Effectiveness of *Phylum Expedition* on the Retention of General Biology 2 Concepts Among Grade 11 STEM Health Allied Students

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Abstract

This study explores the effectiveness of educational video games in enhancing concept retention in General Biology 2 among Grade 11 STEM-HA students at FEU Diliman. With biology's extensive content posing retention challenges, the researchers developed and implemented a custom educational game titled *Phylum Expedition*. Using an experimental design, they compared the performance of two groups: a control group using traditional methods and an experimental group using the video game. Pretests and posttests focused on organismal biology concepts were administered, along with a gameplay satisfaction survey for the experimental group. Results showed that the experimental group had a higher mean gain score (3.67) than the control group (2.24), and a left-tailed t-test confirmed a statistically significant difference, leading to the rejection of the null hypothesis. Students responded positively to the game's lore and gameplay, though found the controls less satisfactory. The study concludes that educational video games can effectively supplement traditional teaching. The researchers recommend integrating or developing educational games in classrooms, encouraging students, teachers, and developers to explore this learning tool.

Keywords: educational video games, biology, retention, *Phylum Expedition*

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Introduction

As video games evolved throughout the years, they are often used as a tool for more than entertainment, as such, the rise of educational video games for education. These games are shown to benefit and enhance students' learning in terms of motivation, interest, and in addition, their communication skills (Macayan et al., 2022). On the contrary, some areas still encompass a gap of what educational video games have covered, more so on the students' retention on content-heavy subjects–specifically of General Biology 2 concepts. As General Biology 2 being a challenging subject, it is reported that students struggle with retention. The students' ability to retain information is an important aspect in learning as it allows them to apply and recall knowledge that they have learned to perform better in academics. Through this, the study aimed to determine the effectiveness of an educational video game, *Phylum Expedition*, on the retention of General Biology 2 concepts of Grade 11 STEM Health Allied Students at FEU Diliman.

Educational video games are widely used in education, most notably in the STEM field, as a tool for enhancing learning through active engagement (Changtong et al., 2020; Punyasettro & Yasri, 2021). These games are described as the combination of fun and enjoyment with learning, improvement, and development (Marin-Suelves et al., 2020).

Retention is influenced by factors such as the ability to learn, prior knowledge, and the importance of the information learned. The use of engaging learning materials, such as educational video games, aids students' interest, understanding, and retention in a subject (Adebisi et al., 2021). Studies show that these games enhance retention through their engaging nature, which motivates students and makes complex concepts simpler and easier to understand (Schroeder, 2024). An example of this is Kahoot, which has been found to enhance retention by 22% compared to traditional classroom lectures (Heidarzade, 2025).

Students from multiple countries find General Biology 2 challenging due to factors such as low motivation, poor study habits, and lack of prior knowledge (Johnstone & Hansell, 1999; Tracy et al., 2022). Other studies highlight struggles caused by content-heavy lessons, which result in content overload (Chiappetta & Fittman, 2010; Zeidan, 2010). Biology concepts can be made simpler through visuals and interactivity to increase participation (CPD Singapore Education Services Pte, 2024). With this, educational video games serve as a new tool to make learning more enjoyable and beneficial.

This study aimed to determine the effectiveness of the researcher-made game prototype *Phylum Expedition* on the Retention of General Biology 2 concepts among Grade 11 STEM Health Allied students of FEU Diliman. The study is focused on students to provide them a fun and immersive way of learning a complex topic of the General Biology 2 curriculum.

Specifically, the study sought to answer the following problems:

1. What is the significant difference in the gain scores between the experimental and control groups of Grade 11 STEM Health Allied on General Biology 2?
2. What aspect of *Phylum Expedition* would help the students retain information during the integration of educational video games into the General Biology 2 curriculum?
3. What are the students' evaluations of the following aspects of *Phylum Expedition* in learning General Biology 2 concepts with respect to:
    3.1. Gameplay
    3.2. Mechanics

3.3. Visuals
3.4. Controls
3.5. Difficulty
3.6. Lore

4. How effective is *Phylum Expedition* on the retention of General Biology 2 concepts among Grade 11 STEM Health Allied students?

This study examined the effectiveness of an educational video game, *Phylum Expedition*, on the retention of General Biology 2 concepts among Grade 11 STEM Health Allied students at FEU Diliman during the academic year 2024–2025. Focusing on Organismal Biology, the study involved sixty-two students from two sections and utilized pretests, posttests, and a validated game survey conducted in the FEU Diliman library. The research was limited to these participants, setting, and data-gathering methods, excluding other strands, grade levels, institutions, and instructional tools.

Methods

This research utilized a quantitative approach to determine the effectiveness of a learning video game, *Phylum Expedition*, in helping students retain General Biology 2 concepts (Bhandari, 2023). Additionally, the researchers employed a pretest–posttest non-equivalent group design (Price et al., n.d.). Two Grade 11 STEM Health Allied classes at FEU Diliman were involved: one class participated in the lecture followed by gameplay (experimental group), while the other class received the lecture only (control group). Both groups were given a pretest and a posttest to measure their academic performance.

To identify the participants, cluster sampling was used, wherein groups or sections were selected instead of individual students (Dovetail Editorial Team, 2023). Two sections were randomly chosen: 11–Sincerity as the experimental group and 11–Steadfast as the control group, with a total of sixty-two (62) students.

The primary instruments employed in this study were pretests and posttests on Organismal Biology. These instruments were piloted and validated by a Grade 11 Biology teacher to ensure content accuracy and appropriateness. After the posttest, the experimental group also completed a survey regarding the educational video game. The survey was validated by Biology teachers, IT professionals, and a game developer to ensure the reliability and relevance of the data collected.

Furthermore, *Phylum Expedition* is a researcher-made educational video game that features a storyline in which a traveler navigates various environments—land, sea, combined habitats, and air—by interacting with different organisms and answering questions correctly to progress. Correct responses increase the player's health and unlock abilities, while incorrect answers reduce health. When the player's health is depleted, the level must be restarted. The game was tested and refined with the assistance of subject and technical experts to ensure quality and functionality.

For data collection, both the experimental and control groups completed a pretest and attended the same General Biology 2 lecture. After the lecture, only the experimental group played *Phylum Expedition* in a computer laboratory setting. Both groups then completed a posttest three weeks later. In addition, the experimental group answered a survey to provide feedback on the game's effectiveness.

Results and Discussions

Table 1
Mean and Standard Deviation of Gain Scores of Both Control and Experimental Groups

Variable	Mean	Standard Deviation
Students Taught Using Traditional Way of Teaching	2.24	1.883
Students Taught with Integration of "*Phylum Expedition*"	3.67	1.575

Table 1 presents the differences between the pretest and posttest scores of both the control and experimental groups. The results of the gain scores indicate that the experimental group demonstrated better retention of the lesson content. The control group showed a higher standard deviation, suggesting that its data values were more dispersed from the mean and therefore less consistent compared to the experimental group, which exhibited a lower standard deviation (Rumsey, 2021; Webb, 2023).

Table 2
Test Statistic of Both Control and Experimental Groups

Computed T-Value	Critical Value	Decision
-3.247	1.6706	-3.247 < 1.6706∴ Reject H0

Table 2 shows the computed T-value and critical value needed to make a decision on whether or not to reject the null hypothesis. The computed T-value is -3.247, which is found in the rejection area with the critical value of 1.6706. Additionally, the T-value is less than the critical value, thus, the decision is to reject the null hypothesis of the control group being greater than or equal to the experimental group.

Table 3
The Aspects That the Students Are Satisfied With and Which Sparked Interest the Most

Questions in Survey	Choices	WM	Verbal Interpretation	Rank
Which part of *Phylum Expedition* are you the most satisfied with?	Gameplay	2.53	Agree	1
	Mechanics	2.24	Disagree	2
	Visuals	2.00	Disagree	3
Which part of *Phylum Expedition* are you the least satisfied with?	Gameplay	2.03	Disagree	2
	Mechanics	2.00	Disagree	3
	Controls	2.53	Agree	1
Which part of *Phylum*	Lore	2.29	Disagree	1

Expedition sparked your attention the most, which made you interested in continuing playing?	Gameplay	2.18	Disagree	2
	Educational Benefit	2.15	Disagree	3

Table 3 is a compilation of results from the survey wherein the students were tasked to rank certain aspects of the game according to the following: most satisfied, least satisfied, and sparked attention the most. Students rated the gameplay and lore the highest, these parts helped hold their attention and made the experience more engaging. On the contrary, the controls of the game received the lowest rating. Some students found it hard to maneuver around, this may have caused slight frustration during gameplay and shows that even if a game is educational, the way it is played still affects the overall learning experience.

Table 4
The Students' Feedbacks on the Integration of "Phylum Expedition" in Learning General Biology 2 Concepts

Questions in Survey	WM	Verbal Interpretation	Rank
has been engaging	3.50	Strongly Agree	1
has been informative	3.44	Strongly Agree	3
has explained a complex concept in a simple and visually appealing manner, making it easier for me to understand and retain the information	3.38	Strongly Agree	4
has not been able to explain the concept clearly, thus making Organismal Biology even more complicated	2.12	Disagree	6
has the right difficulty for the learners in the 11th grade	3.03	Agree	5
is recommended to other learners to help them understand Organismal Biology better	3.47	Strongly Agree	2
TOTAL	3.16	Agree	

Table 4 showcases the results upon collecting and statistically treating the responses from the experimental group from a survey. The experimental group stated that they strongly agree that *Phylum Expedition* has been engaging, has been informative, and has simplified explanations of the complex concepts within Organismal Biology. The students disagreed that the said game has not been able to explain Organismal Biology concepts clearly and agreed that the game is the right difficulty for the 11th grade learners. The results have garnered positive feedback from the students; further proof is that they also strongly agree to recommend Phylum FEU Diliman Basic Education Department (SHS) Expedition to other learners when learning Organismal Biology.

Table 5
The Level of Effect Size Based on Cohen's d

Cohen's d	Interpretation
-0.827	Large Effect

Table 5 exhibits the level of effect size based on Cohen's d. The findings suggest that the educational video game has been significantly effective on students' performance, as indicated by the Cohen's d value of -0.827. These results reflect the effectiveness of *Phylum Expedition* as an educational video game for enhancing student engagement retention.

Conclusion

This study aimed to assess which aspects of *Phylum Expedition* need improvements and how it enhances the retention of Grade 11 STEM-HA students, specifically in General Biology 2 concepts. Gain scores were calculated by subtracting pretest scores from posttest scores. The control group had a mean gain score of 2.24, while the experimental group had a mean gain score of 3.67. Since higher gain scores indicate greater improvement, the results suggest that *Phylum Expedition* is an effective learning aid for Grade 11 STEM Health Allied students.

The researchers also used a survey to further assess aspects of *Phylum Expedition*. Students were most satisfied with the gameplay and least satisfied with the controls. Since most students were unsatisfied with the controls, this aspect will be reworked, as *Phylum Expedition* is still a prototype. The lore or storytelling in the gameplay sparked the most attention, making students interested in continuing the game. The researchers plan to enhance the lore further, giving it a more concrete flow, adding new characters, and improving character writing. These improvements aim to maintain student interest so they can fully benefit from the educational content by finishing the game.

The students are very satisfied with the gameplay and mechanics of *Phylum Expedition*. According to the survey, both were informative, engaging, and not too difficult, indicating that the students enjoyed the gameplay. Gameplay ranked second in sparking student interest, with one comment stating, "I enjoyed the gameplay." However, the participants were neutral about the overall aesthetics. The researchers considered this and improved the visuals to make them more eye-catching, resulting in a higher-quality output. The students agreed that the difficulty level is suitable for 11th graders. Further improvements will be made to tailor the gameplay, mechanics, visuals, lore, controls, and difficulty to better fit 11th-grade learners.

The findings suggest that the educational video game significantly improved students' performance, shown by a Cohen's d value of -0.827. Respondents strongly agree that *Phylum Expedition* is informative and engaging. The game explained complex Organismal Biology concepts in a simple, visually appealing way, making it easier for students to understand and retain information. Survey results showed 38.2% disagreed that the game failed to explain concepts clearly, and 32.4% strongly disagreed that it made Organismal Biology more complicated. These results reflect positive learner feedback toward the game.

Recommendations

The researchers recommend that students use educational video games that are aligned with their lessons, designed to be enjoyable, and effective in helping retain concepts without relying on text-heavy materials. They suggest exploring games like *Phylum Expedition* and even creating their own educational games to develop game design skills and consider game development as a potential career path. Parents are encouraged to research and select suitable educational games for their children and promote their use as a fun and effective way to learn.

Teachers are advised to integrate educational games into their teaching strategies to make learning more engaging and improve retention, and they may also experiment with creating their own games using beginner-friendly tools such as GDevelop. School administrators should provide resources like computer labs and stable internet connections to support game-based learning and organize professional development programs, including workshops and seminars, to help teachers become more innovative and technologically adept.

The Department of Education is urged to review the study for its potential to enhance the curriculum, involve educational experts, and consider incorporating game development into technology-related subjects. They should also evaluate the effectiveness of educational games alongside traditional methods to determine their impact on academic performance. Game developers are encouraged to create educational games that serve as supplementary learning tools, carefully design game elements for better retention, and incorporate personalization and immersive 3D experiences to boost engagement.

Finally, for future researchers, they should use larger sample sizes and different educational levels to test whether results change or remain consistent. They should also study the integration of educational video games into other complex subjects to expand their applicability. Also, the researchers recommend a pre-planned schedule and strict time considerations for students to use educational video games longer. In addition, the researchers recommend maximizing the time spent on game design aspects, as they need to be aligned for an immersive and enjoyable experience while playing and learning. Future researchers should also check the equipment and resources used in the study, like computers and internet connection, to avoid technical issues and limitations. They should also use spaced repetition, such as playing the game every other day, to find out whether it will improve the retention of the students.

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recognize that the extent of their contributions meets accepted standards for scholarly authorship and therefore deem it appropriate to acknowledge their involvement in accordance with ethical research and publication practices.

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