professional development programs that equip teachers with strategies to utilise DGBL effectively without compromising classroom management or curriculum objectives.

Studies indicate that prior experience with digital media plays a crucial role in shaping teachers' confidence in implementing technology-based learning strategies (Ertmer et al., 2012; Tondeur et al., 2012). Teachers with previous exposure to interactive simulations and technology-enhanced learning tools are more likely to embrace DGBL for teaching physics concepts. Additionally, research suggests that positive teacher perceptions are key to the successful adoption of educational technologies in science education (Albirini, 2006).

By examining teachers' comfort levels, perceptions of usefulness, and the factors influencing their intentions to adopt DGBL for teaching specific physics concepts, this study aims to bridge the existing knowledge gap regarding the adoption and utilization of DGBL in Kenya's physics classrooms. While global research has explored DGBL in science education, limited studies have focused on its practical utilisation in Kenyan secondary schools, particularly in physics instruction. By shedding light on how Kenyan physics teachers perceive and integrate digital games, this study will contribute valuable insights to the ongoing discourse on educational technology in the country. Additionally, addressing both the enablers and barriers to DGBL adoption will not only optimize its role in enhancing students' conceptual understanding and engagement but also improve academic achievement in physics. Given the subject's historically low performance in national examinations, leveraging interactive and immersive learning tools such as digital games could provide an innovative strategy to make physics more accessible, engaging, and comprehensible for students. By fostering a supportive environment for DGBL adoption, this study aims to inform policy, teacher training, and resource allocation, ultimately contributing to the improvement of physics education in Kenya.

3. Methodology

This study employed a descriptive survey design within a mixed-methods approach to explore physics teachers' perceptions of digital game utilization in instruction. The combination of questionnaires and teacher interviews facilitated both quantitative and qualitative data collection, ensuring a comprehensive understanding of teachers' perspectives. The questionnaire provided structured, quantifiable responses through descriptive statistics, while the interviews offered in-depth qualitative insights into teachers' attitudes, experiences, and challenges related to digital game-based learning (DGBL). The mixed-methods approach was chosen to enhance the study's statistical generalizability while capturing rich, context-specific narratives from the participants.

The study targeted 69 physics teachers from 42 secondary schools in Murang'a County that were equipped with well-functioning computer laboratories. Purposive sampling was used to select 11 physics teachers as respondents, ensuring representation from those with access to relevant technological resources. Data collection involved a structured questionnaire that examined key aspects such as teachers' comfort levels, perceived usefulness, and intentions to integrate digital games into instruction. To capture the nuances of teachers' attitudes, Likert-scale questions were included to quantify perceptions regarding the effectiveness of digital games. Additionally, semi-structured interviews were conducted to explore deeper reflections on teachers' experiences, challenges, and motivations in adopting DGBL.

Data analysis involved both quantitative and qualitative techniques. Descriptive statistics were employed to summarize numerical data, identifying patterns in teachers' responses regarding their familiarity, comfort, and perceived benefits of digital game-based learning. Meanwhile, qualitative data from interviews underwent thematic analysis following Braun and Clarke's (2006) framework, which facilitated the identification of recurring themes and emerging insights into teachers' engagement with digital games in physics instruction.

4. Findings and Discussion

4.1 Teachers' Perceptions in the Utilisation of Instructional Digital Games

To gain a comprehensive grasp of teachers' perceptions regarding the utilisation of digital games in physics education, data was collected through questionnaires and interviews. The analysis focused on various aspects of teachers' attitudes, including their comfort level with utilising digital games, perceived usefulness, and intentions to incorporate these tools into their teaching practices.

4.1.1 Findings on Teachers' Comfort Level with Utilising Instructional Digital Games

To assess teachers' perceptions of digital game utilisation in physics instruction, they were asked to rate their comfort level with integrating these tools into their teaching. This measure provided valuable insights into their attitudes and willingness to adopt digital games as instructional resources. The findings are presented in Table 1.

Table 1: Teachers' Comfort Level with Utilising Instructional Digital Games

Comfort Level	Number of Teachers	Percentage
Very Uncomfortable	1	9.1%
Uncomfortable	2	18.2%
Neutral	3	27.3%
Comfortable	4	36.4%
Very Comfortable	1	9.1%
Total	11	100%

The data in Table 1 reveals a diverse range of comfort levels among physics teachers regarding the use of instructional digital games. A significant proportion of teachers (45.5%) reported feeling comfortable or very comfortable with the idea of utilising these tools in their teaching. This suggests that nearly half of the surveyed teachers have a positive disposition toward incorporating digital games into their instructional practices.

However, it's important to note that a considerable percentage (27.3%) of teachers expressed a neutral stance. This neutral position could indicate a lack of experience with digital games in education, uncertainty about their effectiveness, or a cautious approach to adopting new teaching technologies. The presence of this substantial neutral group suggests an opportunity for professional development and support to potentially shift these teachers towards a more positive perception of digital games in physics education.

Notably, 27.3% of teachers reported feeling uncomfortable or very uncomfortable with utilising digital games. This discomfort could stem from various factors, such as lack of familiarity with game-based learning, concerns about classroom management when utilising games, or skepticism about the educational value of digital games in physics teaching. To visualize this distribution, Figure 1 presents a pie chart of teachers' comfort levels:

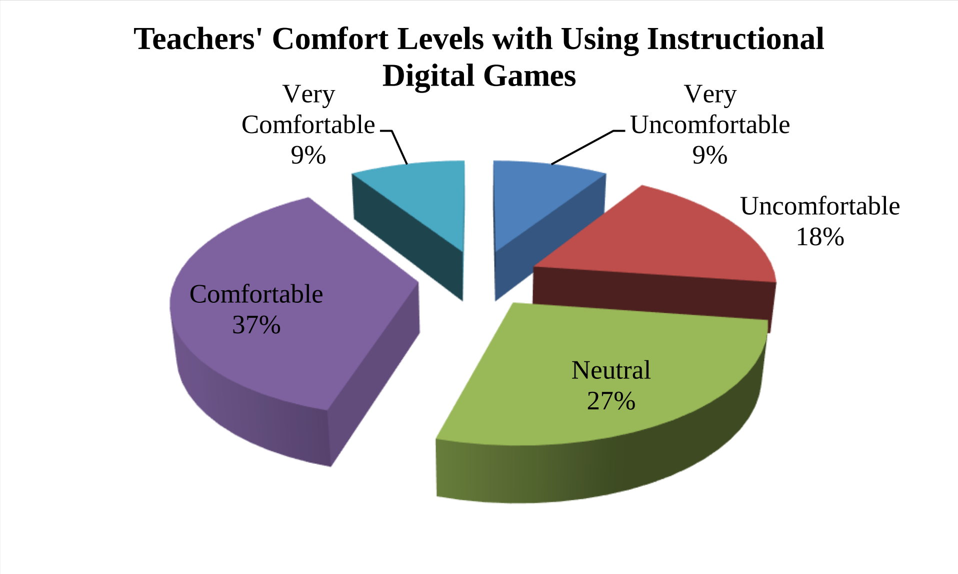

Figure 1: Pie Chart of Teachers' Comfort Levels with Utilising Instructional Digital Games

Qualitative data from interviews provided further insights into teachers' comfort levels. For instance, Teacher A, who reported feeling comfortable with digital games, elaborated on their perspective:

> "I'm comfortable using digital games in physics classes as they enhance engagement, especially for abstract concepts. For instance, simulations of particle behavior improved student understanding and enthusiasm. While I worry about technical issues and lost instructional time, the benefits outweigh the risks."

Conversely, Teacher B, who expressed discomfort with digital games, shared their reservations:

> "I'm hesitant to use digital games in physics due to classroom management challenges and the time needed for integration. Students can get distracted, making it hard to refocus on physics concepts. With exam pressure, I'm unsure if the benefits justify the effort. However, I acknowledge my lack of exposure and would be open to learning with proper training and support."

These qualitative insights provide context to the quantitative data, highlighting the complex factors that influence teachers' comfort levels with instructional digital games. The findings suggest a mixed level of comfort among teachers, which could significantly influence their willingness to adopt and effectively implement digital games in their physics teaching.

4.1.2 Findings on Perceived Usefulness of Instructional Digital Games

To further understand teachers' perceptions, the study assessed their views on the usefulness of instructional digital games in physics education. Teachers rated their perception on a 5-point Likert scale, where 1 represented "Not at all useful" and 5 represented "Extremely useful". This assessment aimed to gauge their attitudes towards the value of these tools in enhancing physics education. Table 2 presents the findings.

Table 1: Teachers' Perceived Usefulness of Instructional Digital Games

Perceived Usefulness	Number of Teachers	Percentage
Not at all useful (1)	0	0%
Slightly useful (2)	2	18.2%
Moderately useful (3)	3	27.3%
Very useful (4)	4	36.4%
Extremely useful (5)	2	18.2%
Total	11	100%

The data in Table 2 reveals a generally positive perception of the usefulness of instructional digital games in physics education. A majority of teachers (54.6%) perceived these games as very or extremely useful, indicating a strong recognition of their potential value in physics teaching. This positive outlook suggests that many teachers see digital games as viable tools for enhancing their instructional practices and potentially improving student learning outcomes in physics.

It's noteworthy that no teachers rated instructional digital games as "Not at all useful," which indicates a baseline acknowledgment of their potential value, even among those who might be hesitant to use them. This absence of completely negative perceptions is encouraging for the potential adoption of game-based learning in physics education.

However, the data also reveals some reservations. A significant portion of teachers (27.3%) viewed these games as only moderately useful, while 18.2% considered them slightly useful. This suggests that while there's a general acceptance of the potential of digital games, there's also a degree of skepticism or uncertainty about their practical usefulness in physics education. These mixed perceptions might stem from various factors, such as limited exposure to effective educational games, concerns about alignment with curriculum standards, or uncertainty about how to integrate games effectively into existing teaching practices.

The qualitative data from interviews provided deeper insights into teachers' perceptions of usefulness. Teacher C, who rated digital games as very useful, elaborated on their perspective:

> "Instructional digital games are highly useful in physics, especially for visualizing abstract concepts. For example, a simulation of electromagnetic waves helps students manipulate wave properties and see real-time effects, bridging the gap between formulas and physical phenomena. Many grasp concepts better through this interactive approach. However, their effectiveness depends on curriculum alignment and purposeful integration into teaching."

Teacher D, who rated the games as moderately useful, shared a more nuanced view:

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> "Instructional digital games can be useful in physics, offering instant feedback and a safe space for experimentation. For example, a projectile motion game allows students to adjust variables like launch angle and velocity, enhancing engagement and understanding. However, these games work best as supplements rather than primary teaching tools. Traditional problem-solving remains essential for mastery, and not all physics topics are well-supported by available games."

These qualitative insights provide context to the quantitative data, highlighting the perspectives teachers hold regarding the usefulness of instructional digital games. Teachers recognize the potential benefits, particularly in areas like concept visualization and student engagement, but also express thoughtful considerations about their limitations and the importance of purposeful use.

4.1.3 Findings on Intention to Incorporate Instructional Digital Games

To assess teachers' perceptions about the future role of instructional digital games in their teaching, they were asked about their likelihood of incorporating these tools into their future physics lessons. This intention reflects their overall attitude toward the utilisation of instructional digital games in physics education and provided insight into potential future adoption rates. Table 3 presents the findings.

Table 2: Teachers' Intention to Incorporate Instructional Digital Games

Likelihood of Incorporation	Number of Teachers	Percentage
Very Unlikely	1	9.1%
Unlikely	2	18.2%
Neutral	3	27.3%
Likely	3	27.3%
Very Likely	2	18.2%
Total	11	100%

The data in Table 3 reveals a diverse range of intentions among physics teachers regarding the incorporation of instructional digital games into their future teaching practices. A significant proportion of teachers (45.5%) indicated that they were likely or very likely to incorporate these games, suggesting a positive outlook towards the utilisation of game-based learning in physics education.

This willingness to adopt digital games aligns with the earlier findings on perceived usefulness, indicating that teachers who see value in these tools are more inclined to consider utilising them in their future lessons. The presence of a substantial group of teachers ready to embrace this technology is encouraging for the potential growth of game-based learning in physics education.

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However, the data also reveals some hesitation among teachers. A considerable percentage (27.3%) expressed a neutral stance, suggesting uncertainty or ambivalence about incorporating digital games into their teaching. This neutral group might represent teachers who are open to the idea but require more information, support, or evidence of effectiveness before committing to adoption.

Notably, 27.3% of teachers indicated that they were unlikely or very unlikely to incorporate digital games. This reluctance could stem from various factors, such as a lack of familiarity with suitable games, concerns about utilisation challenges, or skepticism about the educational value of game-based learning in physics.

To better illustrate the relationship between teachers' comfort levels and their intentions to incorporate instructional digital games, Figure 2 presents a scatter plot of these two variables:

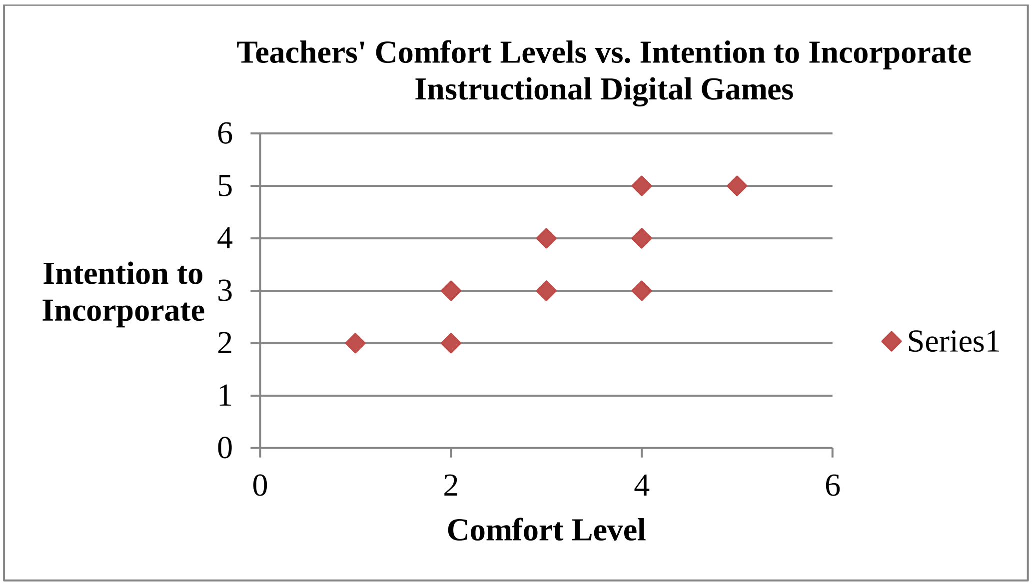

Figure 1: Scatter Plot of Teachers' Comfort Levels vs. Intention to Incorporate Instructional Digital Games

The scatter plot in Figure 2 reveals a general trend where higher comfort levels correlate with increased intention to incorporate digital games, though there are some exceptions to this pattern.

Interview data provided context for these intentions. Teacher E, who was likely to incorporate games, explained their perspective:

> "I'm eager to integrate digital games into my physics teaching, as they enhance student engagement and experimentation. For instance, a virtual lab simulation for circuits allowed students to build and test designs without physical lab constraints, sparking deeper inquiry. However, effective use requires careful planning. I aim to start with small, targeted utilisations, ensuring alignment with curriculum standards and assessments, then expand based on student outcomes and my growing confidence."

In contrast, Teacher F, who was unlikely to incorporate games, cited several concerns:

> "I'm hesitant about using digital games in my physics lessons due to the time required for learning and utilisation, especially with a packed curriculum and exam pressures. While I'm not entirely opposed, I would need clear evidence of their benefits and sufficient training and support. For now, I prefer to refine traditional teaching methods

and hands-on labs, which I know effectively engage students and enhance their understanding."

These qualitative insights highlight both the enthusiasm of those ready to embrace this technology and the valid concerns of those more hesitant.

4.1.4 Findings on Specific Perceptions about Instructional Digital Games

To gain deeper insights into teachers' perceptions, they were asked to rate their agreement with specific statements about instructional digital games on a 5-point Likert scale, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree". This detailed assessment aimed to uncover their attitudes towards various aspects of game-based learning in physics education. Table 4 presents the findings.

Table 3: Teachers' Specific Perceptions about Instructional Digital Games

Statement	Mean Score	SD
1. Digital games can make physics more engaging for students	4.27	0.79
2. Digital games help visualize abstract physics concepts	4.18	0.87
3. Digital games provide valuable instant feedback	4.00	0.89
4. I am concerned about technical issues when utilising digital games	3.73	1.10
5. I worry about losing control of the class when utilising digital games	3.45	1.21
6. Learning to use digital games effectively would take too much time	3.36	1.29
7. Digital games can improve student understanding of physics concepts	3.91	0.94
8. I feel confident in my ability to integrate digital games into my lessons	3.18	1.17

The data in Table 4 offers a comprehensive overview of teachers' perceptions regarding the use of digital games in physics education, revealing both enthusiasm for their potential benefits and concerns about practical utilisation.

Teachers strongly recognized the motivational potential of digital games, noting that these tools significantly enhance student engagement with an average rating of 4.27. This high score suggests that teachers see digital games as a powerful means to capture and maintain student interest in physics concepts, potentially addressing the challenge of student disengagement often faced in traditional physics instruction.

The ability of games to visualize abstract concepts was also highly valued, with a strong agreement rating of 4.18. This perception aligns with one of the key challenges in physics education – helping students grasp abstract and complex concepts. Teachers appear to see digital games as effective tools for making intangible ideas more concrete and understandable for students.

Teachers appreciated the instant feedback provided by digital games, giving this aspect an agreement score of 4.00. This recognition of the value of immediate feedback suggests that teachers see potential in games to enhance the learning process by allowing students to quickly understand and correct misconceptions.

However, the findings also pointed to several concerns. Technical issues were a moderate concern with a score of 3.73, indicating that while teachers see the potential of digital games, they are also wary of the practical challenges that might arise from their utilisation. This concern highlights the need for robust technical support and reliable infrastructure to facilitate the smooth utilization of instructional digital games in physics classrooms.

Classroom management emerged as another challenge, with teachers expressing some worry about maintaining control during game-based activities, reflected by a score of 3.45. This concern suggests that teachers may need support in developing strategies to effectively manage classrooms during game-based learning sessions.

The time investment required to learn and implement digital games also raised concerns, scoring 3.36. This perception underscores the need for efficient professional development programs and user-friendly gaming platforms that minimize the time teachers need to invest in preparation.

Despite these challenges, teachers believed in the educational value of digital games to enhance students' understanding of physics concepts, evidenced by a score of 3.91. This positive perception suggests that teachers see potential in games to not just engage students, but also to meaningfully contribute to their learning outcomes.

However, teachers expressed only moderate confidence in their ability to integrate these games effectively into their teaching practices, with a self-efficacy rating of 3.18. This lower score suggests a need for targeted support and training to boost teachers' confidence and competence in utilising digital games.

To provide context to these quantitative findings, qualitative data from interviews offered deeper insights into teachers' perceptions. For example, teacher H, who expressed concerns about technical issues and classroom management, shared:

> "Digital games have potential, but practical challenges concern me. In a circuit-building simulation lesson, technical issues disrupted learning, leading to frustration and disengagement. However, once resolved, students who engaged showed improved understanding. This experience highlighted both the benefits and drawbacks of digital games. With better technical support and experience in managing game-based lessons, I believe these tools could be highly valuable."

The findings suggest that while teachers recognize the potential of digital games to enhance engagement, visualization, and understanding of physics concepts, they also have valid concerns about practical utilisation. Addressing these concerns could help bridge the gap between the perceived benefits of digital games and their effective utilisation in physics classrooms.

4.2 Discussion of Findings

The findings highlight a dynamic interaction between teachers' attitudes, facilitating factors, and obstacles that shape their perceptions and adoption of DGBL. These insights align with Davis's (1989) Technology Acceptance Model (TAM), which underscores the role of perceived usefulness and ease of use in influencing technology adoption decisions.

The study revealed that while 45.5% of teachers expressed comfort with DGBL, a notable 27.3% remained neutral, indicating a "wait-and-see" stance similar to Rogers et al.'s (2014) early majority adopters. This pattern aligns with broader trends in educational technology adoption, where teachers often demonstrate cautious optimism while awaiting concrete evidence of effectiveness (Sánchez-Mena et al., 2019). Furthermore, the observed correlation between comfort levels and implementation intentions reinforces Ertmer and Ottenbreit-Leftwich’s (2010) argument that teacher confidence plays a crucial role in technology integration.

Teachers' strong recognition of DGBL's potential benefits, particularly in visualization (M=4.18) and engagement (M=4.27), echoes recent empirical findings. For instance, Hussein et al. (2019) documented similar positive perceptions among science teachers regarding DGBL's capacity to make abstract concepts concrete. However, the gap between perceived usefulness and actual implementation intentions suggests the presence of what Ertmer et al. (2012) termed second-order barriers - beliefs and attitudes that affect technology integration.

The concerns expressed about technical issues (M=3.73) and classroom management (M=3.45) align with Baek's (2008) identified barriers to game implementation. These findings are particularly relevant in the Kenyan context, where infrastructure challenges may compound implementation difficulties. The moderate confidence levels in-game integration (M=3.18) suggests a need for what Koh et al. (2015) describe as technological pedagogical content knowledge (TPACK) development specific to game-based learning.

Interestingly, the study reveals a nuanced relationship between teaching experience and DGBL attitudes, supporting Hsu et al.'s (2017) findings that teacher perceptions vary across career stages. The qualitative data particularly illuminates how teachers negotiate between perceived benefits and practical constraints, reflecting what Alfalah (2018) terms the "implementation reality gap" in educational technology adoption.

The findings also highlight the critical role of institutional support and professional development, consistent with Tondeur et al.'s (2012) emphasis on the importance of systemic support for technology integration. The teachers' concerns about time investment (M=3.36) echo recent studies by Hébert et al. (2021), who found that time constraints remain a significant barrier to DGBL adoption across different educational contexts.

5. Conclusion

The study revealed a generally positive disposition among teachers towards the utilisation of digital games in physics education, with a significant proportion expressing comfort and recognizing the potential benefits of DGBL. Teachers acknowledged the capacity of digital games to enhance student engagement and facilitate the visualization of abstract physics concepts, which are often challenging to convey through traditional teaching methods.

Despite the positive perceptions, the study identified several barriers that hinder the widespread adoption of DGBL. Technical issues, classroom management challenges, and the time required to learn and integrate digital games were significant concerns among teachers. These findings underscore the need for robust technical support, effective classroom management strategies, and efficient professional development programs to address these barriers. The moderate confidence levels reported by teachers in their ability to integrate digital games suggest a need for targeted training to enhance their technological pedagogical content knowledge (TPACK) specific to game-based learning.

The study also highlighted the critical role of institutional support in facilitating DGBL adoption. Teachers emphasized the importance of professional development opportunities and access to high-quality, curriculum-aligned digital games. Institutional constraints, such as rigid school structures and insufficient resources, were identified as significant obstacles to the effective implementation of DGBL. Addressing these systemic issues is essential for fostering a supportive environment that encourages the integration of digital games into physics instruction.

6. Recommendations

Several recommendations are proposed to enhance the utilisation of DGBL in physics education within secondary schools in Kenya.

First, it is essential to provide targeted professional development programs for physics teachers. These programs should focus on enhancing teachers' TPACK specific to game-based learning. Training should include practical workshops that demonstrate effective strategies for integrating digital games into physics instruction, addressing both technical and pedagogical aspects. By increasing teachers' confidence and competence, these programs can help overcome the moderate confidence levels reported in the study.

Second, schools should invest in robust technical infrastructure and support systems to facilitate the smooth implementation of DGBL. This includes ensuring reliable internet connectivity, access to appropriate hardware, and technical support staff to assist teachers in managing technical issues. By addressing these infrastructure challenges, schools can reduce the technical barriers that currently hinder the adoption of digital games in physics education.

Third, it is crucial to develop and provide access to high-quality, curriculum-aligned digital games that are specifically designed for physics education. Collaborations between educational technology developers, curriculum experts, and teachers can lead to the creation of games that effectively align with learning objectives and assessment standards. This alignment will help teachers overcome concerns about curriculum fit and enhance the perceived usefulness of digital games.

Fourth, institutional support should be strengthened to create a conducive environment for DGBL adoption. School administrations should encourage and support teachers in experimenting with digital games by providing time, resources, and incentives for innovation in teaching practices. Additionally, fostering a culture of collaboration among teachers can facilitate the sharing of best practices and experiences, further promoting the effective use of digital games in physics instruction.

Finally, policymakers should consider integrating DGBL into national education strategies and curricula. By recognizing the potential of digital games to enhance learning, educational authorities can provide the necessary support and resources to scale up successful DGBL initiatives across schools. This strategic integration can contribute to improving physics education and addressing the historically low performance in national examinations.

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