Teaching Motion Concepts through *Pokémon Unite*: Students' Acceptance and Experiences

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ABSTRACT

Purpose of this study: This study aims to improve student learning outcomes and engagement by investigating the integration of Pokémon Unite into Physics instruction..

Methodology: In this mixed-methods study, thirty Cebu City 12th graders were taught motion-related physics principles via Pokémon Unite. The game's acceptability and efficacy were evaluated using surveys and interviews. The data was analyzed using descriptive statistics and thematic analysis, guaranteeing truthful responses and data integrity.

Main Findings: Results showed high student acceptance, bolstered by the game's engaging gameplay and skillful use of Physics concepts. Students praised the game's enjoyment, relevance, effectiveness, and engagement as a satisfying tool reflected in Physics teaching. Students' good experiences are further clarified through qualitative analysis, highlighting themes like immersive learning environments, collaborative problem-solving, personalized learning, enhanced motivation and interest, and real-world application of physics principles. These results highlight the potential of digital game-based learning in physics education and suggest additional studies and innovative strategies to improve student outcomes.

Novelty/Originality of this study: This study showed that *Pokémon Unite* is a useful teaching tool for Physics and has a high student acceptance and participation level. Through digital game-based learning, it provides fresh perspectives on individualized instruction, group problem-solving, and the practical application of physics ideas.

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1.   INTRODUCTION

Digital game-based learning is becoming a viable method to improve science instruction in the ever-changing field of education [1]-[2]. Even though this approach has much potential, more of it needs to be used, and many science teachers are still learning how to incorporate digital games into their lessons [3]-[4]. Conventional science teaching approaches frequently need to be more fully engaging with students, which causes a rift between the students and the content [5]. Digital games provide an engaging and dynamic learning environment, making them a viable choice due to their interactive and immersive features [6]-[7]. Students can study complex subjects, like Physics, in a more approachable and relatable way by participating in experiential learning through digital games. Experience-based learning emphasizes learning by experience and reflection [8]. In addition to meeting the needs of students who are digital natives, this paradigm toward game-based learning

satisfies the expanding demand for innovative teaching strategies that may close the knowledge gap between theory and practice [9]. To guarantee that these games improve learning outcomes rather than just providing pleasure, digital game-based learning must be carefully planned and optimized to realize its full potential.

In digital game-based learning, strategic team digital games have demonstrated the potential to develop students' problem-solving, critical thinking, and collaborative abilities [10]. *Pokémon Unite* is one such game that has drawn interest as a possible helpful teaching aid for Physics concepts. The Pokémon Company published *Pokémon Unite*, a multiplayer online battle arena game created by TiMi Studios [11]. In this game, users take control of Pokémon characters and fight strategically in a virtual arena. Teamwork and individual skill are both necessary for victory. The game's design strongly emphasizes essential teaching components, including strategy, teamwork, and decision-making, all critical for grasping challenging Physics topics. The way that the game's mechanics require players to constantly examine and react to the movements and interactions of the characters is particularly conducive to teaching motion-related concepts. Because of this alignment, *Pokémon Unite* is a favorite game among young Filipinos and could be a valuable resource for teachers looking to improve their Physics lessons using digital games. However, using these games in classrooms must be done carefully, especially in the Philippines, where access to technology and preparedness for digital integration might differ significantly between urban and rural communities [12]-[13]. Although *Pokémon Unite* can potentially enhance learning outcomes, its effectiveness as a teaching tool depends on how well it is integrated into the curriculum.

Despite the growing interest in digital game-based learning, research examining the use of digital games for teaching motion-related physics concepts is minimal, as evidenced by the application of specific games such as *Angry Birds* [14]. This knowledge of how particular games can be successfully implemented in particular educational situations is lacking because most game-based learning research has focused on broader game-based learning methodologies or general kinds of games like adventure [15] and augmented reality games [16]. This gap is especially noticeable in Physics education, where the abstract nature of many topics challenges conventional teaching approaches. The theoretical, practical, and methodological aspects of employing games for Physics training have yet to be thoroughly investigated, even if digital game-based learning presents a viable option. For example, more research needs to be done on the game's mechanics to teach particular Physics ideas, such as the laws of motion or force and energy concepts. Furthermore, there still needs to be more research on the real-world challenges associated with incorporating a game into an organized learning environment, such as matching the game's content to the curriculum or determining how it affects learning objectives. By filling in these gaps, this study hoped to clarify digital game-based learning and its place in contemporary education by offering insightful information about the viability and effectiveness of using *Pokémon Unite* as a teaching tool for Physics.

The study aimed to investigate how well students receive *Pokémon Unite* as a teaching aid for Physics concepts about motion. With digital games becoming increasingly popular, it is crucial to know how students view and use these tools to apply them in the classroom. Understanding that a satisfying gaming session or high engagement rates do not always translate into successful learning is crucial. Thus, this study examined how much the students enjoy and interact with the game and how it affects their comprehension of Physics concepts. By doing this, the study shed light on the advantages and drawbacks of utilizing *Pokémon Unite* as a teaching tool, giving teachers the knowledge they need to improve and innovate physics education in the age of digital technology.

This study is essential because it adds to the current discussion on digital game-based learning and its use in Physics education. This study thoroughly analyzed how game-based learning might be customized to teach motion-related concepts in Physics by concentrating on *Pokémon Unite*. The study results could deepen our knowledge of successful teaching strategies that help students succeed in Science, Technology, Engineering, and Mathematics. Furthermore, this research addressed the gap in the literature by investigating the viability and effectiveness of utilizing *Pokémon Unite* as a teaching tool. It presented fresh ideas for incorporating digital games into Science instruction in general. By doing this, the study could contribute to the theoretical framework of digital game-based learning and provide valuable suggestions for teachers who want to use these resources in the classroom. Ultimately, the study insights could be used to build more specialized and situation-specific approaches that tackle the particular challenges of teaching Physics in various educational contexts, especially in areas where more conventional approaches might be less successful.

Games in education have become popular, especially in courses like Physics that require a deep understanding of abstract ideas [16]-[18]. This approach incorporates games into the classroom to create dynamic, exciting experiences that motivate students to participate actively in their classes [19], [20]. By presenting complex scientific concepts in a more approachable manner through games, teachers enable students to investigate and comprehend abstract ideas through tangible, hands-on experiences [21]. For instance, games can offer visual representations of concepts like motion [14], [17], [22], heat transfer [23], and wind and gravity theory [24], which help students better understand these ideas. Additionally, games foster a learner-centered climate, allowing students to take chances, explore, and learn from their mistakes without worrying about failing [9], [25]. This helps students develop their critical thinking and problem-solving abilities.

Digital games explicitly designed for Physics education offer unique chances to combine interactive learning components with instructional content [26], [27]. By providing a virtual playground where students can experiment, change variables, and see instant outcomes, these games help students make abstract ideas more relatable [14], [16], [28]. A better comprehension of the concepts results from the frequent use and experimentation that digital platforms enable at a speed that works for each learner [29]. For instance, students can experiment with various scenarios and quickly see how modifications affect outcomes by playing games that imitate the laws of motion [30] or thermodynamics [31]. This interactive feedback loop can foster independent physics concept exploration, confidence-building, and learning reinforcement [32], [33]. Furthermore, many digital games have integrated assessments and progress tracking, which gives teachers important information about what their students are learning and where they might need more help [19], [33].

Students' and teachers' increased adoption of digital games for education reflects the growing interest in these tools. Digital games are often enticing to students because of their interactive features, visual appeal, and chance to learn in a way that is less formal and more fun than conventional techniques [15], [27], [34]. They are inspired by the obstacles and triumphs in the game, which may stimulate their interest in the topic. On the other hand, if digital games are easy to use, clearly help student learning, and correspond well with curricular goals, teachers are more likely to embrace them [35]. Acceptance, however, might differ based on many variables, such as the degree to which the game's content is thought to relate to learning objectives, the resources and support that are available for integrating the game, the degree of digital literacy possessed by both teachers and students and among others as revealed in the systematic reviews of Wang et al. [2] and Ullah et al. [36].

Digital games offer a dynamic and engaging approach to interacting with complicated concepts, demonstrating the potential to improve learning outcomes in Physics [17], [27]. These games provide realistic simulations and scenarios that let students apply their knowledge in a safe setting, helping close the knowledge gap between theory and practice [35], [37]. For instance, by allowing users to manage motion actively [14], [17], [22] and energy [23], [24] and observe the results of their actions right away, digital games can aid students in understanding these concepts. This practical technique can result in better problem-solving abilities, increased information retention, and a deeper comprehension of concepts [2], [33], [36]. Additionally, digital games can accommodate a variety of learning preferences by offering kinesthetic, auditory, or visual learners a variety of ways to interact with the content, similar to results from other techniques such as learning videos [38] and virtual experiments [39]. While there are many advantages to digital games, how well they complement conventional teaching methods, are carefully integrated into the curriculum, and are designed all affect their effectiveness.

Though students' experiences with digital games in physics vary widely, many studies revealed benefits, including improved motivation [15], engagement [40], and self-assurance in their capacity to comprehend complex ideas [33]. Games' interactive and competitive elements can make studying more enjoyable and stimulating, encouraging students to have a more positive attitude about physics [17]. Additionally, games provide opportunities for cooperation and teamwork, which can foster social and communication skills in children as they cooperate to solve challenges or accomplish shared objectives [41]. Even so, particular challenges exist, including the potential for diversion when games lack a strong correlation with academic goals or are inadequately included in the broader learning approach [35], [42]. Technical problems, student differences in digital competency, and potential technological access disparities can also impact digital games' efficacy in the classroom [34], [36], [42]. Therefore, rigorous planning and implementation are necessary to guarantee that digital games improve rather than impede learning in physics education. Digital games can transform physics education by enhancing interaction, effectiveness, and engagement. However, the success of these programs hinges on how well they are incorporated into the curriculum, the unique requirements of the pupils, and the teachers' educational objectives. Continuous investigation and creativity are essential to optimize the advantages of digital game-based learning and tackle any obstacles that may emerge.

This study investigated the acceptance of the digital game *Pokémon Unite* in teaching motion concepts in Grade 12 Physics in a public school in Cebu City, Philippines. Specifically, the researcher determined the level of acceptance in enjoyment, relevance, effectiveness, engagement, and satisfaction through the lens of the students who used the digital game during their Physics classes. To complement this quantitative lens, the researcher also qualitatively explored their experiences when the digital game was used to teach physics.

2. RESEARCH METHOD

2.1 Research Design

This study used mixed methods research using descriptive quantitative and basic qualitative designs, which is appropriate for thoroughly investigating *Pokémon Unite* in teaching motion-related physics concepts. The quantitative component made it possible to analyze data systematically, providing insight into how acceptable *Pokémon Unite* is among students. Through open-ended interviews, the qualitative component provided a better understanding of students' experiences, enhancing the findings with insightful contextual information.

2.2 Research Subjects

Thirty Grade 12 students from a public school in Cebu City in Central Visayas, Philippines, participated in the study. These students were chosen through purposive sampling because they represented a population relevant to examining the application of *Pokémon Unite* in physics teaching. This sampling strategy was selected to ensure that the study's findings would be meaningful and applicable in settings similar to schools, especially in the Philippines.

2.3 Data Collection Techniques and Instruments

The study used both quantitative and qualitative instruments for data collection. A survey questionnaire with a Likert scale and a reliability coefficient of α=0.83 was created by the researcher and used. This survey was created using the recommendations made by Amaefule et al. [43] and was verified for suitability and accuracy by three physics education specialists. This quantitative instrument aimed to gauge how well acceptable *Pokémon Unite* is among students as a physics learning tool. In-depth interviews were also conducted utilizing a semi-structured interview guide, which allowed the researcher to delve into the opinions and individual experiences of the students regarding their use of the game as a means of learning motion concepts. This dual approach made comprehending the students' experiences and overall impressions easier.

2.4 Research Procedures

Before implementing the game, the researcher secured permission from the school principal and informed consent from the student participants. *Pokémon Unite* was used to teach motion concepts like distance/displacement, speed/velocity, and acceleration, specifically solving problems involving the said concepts based on the Grade 12 Physics curriculum guide. Additionally, the game was integrated during the introductory and reinforcement phases of the lesson. In the introductory phase, the game served as a springboard for illustrating motion concepts; for instance, different Pokemon move at varying speeds or change direction to visually represent the concepts of speed and velocity. In the reinforcement phase, the game was used to deepen their understanding by making the game a hands-on application and problem-solving media.

Direct participant engagement was ensured through surveys and in-person interviews, and measures were taken to reduce response bias. To promote honest responses, neutral, open-ended survey questions, and interview protocols were used, along with anonymity and confidentiality measures to minimize bias. Strict data management procedures were implemented, including encryption techniques, restricted access rights, and frequent audits, to protect the integrity and privacy of the information obtained.

2.5 Data Analysis Techniques

Descriptive statistics, such as mean and standard deviation, were used to examine quantitative data from the questionnaires to determine how students felt about *Pokémon Unite*. Braun and Clarke's six-step method for thematic analysis of qualitative interview data made it easier to find recurrent themes and patterns in students' narratives [44]. These quantitative and qualitative analyses thoroughly explained how well Pokémon Unite teaches motion concepts.

3. RESULTS AND DISCUSSION

3.1. Acceptance of *Pokémon Unite*

Table 1 presents the students' acceptance of using *Pokémon Unite* aggregated across motion concepts included in the study.

Table 1. Acceptance of *Pokémon Unite* in Teaching Motion Concepts

Aspect	Description	No. of Items	Mean	SD	Description
Enjoyment	Entertaining and captivating experience	5	4.04	0.78	Acceptable
Relevance	Applicable and pertinent to real-life	5	3.98	0.83	Acceptable
Effectiveness	Facilitating understanding and application	5	3.98	0.84	Acceptable
Engagement	Sustaining motivation and interest	5	4.07	0.86	Acceptable
Satisfaction	Fulfilling and meeting expectations	5	4.11	0.81	Acceptable

Legend: 1.00-1.80 (Not acceptable), 1.81-2.60 (Fairly acceptable), 2.61-3.40 (Moderately acceptable), 3.41-4.20 (Acceptable), 4.21-5.00 (Very acceptable)

The data shown in Table 1 reveal that *Pokémon Unite* is accepted in many ways when it comes to being integrated into motion lessons. The captivating and pleasurable gameplay of the game (Enjoyment, μ=4.04) contributes to its high acceptance. Prior studies have demonstrated the beneficial effects of fascinating games on

students' motivation and pleasure in their studies [45]. Students' pleasure in the game was enhanced by its immersive and interactive elements, which made learning more entertaining and engaging. Relevance and effectiveness (μ=3.98) also indicate that students consider the game to help them learn meaningful motion concepts. This is explained by how the mechanics and settings of the game incorporate Physics concepts, giving them real-world applications and solving problems [15]. The game's instant feedback and experimental opportunities, as reported by the participants, also contributed to its increased efficacy as a teaching tool, helping students understand Physics concepts more thoroughly.

When utilizing *Pokémon Unite* for Physics instruction, students demonstrated a high level of engagement (μ=4.07). This is explained by the game's immersive and interactive aspects, encouraging prolonged attention and active participation [15]. The game's dynamic and interactive gameplay encouraged investment and involvement in the learning process, as asserted by the participants, raising interest in Physics. Ultimately, the Satisfaction aspect (μ=4.11) indicates that students were delighted with Physics teaching through the game, given that it can match or exceed their expectations, offering a rewarding and positive educational experience [14]. The high students' acceptance of the game Physics teaching could be attributed to the overall positive experience and satisfaction from utilizing it.

3.2. Experiences while Using Pokémon Unite
Analysis of the qualitative transcripts revealed five themes, as discussed below.

3.2.1 Immersive Learning Environment
Students were inspired to investigate the physics ideas offered in the game and were fully absorbed in the learning environment created by *Pokémon Unite*. Because of the immersive experience provided by the game's vibrant graphics and interactive features, students could experience physics in a setting that seemed real and relevant, making abstract ideas easier to understand. Students felt they were active participants in their learning process rather than merely passive information users, significantly improving their comprehension of physics topics. This level of engagement led to a heightened sense of involvement.

A male game player stated, *"Sa dihang nagduwa ko ug Pokémon Unite, na-feel nako nga mura nakog na-experience ang mga Physics concepts sa klase. Kung mu-paspas akoang Pokemon, ma-relate dayon nako sa speed or acceleration."* ("When I was playing Pokémon Unite, it felt like I was experiencing the Physics concepts we learned in class. Like when my character moved faster, I could relate it to speed and velocity.") A female newcomer also supports this statement, *"Ang mga graphics ug animation sa dula maoy ningbuhi sa mga physics concepts. Naa ko sa dula, nag-experiment sa lainlaing mga motions ug forces."* ("The game's graphics and animations made the physics concepts come to life for me. I was in the game, experimenting with different motions and forces.")

Pokémon Unite's dynamic visuals and interactive gaming mechanics made a big difference in establishing an engaging learning environment where students felt utterly involved. These components attracted and maintained their attention, enabling users to interact more fully with the physical ideas the game presents. Students were encouraged to use their grasp of physics in relevant and practical ways as they worked through realistic scenarios and obstacles, reinforcing their learning. This immersive encounter is consistent with earlier studies that demonstrate how these settings might promote more profound learning possibilities by increasing the relatability and accessibility of abstract ideas. Ultimately, the game's interactive and visual components improved students' understanding of complex concepts, highlighting the potential of digital games as helpful teaching aids [15].

3.2.2 Practical Application of Physics Concepts
Students' understanding and appreciation of physics deepened when they actively applied the concepts they learned in *Pokémon Unite* to real-world situations. Due to the interactive approach in the game environment, students could understand the relevance and practical application of abstract concepts in everyday life. Students found connecting theoretical knowledge and practical application more straightforward when interacting with these topics through gaming, improving their learning experience.

A male student who has frequently played the game shared, *"Sa dula, kinahanglan nako nga mag-estratehiya ug maka-compute ang strong angles og trajectory aron maigo ang laing team. Kini sama sa paggamit sa projectile motion nga ma-enjoy og maka-learn ka."* ("In the game, I had to strategize and calculate the best angles and trajectories to achieve certain goals. It was like applying projectile motion concepts fun and meaningfully.") Another male player reflected, *"Ang pagdula sa Pokémon Unite nakatabang nako nga masabtan kung nganong mahitabo ang mga butang sa Physics. Mura siya og real-life experience diin makita nako ang cause ug effect niini.."* ("Playing *Pokémon Unite* helped me understand why specific actions have consequences in Physics. It is like a real-life experiment where you see cause and effect in action.")

Offering concrete examples and contexts within the game, students could visualize and comprehend the practical applications of physics concepts. This experience closed the gap between abstract theory and real-world application, increasing the relatability and engagement of the learning process. Students could solve puzzles and experiment dynamically by actively participating in the game's situations, strengthening their understanding of

physics concepts. Such an approach is consistent with research showing how games can create meaningful learning contexts that increase student engagement and help them understand complicated concepts at a deeper level. With this, the approach promoted a deeper connection between the students and the subject of physics by assisting them to see it as applicable to their everyday lives [15], [46], [47].

3.2.3 Collaborative Learning and Problem-Solving

As they played *Pokémon Unite*, students actively participated in cooperative learning and problem-solving, cooperating to overcome obstacles and accomplish shared objectives. In this cooperative multiplayer setting, students collaborated and worked as a team, planning and helping one another in real time. Through these exchanges, they gained a sense of unity and the ability to think critically, realizing the value of teamwork in reaching goals as a group.

One female player commented, "*Naa mi team mentality kung magduwa mi ug Pokémon Unite. Magplano mi sa amoang buhatunon, nga makatabang sa amoang pagsabot sa concepts sa motion like velocity og force.*" ("Playing Pokémon Unite with my classmates felt like we were on a team to win the game. We strategize and coordinate our actions, helping us understand concepts like force and momentum.") A male student new to the game mentioned, "*Kung maglisud mi sa dula, mag brainstorm mi para makadaog. Mura ka og naa sa physics lab nga nagtinabangay mo sa experiment para makakat-on*" ("When we encountered difficult tasks or challenges in the game, we had to brainstorm and problem-solve. It was like a mini physics lab where we experimented and learned from each other's insights.")

The collaborative learning activities in the game encouraged students to actively participate and help one another, strengthening their sense of community. Students felt a sense of community and purpose as they collaborated to accomplish shared objectives, increasing their engagement and investment in learning. This dynamic is consistent with research from the literature that shows how cooperative gaming environments improve players' ability to communicate, work as a team, and solve problems. In addition to enhancing learning results, the game's positive interactions and shared experiences strengthened students' bonds with one another and the subject matter. Due to this, the collaborative aspects of the game were vital in sustaining high levels of engagement and cultivating a positive learning environment [48].

3.2.4 Personalized Learning and Self-Discovery

With *Pokémon Unite*, students could explore physical principles in a way that best matched their learning methods. The game adapted experiences to each player's talents and interests, enabling personalized learning and self-discovery. Because of the game's open-ended design, students could explore freely, learn from their failures, and feel more independent and confident in their ability to solve problems than they would have in a regular classroom. Through hands-on, individualized exploration, students could expand their comprehension of physics principles and enhance their general enthusiasm for the subject matter in this autonomous and self-directed learning setting, encouraging them to take initiative in their education.

One male newcomer to the game shared, "*Tungod sa Pokémon Unite, nakakat-on ko sa akoang kaugalingon og nigamit og mga lain-laing strategies para makadaog. Ma-control nako akoang journey, maong rewarding ug meaningful siya.*" ("In *Pokémon Unite*, I could learn at my own pace and explore different strategies to achieve my goals. It was like having control over my learning journey, which made it more rewarding and meaningful.") A male *Pokémon Unite* player realized, "*Na-appreciate nako ang Pokemon nite nga dili dayon muhatag ug answer. Maka-discover ko because of trial and error. Mas maka-learn ka sa imohang mistakes kaysa sa makakuha og things right at the first time.*" ("I appreciated that *Pokémon Unite* did not just tell me the answers; it allowed me to discover them through trial and error. I learned more from my mistakes than from getting things right the first time.")

With the help of the game's customizable and exploratory capabilities, students could take charge of their education. They gained the self-assurance to tackle challenging physics topics through practical experimentation [49]-[51]. The game fostered a deeper connection with the content, resulting in more meaningful learning results by letting students learn at their own pace and approach issues in ways that resonated with their unique learning styles. This learning autonomy inspired students to take on challenges, hone their problem-solving skills, and grow more accountable for their academic achievement [15].

3.2.5 Enhanced Motivation and Interest in Physics

Students' motivation to learn was significantly boosted when they discovered that the game's integration of physics concepts made the subject more engaging and applicable to their daily lives. The game's skillful integration of physics concepts into its mechanics stimulated their attention, transforming theoretical ideas into captivating problems. This strategy sparked their interest and motivated them to learn more about the concept, increasing their desire to investigate and comprehend the intricacies of physics.

One female student new to the game highlighted, "*Saona katong wala pako kadula sa Pokémon Unite, wala nako damha nga ingon-ani ka interesting ang Physics. Tungod sad ula, naka-realize ko nga ang Physics kay*

dili ram ga equations but apil sad diay ang pag-understand sa world." ("Before playing *Pokémon Unite*, I never thought Physics could be this interesting. The game made me realize that Physics is not just about equations but about understanding how the world works.") Another newcomer opined, "*Ang dula ning-challenge nako nga mag-think critically og creatively, nga nakapa-confident nako sa akoa skills. Wala ko nakahunahuna nga ingon-ani ko ma-enjoy sa paglearn sa Physics hangtud nakadula ko sa Pokémon Unite.*" ("The game challenged me to think critically and creatively, making me feel more confident in my skills. I never thought I could enjoy learning about Physics so much until I played *Pokémon Unite*.")

The game increased students' enthusiasm and interest in physics by delivering the topic engagingly and interactively. This strategy aligns with studies highlighting the value of meaningful and stimulating learning opportunities in developing students' intrinsic motivation and pique their interest in academic subjects. The game made learning more engaging, motivating students to put in more effort to comprehend the content by turning abstract physics ideas into interactive problems. These results are consistent with the research showing how game-based learning settings enhance students' motivation, curiosity, and excitement for learning. Ultimately, the game's capacity to make learning engaging and applicable greatly affected students' interest in physics [48], [52].

4. CONCLUSION

Students generally regard *Pokémon Unite* as a valuable tool for integrating physics learning based on its immersive setting, real-world application of physics concepts, collaborative learning opportunities, personalized experiences, and enhanced motivation. However, it is imperative to note that while high engagement or positive experiences are important indicators, they do not inherently signify effective teaching instruction. Students can enjoy the game without achieving significant learning outcomes. Therefore, the distinction between engagement and effective learning must be carefully considered when evaluating the impact of digital games on physics education. To solve this, more research is advised to examine the effects of employing games such as *Pokémon Unite* in physics training through experimental means. This investigation should focus on engagement, measurable learning outcomes, and broader academic applicability. New theories or notions that improve the use of digital games in educational settings and guarantee they significantly advance students' academic performance may result from this further research.

REFERENCES

[1] Y. L. Tsai, and C. C. Tsai, "A meta-analysis of research on digital game-based science learning," Journal of Computer Assisted Learning. vol. 280, pp. 280-294, 2020, https://eric.ed.gov/?id=EJ1253796

[2] L. H. Wang, B. Chen, G. J. Hwang, J. Q. Guan, and Y. Q. Wang, "Effects of digital game-based STEM education on students' learning achievement: A meta-analysis," International Journal of STEM Education, vol. 9, 2022, doi: 10.1186/s40594-022-00344-0.

[3] P. Kaimara, E. Fokides, A. Oikonomou, and I. Deliyannis, "Potential barriers to the implementation of digital game-based learning in the classroom: Pre-service teachers' views," Technology, Knowledge and Learning, vol. 26, pp. 825-844, 2021, doi: 10.1007/s10758-021-09512-7.

[4] Y. H. Wang, "Integrating games, e-books and AR techniques to support project-based science learning," Educational Technology & Society, vol. 23, pp. 53-67, 2020. https://www.jstor.org/stable/26926426

[5] M. Prince, R. Felder, and R. Brent, "Active student engagement in online STEM classes: approaches and recommendations," Advances in Engineering Education, vol. 8, pp. 1-25, 2020, https://www.researchgate.net/publication/347513842_ACTIVE_STUDENT_ENGAGEMENT_IN_ONLINE_STEM_CLASSES_APPROACHES_AND_RECOMMENDATIONS

[6] T. H. Laine, and R. S. Lindberg, "Designing engaging games for education: A systematic literature review on game motivators and design principles," IEEE Transactions on Learning Technologies, vol. 13, pp. 804-821, 2020, doi: 10.1109/TLT.2020.3018503.

[7] M. Thompson, C. Uz-Bilgin, M. S. Tutwiler, M. Anteneh, J. C. Meija, A. Wang, P. Tan, R. Eberhardt, D. Roy, J. Perry, and E. Klopfer, "Immersion positively affects learning in virtual reality games compared to equally interactive 2d games," Information and Learning Sciences, vol. 122, pp. 442-463, 2020, doi: 10.1108/ILS-12-2020-0252.

[8] D. van Breukelen, "Design-based concept learning in physics education: electricity," in Design-Based Concept Learning in Science and Technology Education, pp. 75-100, 2021, doi: 10.1163/9789004450004_005.

[9] P. Y. Chen, G. J. Hwang, S. Y. Yeh, Y. T. Chen, T. W. Chen, and C. H. Chien, "Three decades of game-based learning in science and mathematics education: An integrated bibliometric analysis and systematic review," Journal of Computers in Education, vol. 9, pp. 455-476, 2021, doi: 10.1007/s40692-021-00210-y.

[10] H. L. Chen, and C. T. Wu, "A digital role-playing game for learning: Effects on critical thinking and motivation," Interactive Learning Environments, vol. 31, pp. 3018-3030, 2023, doi: 10.1080/10494820.2021.1916765.

[11] L. Kai, W. H. Tan, "Dimensions of interactive pervasive game design: Systematic review," JMIR Serious Games, vol. 11, 2023, doi: 10.2196/42878.

[12] E. N. Que, "Sustaining successful ICT integration in remote rural schools," Pertanika Journal of Social Science & Humanities, vol. 29, pp. 1487-1506, 2021, doi: 10.47836/pjssh.29.3.02.

[13] R. Alda, H. Boholano, and F. Dayagbil, "Teacher education institutions in the Philippines towards 4.0," International Journal of Learning, Teaching and Educational Research, vol. 19, pp. 137-154, 2020, doi: 10.26803/ijlter.19.8.8.

[14] S. Umrani, S. Rajper, S. H. Talpur, I. A. Shah, and A. Shujrah, "Games based learning: a case of learning physics using Angry Birds," Indian Journal of Science and Technology, vol. 13, pp. 3778-3784, 2020, doi: 10.17485/IJST/v13i36.853.

[15] I. A. Rizki, H. V. Saphira, Y. Alfarizy, A. D. Saputri, R. Ramadani, and N. Suprapto, "Adventuring physics: Integration of adventure game and augmented reality based on android in physics learning," International Journal of Interactive Mobile Technologies, vol. 17, pp. 4-21, 2023, doi: 10.3991/ijim.v17i01.35211.

[16] M. Zafeiropoulou, C. Volioti, E. Keramopoulos, and T. Sapounidis, "Developing physics experiments using augmented reality game-based learning approach: a pilot study in primary school," Computers, vol. 10, 2021, doi: 10.3390/computers10100126.

[17] Z. Yıldırım, and M. Baran, "A comparative analysis of the effect of physical activity games and digital games on 9th grade students' achievement in physics," Education and Information Technologies, vol. 26, pp. 543-563, 2021, doi: 10.1007/s10639-020-10280-7.

[18] A. Cardinot, V. McCauley, and J. Fairfield, "Designing physics board games: a practical guide for educators," Physics Education, vol. 57, 2022, doi: 10.1088/1361-6552/ac4ac4.

[19] V. Shute, S. Rahimi, G. Smith, F. Ke, R. Almond, C. Dai, R. Kuba, K. Liu, X. Yang, and C. Sun, "Maximizing learning without sacrificing the fun: Stealth assessment, adaptivity and learning supports in educational games," Journal of Computer Assisted Learning, vol. 37, pp. 127-141, 2020, doi: 10.1111/jcal.12473.

[20] H. Putranta, H. Kuswanto, M. Hajaroh, and S. I. A. Dwiningrum, "Strategies of physics learning based on traditional games in senior high schools during the Covid-19 pandemic," Revista Mexicana de Física E, vol. 19, pp. 1-15, 2022, doi: 10.31349/RevMexFisE.19.010207.

[21] J. Sjöberg, and E. Brooks, "Collaborative interactions in problem-solving activities: School children's orientations while developing digital game designs using smart mobile technology," International Journal of Child-Computer Interaction, vol. 33, 2022, doi: 10.1016/j.ijcci.2022.100456.

[22] R. D. H. Jamalludin, and L. Nuraini, "The development of interactive learning media of parabolic motion lesson materials with patil lele traditional games," Jurnal Berkala Ilmiah Pendidikan Fisika, vol. 9, pp. 126-134, 2021, doi: 10.20527/bipf.v9i2.10399.

[23] W. Rohlfs, C. H. Venner, M. Alarouri, D. J. G. Kuiphuis, and R. Kneer, "HeatQuiz: Combining flipped-classroom, game-based learning, and systematic problem analysis in heat transfer education," International Heat Transfer Conference, vol. 17, 2023, doi: 10.1615/IHTC17.70-20.

[24] K. Wattanatchariya, S. Chuchuaikam and N. Dejdumrong, "An educational game for learning wind and gravity theory on iOS: Drop donuts," 2011 Eighth International Joint Conference on Computer Science and Software Engineering, pp. 387-392, 2011, doi: 10.1109/JCSSE.2011.5930152.

[25] C. Liu, T. Ratanaolam, and K. Sriwisathiyakul, "Based on the learners' needs of game based learning in Sanda teaching: a learner-centered approach", Educational Administration: Theory and Practice, vol. 30, pp. 3995-4007, 2024, doi: 10.53555/kuey.v30i6.6387.

[26] T. Katanosaka, M. Khan, and K. Sakamura, "PhyGame: An interactive and gamified learning support system for secondary physics education," International Journal of Advanced Computer Science & Applications, vol. 15, pp. 84-94, 2024, doi: 10.14569/IJACSA.2024.0150611.

[27] S. A. Ishak, R. Din, N. Othman, S. Gabarre, and U. A. Hasran, "Rethinking the ideology of using digital games to increase individual interest in STEM," Sustainability, vol. 14, 2022, doi: 10.3390/su14084519.

[28] M. A. Neroni, A. Oti, and N. Crilly, "Virtual reality design-build-test games with physics simulation: Opportunities for researching design cognition," International Journal of Design Creativity and Innovation, vol. 9, pp. 139-173, 2021, doi: 10.1080/21650349.2021.1929500.

[29] C. H. Chen, K. Huang, and J. H. Liu, "Inquiry-enhanced digital game-based learning: effects on secondary students' conceptual understanding in science, game performance, and behavioral patterns," The Asia-Pacific Education Researcher, vol. 29, pp. 319-330, 2020, doi: 10.1007/s40299-019-00486-w.

[30] H. Iida and M. N. A. Khalid, "Using games to study law of motions in mind," IEEE Access, vol. 8, pp. 138701-138709, 2020, doi: 10.1109/ACCESS.2020.3012597.

[31] F. Chaundhry, A. Bashir, K. ul Haq, and H. Riaz, "Comparative study on the digital game and computer simulation to curtail student's misconception about heat and temperature," European Journal of Physics Education, vol. 12, pp. 1-10, 2021, https://files.eric.ed.gov/fulltext/EJ1413723.pdf

[32] H. Zeng, S. N. Zhou, G. R. Hong, Q. Y. Li, and S. Q. Xu, "Evaluation of interactive game-based learning in physics domain," Journal of Baltic Science Education, vol. 19, pp. 484-498, 2020, doi: 10.33225/jbse/20.19.484.

[33] J. Wang, A. Stebbins, and R. E. Ferdig, "Examining the effects of students' self-efficacy and prior knowledge on learning and visual behavior in a physics game," Computers & Education, vol. 178, 2022, doi: 10.1016/j.compedu.2021.104405.

[34] U. A. Deta, F. K. Kurniawan, N. A. Lestari, M. Yantidewi, M. N. R. Jauhariyah, and B. K. Prahani, "Literature review on the use of educational physics games in improving learning outcomes," Journal of Physics: Conference Series, vol. 1805, 2021, doi: 10.1088/1742-6596/1805/1/012038.

[35] J. Y. Low, B. Balakrishnan, and M. I. H. Yaacob, "Game-based learning: current practices and perceptions of secondary school physics teachers in Malaysia," The International Journal of Science, Mathematics and Technology Learning, vol. 31, 2023, doi: 10.18848/2327-7971/CGP/v31i01/1-21.

[36] M. Ullah, S. U. Amin, M. Munsif, M. M. Yamin, U. Safaev, H. Khan, S. Khan, and H. Ullah, "Serious games in science education: a systematic literature," Virtual Reality & Intelligent Hardware, vol. 4, pp. 189-209, 2022, doi: 10.1016/j.vrih.2022.02.001.

[37] K. Rogers, S. Karaosmanoglu, M. Altmeyer, A. Suarez, and L. E. Nacke, "Much realistic, such wow! a systematic literature review of realism in digital games," Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems, pp. 1-21, 2022, doi: 10.1145/3491102.3501875.

[38] R. Yusnanto, and A. Rahayu, "Application of learning video based on visual, auditory, and kinesthetic learning styles to increase thermodynamics learning motivation at Grade XI in high school," 3rd Tarumanagara International Conference on the Applications of Social Sciences and Humanities, pp. 1715-1719, 2022, doi: 10.2991/assehr.k.220404.278.

[39] H. Hermansyah, N. Nurhairunnisah, I. M. Sentaya, I. G. M. Sulindra, N. Andriani, and G. Gunawan, "The effect of physics virtual experiments on mastery concept based on students learning style," Journal of Physics: Conference Series, vol. 1933, 2021, doi: 10.1088/1742-6596/1933/1/012079.

[40] Y. Wang, "Effects of augmented reality game-based learning on students' engagement," International Journal of Science Education, Part B, vol. 12, pp. 254-270, 2022, doi: 10.1080/21548455.2022.2072015.

[41] M. D. C. Córdova Martínez, and R. Alfonte Zapana, "Collaborative game model for teaching physics using smartphone sensors," Proceedings of the 2020 4th International Conference on Education and E-Learning, pp. 6-10, 2020, doi: 10.1145/3439147.3439153.

[42] F. C. Wibowo, H. Nasbey, L. A. Sanjaya, and D. R. Darman, "Development of game open online physics instructional (GOOPI) for improving 21st-century careers: creativity skill (21-CC: CS)," International Journal of Advanced Trends in Computer Science and Engineering, vol. 9, pp. 2625-2631, 2020, doi: 10.30534/ijatcse/2020/20932020.

[43] C. O. Amaefule, J. Breitwieser, D. Biedermann, L. Nobbe, H. Drachsler, and G. Brod, "Fostering children's acceptance of educational apps: the importance of designing enjoyable learning activities," British Journal of Educational Technology, vol. 54, pp. 1351-1372, 2023, doi: 10.1111/bjet.13314.

[44] V. Braun, and V. Clarke, "Using thematic analysis in psychology," Qualitative Research in Psychology, vol. 3, pp. 77-101, 2006, doi: 10.1191/1478088706qp063oa.

[45] N. Barz, M. Bernick, L. Dörrenbächer-Ulrich, and F. Perels, "The effect of digital game-based learning interventions on cognitive, metacognitive, and affective-motivational learning outcomes in school: a meta-analysis," Review of Educational Research, vol. 94, pp. 193-227, 2024, doi: 10.3102/00346543231167795.

[46]   F. M. D. Abenes, D. G. Caballes, and K. B. L. San Luis, "Assessment of students in digital game-based learning in teaching physics 7," Automation and Autonomous System, vol. 12, pp. 62-69, 2020, doi: 10.36039/AA022020001.

[47] M. Gaviño, and J. V. Aliazas, "Physics quest: digital game-based lessons for seventh grade," International Journal for Science and Advanced Research in Technology, vol. 10, pp. 82-193, 2024, doi: 10.5281/zenodo.10677644.

[48] A. C. Barton, J. Sheen, and L. K. Byrne, "Immediate attention enhancement and restoration from interactive and immersive technologies: a scoping review," Frontiers in Psychology, vol. 11, 2020, doi: 10.3389/fpsyg.2020.02050.

[49] M. A. Amin, S. H. S. Abdullah, and H. El-Mahalawy, "Analysis of the influence of students' attitudes on high school students' learning motivation", Sch. Jo. Phs. Ed, vol. 4, no. 3, pp. 71-77, 2023, doi: 10.37251/sjpe.v4i3.705.

[50] S. Agustin, "Hubungan motivasi dengan hasil belajar fisika siswa kelas XII di SMA Negeri 10 Kota Jambi", Sch. Jo. Phs. Ed, vol. 3, no. 1, pp. 5-9, 2022, doi: 10.37251/sjpe.v3i1.484.

[51] M. Purnomo, W. M. Aimran, and S. Prasitpong, "Implementation of learning with the problem posing method to increase activeness and learning outcomes of physics in the material of temperature and heat", Sch. Jo. Phs. Ed, vol. 4, no. 3, pp. 64-70,. 2023, doi: 10.37251/sjpe.v4i3.696.

[52] J. Zeng, S. Parks, and J. Shang, "To learn scientifically, effectively, and enjoyably: a review of educational games," Human Behavior and Emergent Technology, vol. 2, pp. 186-195, 2020, doi: 10.1002/hbe2.188.