International Journal of Modern Education
EISSN: 2637-0905
IJMOE

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

INTERNATIONAL JOURNAL OF MODERN EDUCATION (IJMOE)
www.ijmoe.com

GLOBAL ACADEMIC EXCELLENCE

EFFECTIVENESS OF PHYSICS ENERGISER BRAIN BOOSTER TOWARDS STUDENTS' PERFORMANCE IN PHYSICS SUBJECT FOR DIPLOMA ENGINEERING STUDENTS

Suhaiza Hasan[1*], Ainorkhilah Mahmood[2], Abdul Halim Abdul Hamid[3], Sharaf Ahmad[4], Mohd Haris Ridzuan Ooi Abdullah[5], Mohd Muzafa Jumidali[6]

[1] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: suhaiza@uitm.edu.my
[2] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: ainorkhilah_sp@uitm.edu.my
[3] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: abdhalim@uitm.edu.my
[4] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: sharaf@uitm.edu.my
[5] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: ooiaikseng@uitm.edu.my
[6] Department of Applied Sciences, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Penang, Malaysia
Email: mohdmuza433@uitm.edu.my
[*] Corresponding Author

Article Info:

Article history:
Received date: 30.01.2025
Revised date: 12.02.2025
Accepted date: 16.03.2025
Published date: 26.03.2025

To cite this document:

Hasan, M., Mahmood, A., Ahmad, S., Hamid, A. H. A., Abdullah, M. H. R. O. & Jumidali, M. M. (2025).

Abstract:

Physics is a fundamental yet challenging subject for engineering students due to its abstract concepts and high cognitive demands. This study investigates the effectiveness of the Physics Energiser Brain Booster (PEBB) module in enhancing students' performance and engagement in physics. Conducted at Universiti Teknologi MARA (UiTM) Penang Branch with 30 Diploma in Mechanical Engineering students who had previously failed the subject, the PEBB module incorporated four structured brain booster activities: Momentum Word Scramble, Rotational Motion Puzzle Maze, Matter Word Search, and PHY-bing. Data were collected through Students Feedback Evaluation of the PEBB Module and final exam results. The findings revealed that all students passed the final exam after participating in the PEBB, with

Effectiveness Of Physics Energizer Brain Booster Towards Students' Performance In Physics Subject For Diploma Engineering Students. *International Journal of Modern Education, 7* (24), 1073-1084.

DOI: 10.35631/IJMOE.724075

significant improvements in their confidence, concentration, and familiarity with physics terminology. While these results are promising, future research should adopt a more rigorous experimental design, including a control group and pre-test/post-test assessments, to validate the effectiveness of the PEBB. Additionally, studies could explore the long-term impact of such interventions on students' conceptual understanding and retention of knowledge, as well as investigate the applicability of the PEBB in broader STEM education contexts and diverse student populations.

Keywords:

Physics Energiser, Brain Booster, Cognitive Engagement, Brain-based Learning, Active Learning

Introduction

Physics is a foundational subject for engineering students, providing the theoretical basis for understanding complex technical concepts. However, many students struggle with physics due to its abstract nature and the high cognitive demands required for critical thinking (Brewe et al., 2018). These challenges often result in poor academic performance and disengagement from learning activities, particularly in subjects requiring sustained mental effort like physics (Redish, 2017). Addressing these challenges is crucial for improving learning outcomes in Science, Technology, Engineering, and Mathematics (STEM) fields. Strategies such as enhancing teaching methods, integrating visual aids, fostering a growth mindset, and providing targeted support can help students develop a deeper understanding of physics (National Academies of Sciences, Engineering, and Medicine, 2020). Recent advancements in cognitive science and educational technology have led to the development of innovative teaching strategies, such as brain-based learning and gamification, which aim to enhance student engagement and performance in physics (Jensen, 2020; Papadakis et al., 2022). Brain-based learning grounded in neuroscience, seeks to optimize learning environments by aligning teaching methods with the brain's natural processes for acquiring and retaining information, while gamification incorporates game elements to make learning more interactive and enjoyable (Sousa, 2020; Zourmpakis et al., 2023). These strategies have shown promise in improving students' motivation, focus, and conceptual understanding in STEM subjects (Papadakis, 2022). Among these strategies, energisers, or brain boosters short, dynamic activities that stimulate mental alertness have gained attention for their potential to increase students' cognitive engagement and focus (Godwin & Fisher, 2018). By breaking up sustained concentration periods, such interventions reduce cognitive fatigue and re-energize students, making it easier for them to grasp and retain complex information (Jensen, 2020). In the context of physics education, energisers have shown promise in maintaining students' attention during challenging lessons. Studies have demonstrated that active learning techniques, including short bursts of physical or mental activity, can enhance comprehension and retention of material in STEM subjects (Freeman et al., 2014). Furthermore, brain boosters can cultivate a more dynamic and stimulating classroom atmosphere, which is especially advantageous for students who find abstract disciplines such as physics challenging (Riley & Masters, 2021). These techniques may be especially effective for diploma engineering students, who often come from diverse educational backgrounds and may have varying levels of preparedness for tackling the complexities of physics (Velez et al., 2019).

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

This study explores the effectiveness of the PEBB module, a brain-based learning intervention designed to enhance students' cognitive engagement and performance in physics. The PEBB module incorporates structured activities such as word search and scrambles, puzzles, and bingo games to reinforce physics concepts and terminology.

Literature Review

Physics, as a core subject in engineering education, poses significant challenges for many students. A study by Kaltakci-Gurel and Eryilmaz (2020) found that students struggle to visualize and conceptualize abstract physics principles, leading to misconceptions and difficulties in problem-solving. The authors emphasized that traditional teaching methods, which rely heavily on lectures and rote memorization, often fail to address these challenges effectively. Moreover, Redish (2003) notes that physics often involves abstract concepts that require high levels of cognitive engagement, which can hinder comprehension, especially among students in non-science disciplines like engineering. The diploma engineering students frequently face difficulties in connecting theoretical knowledge with practical applications, which results in lower performance in the subject (Adams & Wieman, 2011). Recent studies have highlighted the importance of addressing these challenges through active learning strategies that promote critical thinking and problem-solving skills (Freeman et al., 2014).

Brain-based learning strategies, grounded in neuroscience, aim to optimize learning environments by aligning teaching methods with the brain's natural processes (Jensen, 2020). This approach emphasizes understanding how the brain naturally learns, incorporating elements like physical movement, music, and regular breaks to boost cognitive abilities. The goal of these strategies is to alleviate cognitive overload, foster neural connections, and enhance memory retention (Sousa, 2020). "Energisers" or brain boosters are short, structured activities that stimulate mental alertness and are often employed in educational settings to counter cognitive fatigue. According to Godwin and Fisher (2018), such interventions increase engagement and attentiveness, particularly when employed before or during tasks that require sustained cognitive effort. Studies have demonstrated that brain-based learning interventions can improve performance by enhancing focus, decreasing stress levels and retention complex concepts (Duman, 2010; Sousa, 2020).

Energisers and brain boosters are increasingly recognised as effective tools for promoting active learning, particularly in rigorous subjects like physics. These activities, designed to be short bursts of physical or mental activity, can help students refocus, increase energy levels, and improve overall cognitive function (Shoval, 2011). In the context of physics education, where problem-solving and critical thinking are essential, energisers can play a key role in sustaining cognitive engagement and alleviating mental fatigue (Wieman & Perkins, 2005). Research conducted by Newton and Pritchard (2009) revealed that physics students who participated in brief, structured brain booster activities prior to tackling complex problems showed markedly improved concept retention and greater accuracy in problem-solving. In a related study, Riley and Masters (2016) noted that integrating physical activities into the physics curriculum enhanced student performance, especially in domains requiring spatial reasoning and abstract thinking skills that are crucial for grasping physics principles. Integrating energiser brain boosters into the learning environment enhances students' cognitive engagement, alleviates anxiety, and improves their comprehension of complex physics ideas (Abrahams & Millar, 2008).

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075
Gamification has emerged as a powerful tool for enhancing student motivation and engagement in science education. Papadakis et al. (2022) demonstrated that gamification approaches significantly improve students' motivation and learning outcomes in science education. Similarly, Zourmpakis et al. (2023) proposed a framework for adaptive gamification in physics education, emphasizing the need for personalized learning experiences that cater to diverse student needs. These findings align with the broader literature on active learning, which suggests that interactive and engaging teaching methods can improve students' conceptual understanding and problem-solving abilities (Freeman et al., 2014).

Methodology

Study Design
This study employed a mixed-methods approach to evaluate the effectiveness of the PEBB module. The study was conducted at Universiti Teknologi MARA (UiTM) Penang Branch with 30 Diploma in Mechanical Engineering students who had previously failed the PHY130 course on their first attempt**.** These students are repeaters, now taking the course for a second time. The primary aim was to evaluate the effectiveness of this module in enhancing students' performance and engagement in fundamental physics concepts.

The PEBB module included four (4) structured energiser brain booster activities: Momentum Word Scrambles, Rotational Motion Puzzle Maze, Matter Word Search, and PHY-bing! as shown in Figure 1.

- **Momentum Word Scramble:** An interactive exercise where students unscrambled terms related to momentum to reinforce their understanding of the concept.
- **Rotational Motion Maze Puzzle:** A puzzle activity that challenged students to navigate through a maze while applying principles of rotational motion.
- **Matter Word Search:** A word search game focused on terminology associated with matter, encouraging students to familiarize themselves with key concepts and definitions.
- **PHY-bing:** A bingo game that incorporated various physics terms and principles, promoting peer interaction and competition.

Data Collection
Data were collected through students feedback evaluation of PEBB module after completing the activities and final exam results. The feedback assessed students' perceptions of the PEBB activities, including their enjoyment, familiarity with physics terms, concentration, confidence, and preparation for the final exam. Final exam results were analysed to determine the impact of the PEBB on students' academic performance. This mixed-methods approach allowed for a comprehensive evaluation of both qualitative and quantitative aspects of the students' learning experiences, providing valuable feedback for future iterations of the module. By implementing this innovative approach, the study aimed to identify effective strategies to enhance student learning and engagement in fundamental physics, contributing to improved academic performance in engineering education.

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

Figure 1: Physics Energizer Activities in PEBB Module

Result and Discussion

Students Feedback analysis of the PEBB

The PEBB survey consists of responses that highlight the following enjoyment of the brain booster, familiarization with physics terms, sharpening concentration during learning, boosting confidence to perform in PHY130, preparation for the final exam and desire for the program to continue. The charts will provide insight into the specific responses related to that statement as shown in Figure 2.

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

The students' feedback about Enjoyment of the PEBB is strongly supported by the overwhelmingly positive sentiment from students, with 80.6% Strongly Agreeing that they found it enjoyable and 16.1% Agreeing, indicating a high level of enthusiasm and satisfaction with the experience. This result has shown that when students enjoy learning activities, their cognitive engagement increases, leading to better information retention. Active learning strategies, such as interactive exercises and games like brain boosters, make learning more stimulating, which increases students' intrinsic motivation and leads to better learning outcomes (Barak & Dori, 2021). These findings align with previous research on the benefits of active learning and gamification in STEM education (Papadakis et al., 2022).

Students' evaluation indicates strong support for the Familiarisation with Physics Terms, with 77.4% Strongly Agreeing that the PEBB significantly enhanced their understanding of physics vocabulary, and an additional 19.4% Agreeing. This demonstrates the tool's significant impact on enhancing their understanding of physics terms. Cognitive psychology suggests that repeated exposure to technical vocabulary, reinforced through activities like the brain booster, aids students in better internalising and recalling information. The spacing effect, where learning is distributed over time, is known to enhance the long-term retention of complex concepts (Kang, 2016). Recent study has further validated these findings, emphasising the effectiveness of active learning and gamification in improving vocabulary acquisition and retention. For instance, Zourmpakis et al. (2023) highlighted that adaptive learning tools, which provide repeated and spaced exposure to key concepts, are particularly effective in helping students master complex terminology in STEM subjects.

Student feedback on the Sharpening of Concentration is strongly validated by their responses, with 74.2% Strongly Agreeing and an additional 22.6% Agreeing that the PEBB activities improved their focus. This indicates that the PEBB had a substantial effect on enhancing students' attention and concentration during their academic work. The use of concentration-boosting activities, such as brain games and puzzles, is supported by research as an effective method for improving focus during learning. Gazzaley and Rosen (2016) highlight that brain training exercises are particularly beneficial for strengthening attention span, a critical skill for disciplines like physics that require prolonged cognitive engagement.

The statement Boosting Confidence to Perform in PHY130 is strongly supported by students' feedback, with 71.0% Strongly Agreeing that the PEBB boosted their confidence, and an additional 25.8% Agreeing. This indicates that the PEBB had a positive effect on enhancing students' self-assurance, particularly in their ability to perform well in PHY130. Confidence is crucial in academic achievement, prompting students to confront problems with a proactive attitude, resulting in enhanced engagement and outcomes in rigorous courses such as physics. Building students' confidence is key to reducing anxiety and increasing self-efficacy, which, in turn, improves academic performance. According to Bandura's self-efficacy theory, students who believe in their abilities are more likely to succeed in challenging tasks, such as exams (Bandura, 1997). Recent studies have further validated these findings, demonstrating that interventions like the PEBB, which incorporate active learning and gamification, significantly enhance students' self-efficacy and confidence in STEM subjects. For instance, Papadakis et al. (2022) found that gamified learning environments foster a sense of accomplishment and competence, which directly contributes to increased confidence and motivation. Additionally, Schunk and DiBenedetto (2020) emphasized the role of self-efficacy in academic resilience,

International Journal of Modern Education
IJMOE
EISSN: 2637-0905
Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

noting that students with higher confidence levels are better equipped to overcome setbacks and perform well in demanding courses. These findings underscore the importance of interventions like the PEBB in fostering confidence and self-efficacy, which are critical for academic success in physics and other STEM disciplines.

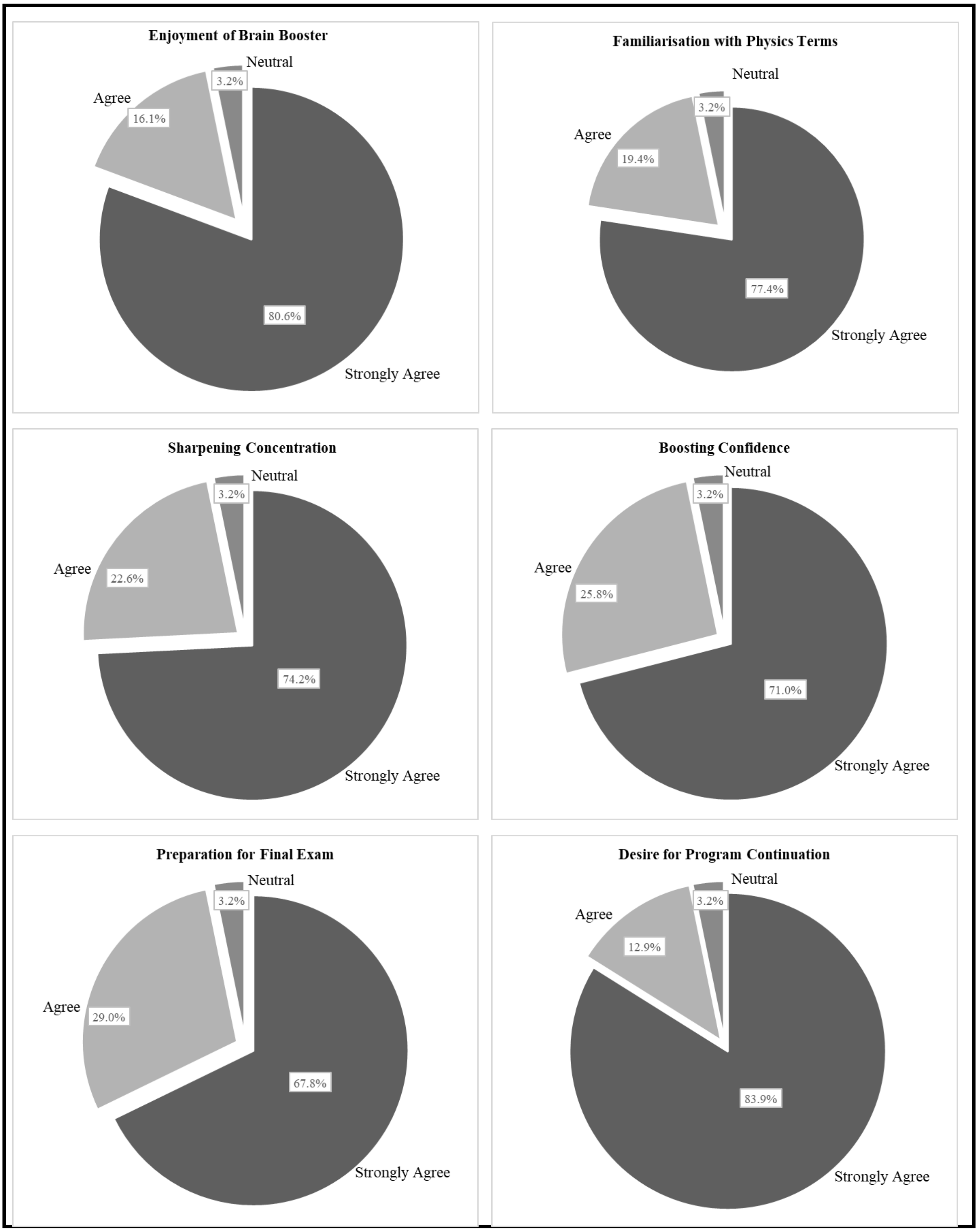

Figure 2: Students' Feedback Analysis PHY130 Energizer Brain Booster (PEBB)

International Journal of Modern Education IJMOE
EISSN: 2637-0905
Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

The students' feedback on Preparation for Final Exam strongly reflects the positive impact of the PEBB, with 67.8% Strongly Agreeing that it helped them prepare for the final exam, and an additional 29.0% Agreeing. This suggests that the PEBB was successful in preparing students for the exam by equipping them with the necessary tools and confidence to achieve success. Effective exam preparation involves not only possessing knowledge but also the ability to concentrate and retain information which both skills that were likely improved through the cognitive exercises provided by the PEBB. Effective exam preparation strategies, such as practice exercises, enhance performance by reducing test anxiety and increasing familiarity with exam formats. A meta-analysis by Roediger and Butler (2014) showed that students who engage in regular self-testing and revision exercises perform better in final exams.

The feedback on the Desire for Program Continuation underscores the strong positive reception of the PEBB among students, with 83.9% Strongly Agreeing and an additional 12.9% Agreeing that they wish for the program to continue. This overwhelming endorsement reflects the perceived value of the PEBB and demonstrates students' enthusiasm for its continuation, highlighting its effectiveness and positive impact on their learning experience. The high level of interest in maintaining the program suggests that it effectively met students' needs, fostering enthusiasm for further engagement in similar initiatives. The strong demand for the continuation of the PEBB reflects students' preference for innovative teaching methods that go beyond traditional lecture-based approaches. This preference aligns with recent educational trends emphasising interactive and gamified learning experiences. For instance, a meta-analysis by Zeng (2024) revealed a moderately positive effect of gamification on student academic performance, underscoring its efficacy in enhancing learning outcomes.

The findings from the feedback on the effectiveness of the PEBB module underscore its significant positive impact on student engagement in physics. By incorporating structured, interactive activities, the PEBB module not only enhanced students' interest in learning but also improved their ability to grasp complex physics concepts. Additionally, these results suggest that cognitive and engagement-enhancing tools like the PEBB module intervation are valuable in improving learning outcomes. Consequently, these module ought to be maintained and broadened to additional classes to further augment student achievement.

Student Performance in the PHY130 Final Examination

Figure 3 shows the final exam results for PHY130 provides significant insight into the effectiveness of the PEBB for students who were retaking the subject after previously failing. All students who participated in the PEBB passed the final exam, with the majority achieving grades in the B and C ranges. This represents a significant improvement compared to their previous performance, where all students had failed the course. However, the absence of a control group limits the ability to attribute these improvements solely to the PEBB intervention. Tinto (2021) emphasises that supplemental academic support programs, particularly for at-risk or repeating students, can markedly enhance retention and success rates by offering a structured framework that reinforces essential knowledge and skills.

Although the majority of students passed, only a select few attained A grades, with most aggregating in the B and C categories. This distribution indicates that the PEBB was successful in assisting students to attain a passing level, although it may not have adequately equipped them for the highest levels of accomplishment. For repeaters, knowledge of key concepts is crucial for transitioning from failure to success. Achieving A-level achievement frequently

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

necessitates supplementary advanced problem-solving abilities, which may not have been the central emphasis of the PEBB. Fong et al. (2019) found that targeted support programs can be effective in helping struggling students achieve passing grades but may need to be supplemented with higher-order cognitive skill development to enable top performance.

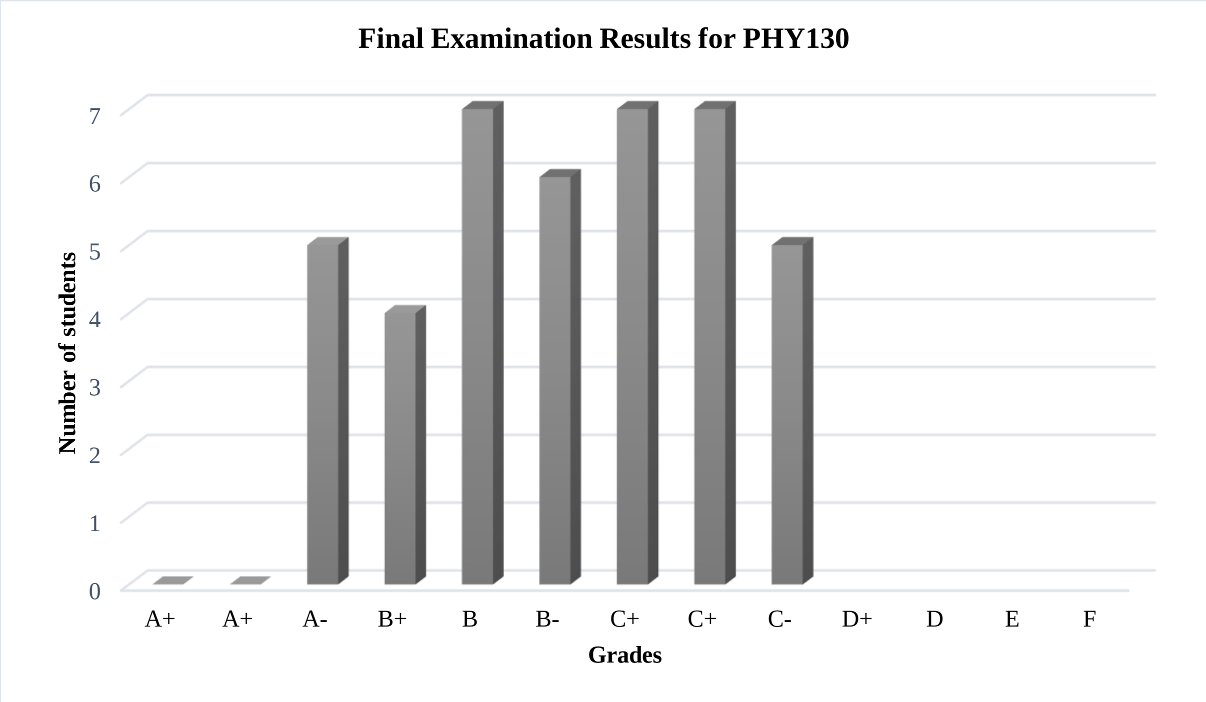

Figure 3: Final Examination PHY130 Results

The survey responses (Figure 2) show that the PEBB increased student confidence and familiarity with physics terminology. This newfound confidence likely reduced exam-related anxiety, contributing to students' ability to perform better on their second attempt. Confidence is a pivotal determinant of academic achievement, particularly among students who are retaking a course following an initial failure. The PEBB module likely exerted a positive influence on student confidence, cultivating a more favorable disposition toward the subject matter. This enhanced confidence facilitated deeper engagement and more consistent academic performance, underscoring the module's potential to mitigate the psychological barriers associated with course repetition. Schunk and DiBenedetto (2020) highlight the role of self-efficacy and confidence in academic performance, especially among students who have previously faced setbacks. This can create resilience and help students overcome previous failures, improving performance upon re-examination.

High levels of enjoyment reported in the survey (80.6% Strongly Agree on Enjoyment) indicate that students found the program engaging, which likely contributed to their success. For repeaters, enjoyment and engagement can be critical in changing previously negative perceptions of a subject. The PEBB seems to have re-engaged students by making learning more interactive and enjoyable, potentially increasing their intrinsic motivation and willingness to engage with the material. Kuh and O'Donnell (2019) found that student engagement in enjoyable, interactive learning activities can foster positive attitudes towards challenging subjects, which helps improve academic resilience and performance in repeated courses.

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075

None of the students failed the exam this semester, and a majority expressed a desire for the continuation of the PEBB. The program's success in helping all students pass after previous failures indicates that it provided essential academic support that was previously lacking. The overwhelming desire for the program's continuation underscores students' recognition of its significant value, suggesting that such interventions can serve as a sustainable mechanism to foster academic success. This finding aligns with the emphasis by Lawson and Lawson (2021) on the necessity of continuous support structures for students experiencing academic difficulties, further reinforcing the importance of maintaining and expanding such programs to address persistent learning challenges effectively.

The improvement from failing to passing grades for repeat students in PHY130 demonstrates the PEBB's efficacy in addressing key academic challenges. To further enhance outcomes, especially for students aiming to achieve A grades, the program could incorporate additional components focused on higher-order cognitive skills such as critical thinking and advanced problem-solving. Implementing these enhancements could support students not only in passing but in excelling academically.

Conclusion

The PEBB has demonstrated significant effectiveness in enhancing students' performance in Physics for diploma engineering students, as evidenced by the remarkable achievement of all repeaters passing the final exam. Student feedback highlights that the tool not only enhances familiarity with essential physics terminology but also strengthens concentration and builds confidence for excelling in physics. The PEBB was particularly effective in aiding exam preparation, and its interactive design garnered significant support for its ongoing implementation. These findings indicate that integrating cognitive energisers into the curriculum can drive meaningful advancements in learning outcomes and overall academic performance. The study acknowledges several limitations, including the small sample size, lack of a control group, and reliance on self-reported data. Future study should adopt a more rigorous experimental design, incorporating pre-test and post-test assessments with a control group to validate the findings.

Acknowledgements

The authors express their gratitude to Department of Applied Sciences, Universiti Teknologi MARA Cawangan Pulau Pinang for respective contributions of support and access to workstation facilities.

References

Abrahams, I., & Millar, R. (2008). Does practical work really work? A study of the effectiveness of practical work as a teaching and learning method in school science. *International Journal of Science Education,* 30(14), 1945–1969. https://doi.org/10.1080/09500690701749305

Adams, W. K., & Wieman, C. E. (2011). Development and validation of instruments to measure learning of expert-like thinking. *International Journal of Science Education*, 33(9), 1289–1312. https://doi.org/10.1080/09500693.2010.512369

Brewe, E., Traxler, A. L., de la Garza, J., & Kramer, L. H. (2018). Extending positive CLASS results across multiple instructors and multiple courses with a focus on problem-solving. *Physical Review Physics Education Research,* 14(2), 020129. https://doi.org/10.1103/PhysRevPhysEducRes.14.020129

Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075
Duman, B. (2010). The effects of brain-based learning on the academic achievement of students with different learning styles. *Educational Sciences: Theory & Practice,* 10(4), 2077–2103.

Fong, C. J., Davis, C. W., Kim, Y., Kim, Y. W., Marriott, L., & Kim, S. Y. (2019). Psychosocial factors and community college student success: A meta-analytic investigation. *Review of Educational Research,* 89(2), 272–308. https://doi.org/10.3102/0034654319825791

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences,* 111(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Godwin, K. E., & Fisher, A. V. (2018). The effects of brain breaks on the engagement and achievement of elementary school students. *Journal of Educational Psychology,* 110(5), 658–667. https://doi.org/10.1037/edu0000240

Jensen, E. (2020). Brain-based learning: The new paradigm of teaching (2nd ed.). *Corwin Press.*

Kaltakci-Gurel, D., & Eryilmaz, A. (2020). Addressing misconceptions in physics education: A review of recent research. Physical Review Physics Education Research, 16(2), 020101. https://doi.org/10.1103/PhysRevPhysEducRes.16.020101

Kuh, G. D., & O'Donnell, K. (2019). Using evidence of student learning to improve higher education. *John Wiley & Sons*. https://doi.org/10.1002/9781119242883

Lawson, M. A., & Lawson, H. A. (2021). Transforming schools by developing student support systems. *Educational Researcher,* 50(3), 162–170. https://doi.org/10.3102/0013189X20984499

National Academies of Sciences, Engineering, and Medicine. (2020). Promising practices for addressing the underrepresentation of women in STEM: Enhancing diversity and inclusion. *National Academies Press*. https://doi.org/10.17226/25585

Newton, D. P., & Pritchard, R. (2009). Thinking space: Encouraging students to use cognitive strategies. *Physics Education,* 44(6), 615–619. https://doi.org/10.1088/0031-9120/44/6/004

Papadakis, S. (2022). Apps to promote computational thinking and coding skills to young age children: A pedagogical challenge for the 21st century learners. *Educational Process: International Journal (EDUPIJ)*, 11(1), 7-13.

Papadakis, S., Zourmpakis, A. I., & Kalogiannakis, M. (2022). Analyzing the impact of a gamification approach on primary students' motivation and learning in science education. *International Conference on Interactive Collaborative Learning*, 701-711. https://doi.org/10.1007/978-3-030-93907-6_45

Redish, E. F. (2003). Teaching physics: With the physics suite. *John Wiley & Sons.*

Riley, C. A., & Masters, M. F. (2016). The effectiveness of active learning strategies in physics education. *American Journal of Physics,* 84(7), 574–582. https://doi.org/10.1119/1.4947438

Riley, C. A., & Masters, M. F. (2021). The impact of active learning strategies on student engagement and success in introductory physics. *American Journal of Physics,* 89(4), 372–378. https://doi.org/10.1119/10.0003437

Schunk, D. H., & DiBenedetto, M. K. (2020). Motivation and social cognitive theory. *Contemporary Educational Psychology,* 60, 101832. https://doi.org/10.1016/j.cedpsych.2020.101832

International Journal of Modern Education
EISSN: 2637-0905
IJMOE
Volume 7 Issue 24 (March 2025) PP. 1073-1084
DOI: 10.35631/IJMOE.724075
Shoval, E. (2011). Integrating movement in academic lessons: Teachers' perceptions and teaching strategies. *Educational Studies,* 37(6), 695–711. https://doi.org/10.1080/03055698.2010.539834

Sousa, D. A. (2020). How the brain learns (6th ed.). *Corwin Press.*

Tinto, V. (2021). Revisiting the foundations of student success. *Studies in Higher Education,* 46(9), 1829–1841. https://doi.org/10.1080/03075079.2020.1868667

Velez, J. J., Cano, J., & Bandura, A. (2019). Predicting success of engineering students based on cognitive and non-cognitive factors. *Journal of Engineering Education,* 108(3), 518–534. https://doi.org/10.1002/jee.20293

Velez, J. J., Cano, J., & Bandura, A. (2013). Predicting engineering students' academic success from high school mathematics performance. *Journal of Engineering Education,* 102(3), 449–461. https://doi.org/10.1002/jee.20023

Wieman, C., & Perkins, K. (2005). Transforming physics education. *Physics Today,* 58(11), 36–41. https://doi.org/10.1063/1.2155756

Zeng, J. (2024). Exploring the impact of gamification on students' academic performance: A comprehensive meta-analysis of studies from the year 2008 to 2023. British Journal of Educational Technology.

Zourmpakis, A. I., Kalogiannakis, M., & Papadakis, S. (2023). A review of the literature for designing and developing a framework for adaptive gamification in physics education. *The International Handbook of Physics Education Research: Teaching Physics*, 5(1), 1-15. https://doi.org/10.1007/978-3-030-98745-6_1