



INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT



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ISSN: 2226-6348

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To Link this Article: <http://dx.doi.org/10.6007/IJARPED/v12-i1/16108>

DOI:10.6007/IJARPED/v12-i1/16108

Received: 07 November 2022, **Revised:** 09 December 2022, **Accepted:** 23 December 2022

Published Online: 05 January 2023

In-Text Citation: (Rashid et al., 2023)

To Cite this Article: Rashid, S. N. M., Abdullah, S. Z., Makhtar, N., Jaafar, N. F., & Zuraimi, N. A. (2023).

Effectiveness of Virtual Explorace Game Towards Students' Performance in Physics Subject During Pre-Diploma Programme. *International Journal of Academic Research in Progressive Education and Development*, 12(1), 49–59.

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Vol. 12(1) 2023, Pg. 49 - 59

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Effectiveness of Virtual Explorace Game Towards Students' Performance in Physics Subject During Pre-Diploma Programme

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Abstract

The COVID-19 pandemic has affected most countries around the world, forcing most of Malaysia's educational institutions to shift from face-to-face learning to e-learning or known as open and distance learning (ODL). Students must adopt new learning methods as educational technology advances in order to increase their interests, participations, and motivations in Science subjects'. The purpose of this study is to analyze and investigate the effectiveness of introducing game-based learning activities on students' performance in Physics classes. The research was carried out in UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah, where the Virtual Physics Explorace activity was implemented for 52 Pre-Diploma students. It was carried out via the Telegram platform, with three checkpoints to be completed in a two-hours' session. Each checkpoint contains a game created with online platforms such as Kahoot, Quizizz, and Word Wall templates, and it covers Physics' topics such as measurement, kinematics, dynamics, energy, waves, optics, and electricity. The students' performance was evaluated based on the total scores they achieved during the activity and compared to their previous Sijil Pelajaran Malaysia's (SPM) grade and continuous assessments' grade in the Pre-Diploma programme. According to the findings, 65.71 percent of them received credit grade (at least a C) in Physics or Science subjects during SPM level, meanwhile 77.14 percent during the virtual Physics explorace activity, and 85.71 percent in their Physics continuous assessments' marks. This also suggests that gamification can be used as a multifaceted tool to improve students' engagement in class and their understanding of Physics' concepts in an interactive way.

Keywords: Online, Gamification, Physics, Pre-Diploma, Performance

Introduction

The National Education Philosophy states that education in Malaysia is an ongoing effort towards further developing the potential of individuals in a holistic and integrated manner,

so as to produce individuals who are intellectually, spiritually, emotionally, and physically balanced and harmonious, based on a firm belief in and devotion to God (KPM, 2013). In essence, educators need to embrace the technology-immersed classroom to cater to the current generation's inclination towards technology-enhanced learning (Hasram *et al.*, 2021) with the shift to online education due to the pandemic (Chin *et al.*, 2022). To support teachers in online teaching implementation, the Malaysian Ministry of Education recommended various online learning platforms, such as Google Classroom, Microsoft Teams, EduwebTV/CikgooTube, Edpuzzle, Quizizz, and Kahoot (KPM, 2020).

Physics has always been thought of as the most difficult subject as it involves abstract concepts. Research has shown that technology has the potential to increase understanding of abstract concepts (Alias *et al.*, 2013). A study by Eldy *et al.* (2015) with 25 students of Physics with Electronic Programme in University Malaysia Sabah, seems ready and adapting well in e-learning activities as they respond favorably to the positive advantages they gain by going through e-learning. Positive learning attitudes are an important aspect in the process of learning science like physics (Ibrahim *et al.*, 2019). Besides, teachers play a very important role in ensuring students' interest towards Physics and the related self-concept. Their attitude can empower or marginalize students in the subject and their practices are the key to the change in students' performance in Physics (Saleh, 2014). To better understand the relationship between gamification and learning performance, a study was conducted among Pre-Diploma students at UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah to determine whether they believe the impact of explorace games on Physics understanding.

"Gamification" was invented by British computer programmer Nick Pelling in 2002, but became widely used only in 2010 (Kamasheva *et al.*, 2015). Technological developments allow the use of game elements in a non-game context by extending the methods that can be employed by educators in developing lesson plans (Rahman *et al.*, 2018). Furthermore, gamification is flexible enough and adaptable for academic use in local settings. Educators should consider gamifying their content to raise their student's motivation and engagement level in the classroom while the policymaker should consider the gamification approach in their decision making while drafting future education policies and strategies (Essam *et al.*, 2020) and giving more funds to experiment with more gamification models could be a worthwhile endeavor (Qing *et al.*, 2021). Students reported being engaged through gamification so educators can use it as one of many tools to increase student engagement if the students become bored by more standard lesson plans (Qing *et al.*, 2021).

Colleges and universities have developed several activities to bridge the gap between high schools and higher education during the last decades. These activities help students to experience authentic science investigations with hands-on activities. This serves to increase student motivation for choosing Science, Technology, Engineering & Mathematics (STEM) by connecting textbook theory with 'real' life science (Nawawi *et al.*, 2021). The design of the Word of Wall (WOW) online game in Word Wall platform encourages the use of mobile and gamified learning in class as a teaching aid and serves as supplementary material to encourage fun and independent out-of-class learning. It is important to take pupils' perceptions towards the ease of use of online educational games into consideration to ensure the effectiveness and successful implementation of online games in education (Hasram *et al.*, 2021). The data analysis of this study from Woei *et al.* (2021) also shows that this Word Wall

game has successfully increased student achievement in the topic taught by the teacher and also increased students' intrinsic motivation. Aspects such as attitudes towards gamification, students' motivation and students' perceptions play significant roles in ensuring learning can be enhanced by using these effective methods which can ensure the maximum level of learning, thus ensuring the knowledge conveyed by the teacher is delivered effectively (Ismail *et al.*, 2018).

Methodology

Introduction

In this study, the ADDIE model was used as the main framework in the development of virtual physics explorace programme. This model consists of five elements – Analysis, Design, Development, Implementation and Evaluation (Herout, 2016). Most of the researchers use this model due to the advantages such as a systematic approach, regular framework, can be integrated and easy to learn (Hidayanto *et. al.*, 2017; Aadenan *et. al.*, 2018). To ensure that the objectives are met, educational materials must be designed with the necessary knowledge and skills.

Participants

52 Pre-Diploma students from UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah participated in the Virtual Physics Explorace. 16 were from Pre-Diploma Science (STEM C and Arts Streams) (AS002/003) students with no pure science background, while the remaining 36 were Pre-Diploma (Science) (PD007/008) with pure science background. For AS002/003 students, second semester students from class N3AS0022A were involved in the programme, while for PD007/008, two groups; from classes N3PD0071A and N3PD0071B were involved. The virtual exploration activity was carried out over three days with a specific group of students, with each day lasting approximately two hours. The schedule for the programme is shown in Table 1.

Table 1

Programme Details

| Date/Day | Time | Participants |
|------------------------|-----------------------|---|
| 20 May 2022 (Friday) | 10.00 am – 12.00 noon | PD007/008 students Class : N3PD0071B |
| 23 May 2022 (Monday) | 2.00 – 4.00 pm | PD007/008 students Class : N3PD0071A |
| 26 May 2022 (Thursday) | 2.00 – 4.00 pm | AS002/003 students Class : N3AS0022A |
| 27 May 2022 (Friday) | 10.00 – 11.00 am | Closing ceremony |

Procedure

Since this was the first time the programme was run by the Department of Physics, a meeting with the facilitators was held to obtain clear instructions and recommendations to

ensure that the virtual physics explorace programme could run and be managed smoothly and effectively. Kahoot, Quizizz, and Word Wall are three types of learning games that were chosen as the checkpoints in the programme. As programme committee members, a group of three lecturers were assigned to develop a list of multiple-choice questions (MCQ) based on the course materials to match the games chosen. The Kahoot and Quizizz games each asked about 10 questions of varying difficulty, while the Word Wall game asked about 25 questions. This programme was run on the Telegram platform, and Telegram Meet was used to communicate between the organizers and the students. Three days before the first session of the programme, a video briefing about the programme and the rules of the games is given. Students must first fill out an attendance form, and the programme will begin once all students have joined the program's Telegram group. There was a moderator for each session who gave instructions to keep the students on track. There are three checkpoints that the students must pass. The first checkpoint was a Wordwall game, the second was a Quizizz game, and the third was a Kahoot game. The facilitators shared the link to the students via Telegram group to complete checkpoints 1 and 2. Meanwhile, at checkpoint 3, the game was played in real time, with the questions controlled by the facilitator. Each checkpoint allowed the students to complete the game for half an hour. The flow of the programme is shown in the figure below.

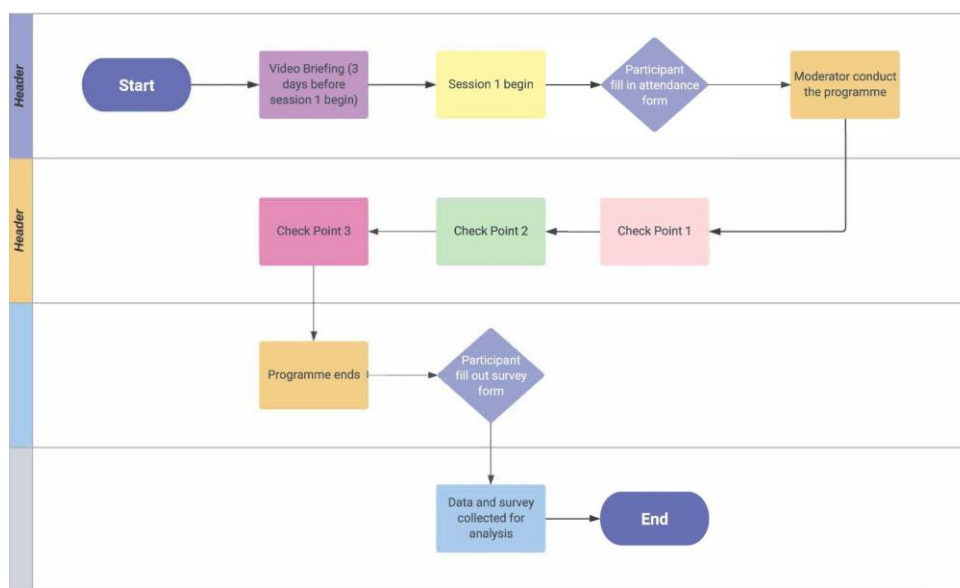


Figure 1: Flow chart of Virtual Physics Explorace Programme

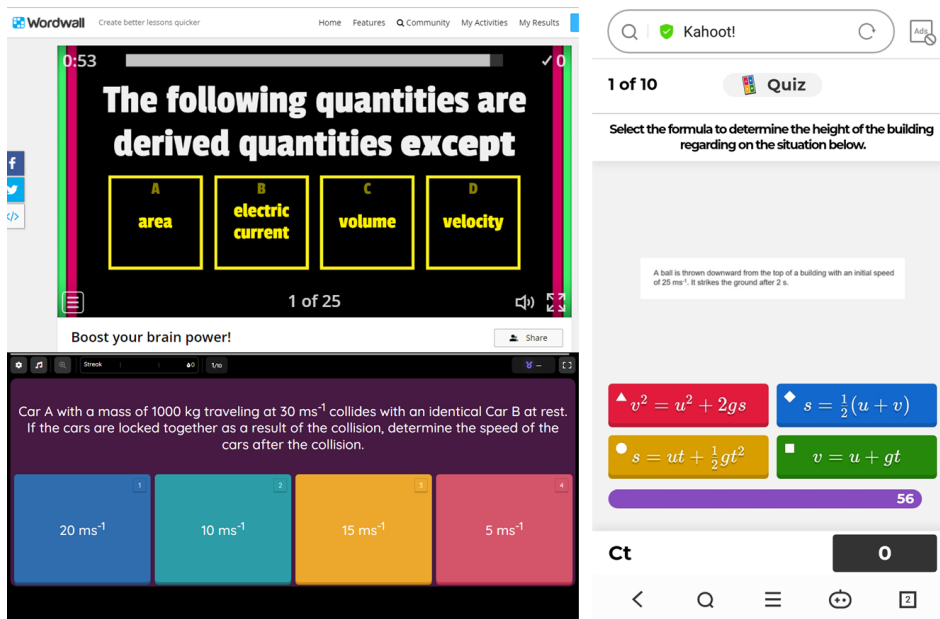


Figure 2 - Display of three checkpoints (Word Wall, Quizizz and Kahoot)

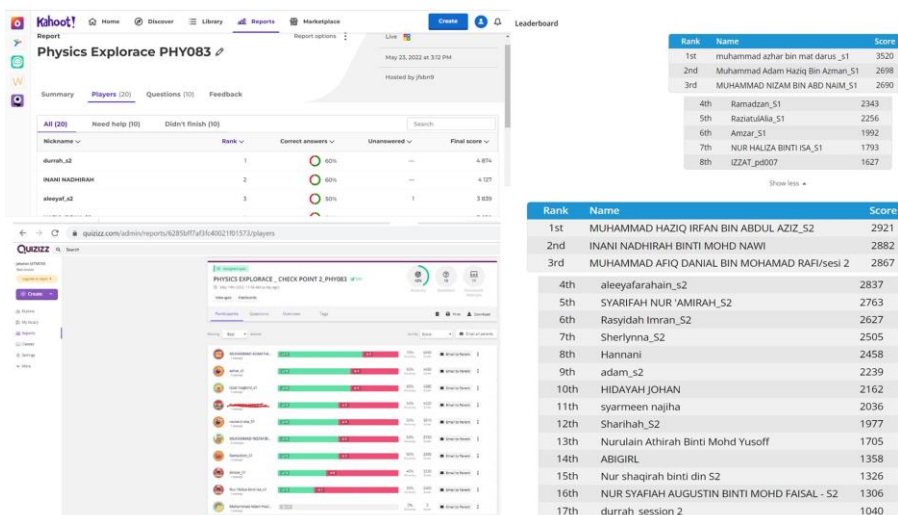


Figure 3 - Leaderboard scores for three checkpoints (Kahoot, Quizizz, Wordwall)

Data Collection and Analysis

Two facilitators were stationed at each checkpoint. The facilitators are responsible for ensuring that the game runs smoothly. Once the game was completed, the facilitators collected the students' scores and recorded them in the datasheet provided. All marks were added up for the three games, and the top twelve marks were chosen for the first, second, and third place winners. After the Virtual Physics Explorace programme ended, students were given an evaluation form to see how effective the programme was in increasing their understanding of Physics topics that will be evaluated in their upcoming continuous assessments. All items in this questionnaire were measured using the Likert scale showing '1-Strongly Disagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree'.

Results and Discussion

The evaluation form was completed by 35 students, with 63% from Pre-Diploma (Science) (PD007/008) students and 37% from Pre-Diploma Science (STEM C and Arts Streams) (AS002/003) students. Before participating in the Virtual Physics Explorace programme, their SPM grades in subjects such as Mathematics, Additional Mathematics, Science, Physics, and English were recorded. According to the data, all of them received at least a C in Mathematics, which is required for enrollment in both Pre-Diploma programmes. Meanwhile, 68.6% of students received at least a C in English. Additional Mathematics and Physics were taken by PD007/008 students, with only 27.3% and 45.5% receiving at least a C, respectively. AS002/003 students took Science, and 100% of them received at least a B, which is required for enrollment in the Pre-Diploma Science (STEM C and Arts Streams) programme. It is expected that their performance in these subjects will have an impact on their ability to achieve good results in Physics' continuous assessment during the Pre-Diploma programme, as the medium of instruction in UiTM is English, and learning Physics requires mathematical knowledge (Pinsky *et al.*, 2014) as it involved cognitive and problem-solving skills.

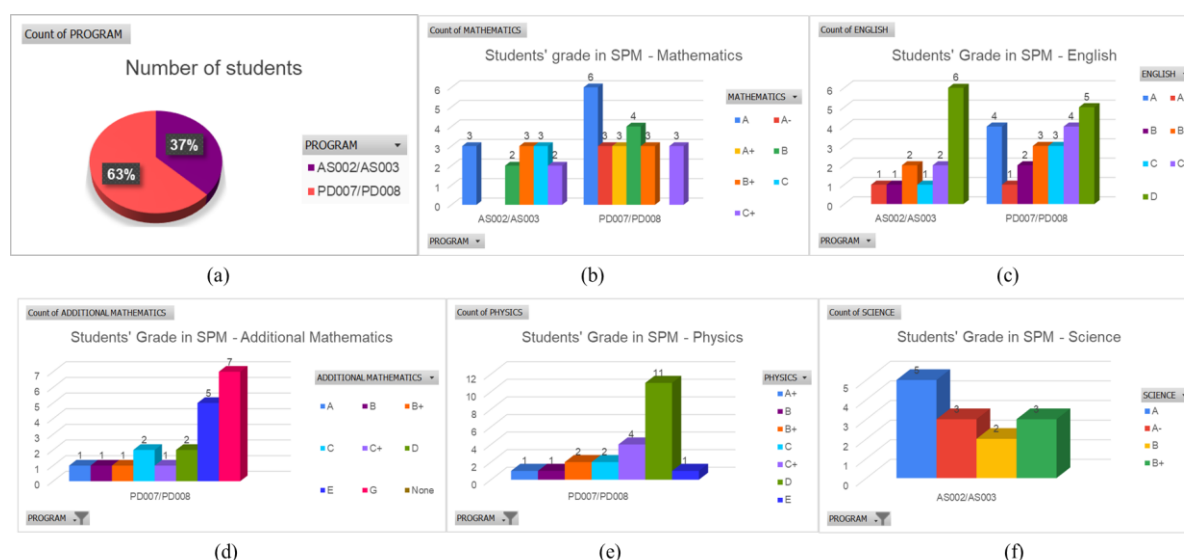


Figure 4 (a) Number of respondents (b) to (f) Students' grade in SPM for subject Mathematics, English, Additional Mathematics, Physics and Science

Four elements were analyzed from the Virtual Physics Explorace activity conducted with the students in terms of the effectiveness of the programme as a revision tool, the interactivensness of the platform or games, the benefits received by the students, and the quality of the internet connection during the activity. Based on the responses given, it was found that all scores from the four statements are above average with the highest mean value of 4.40. This indicates that respondents agree with the statements that the Virtual Physics Explorace programme helps them review topics taught in class and prepares them for the upcoming continuous assessment, which was held in Weeks 8 and 13 of the current semester.

Table 2

Mean value of the effectiveness, interactiveness and quality of the internet during Virtual Physics Explorace Programme

| Factor | Statement | Mean value |
|--|--|------------|
| Effectiveness of the Virtual Physics Explorace programme | This programme is useful as my initial preparation for the test. | 4.26 |
| | This program's knowledge is extremely beneficial. | 4.37 |
| Interactiveness of platforms used | Interactive games (Kahoot, Word Wall, and Quizizz) are excellent revision tools. | 4.37 |
| Quality of the internet | Please rate the quality of your internet access while participating in this Virtual Physics Explorace programme. | 4.40 |

Besides that, their performance in the Physics course was compared between grades earned during the explorace programme and continuous assessment grades. According to the findings, 77.14% of participants received a credit grade (at least a C) during the Virtual Physics Explorace activity, which increased to 85.71% in their Physics continuous assessments. This demonstrates that the use of game-based learning activities increases students' interest, participation, and motivation, as well as their understanding of the course. Kahoot, Wordwall, and Quizizz were chosen as gamified educational tools because they have demonstrated positive learning outcomes through the incorporation of unique game elements such as leader boards and quiz reports (Yunus *et al.*, 2021) that can be accessed directly from a mobile phone or laptop.

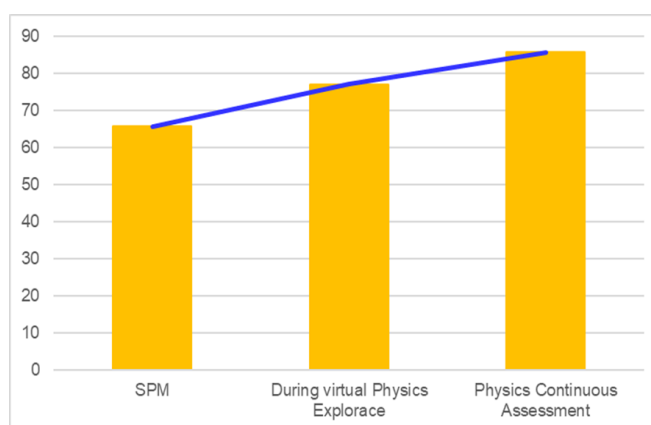


Figure 5 Comparison of students' achievement in Physics subject

According to the data gathered, game-based learning not only prepares lecturers and students to meet the demands of understanding Physics concepts, but it also promotes digital literacy among the young generation, which is in line with the demands of the fourth industrial revolution (IR 4.0) (Yunus *et al.*, 2021). Apart from that, the internet connection

plays a major role to ensure that students can participate actively in online classes, as 97.1% of them had good internet access when the programme was conducted. Considering the benefits, the Telegram application was chosen as a platform for Virtual Physics Explorace activity in this study. For example, the application is simple to download and use because participants can access it via any type of communication device, such as smartphones, tablets, and computers (Iksan *et.al.*, 2017).

Conclusion

This study discovered that students' performance in Physics courses during their Pre-Diploma programme improved as they actively participated in the Virtual Physics Explorace activity hosted by the Department of Physics and Material Science, UiTM Cawangan Negeri Sembilan Kampus Kuala Pilah. As compared to their SPM grade, only 65.71% of them received credit grade (at least a C) in Physics or Science subjects. The percentage rose to 77.14% during the virtual Physics exploration activity and 85.71% in their Physics continuous assessments marks. Based on this output, it is expected that the majority of students will pass this course during their final examination in August 2022. This study also discovered that game-based learning activities help them to revise topics taught in class in a fun way. Compared to the traditional teaching method, this approach was able to increase students' engagement in class. This programme should be expanded in the future to include elements such as participant learning style (Yildiz, 2021; Smiderle *et. al.*, 2020) to ensure that each game created is appropriate and effective for each participant with a different learning style. This approach will ensure that this technique is more interesting and appealing for improving the learning process.

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