Diversitas Journal
ISSN 2525-5215
Volume 10, Issue 1(Jan./Mar. 2025) p. 0210 – 0223
https://diversitasjournal.com.br/diversitas_journal

Development of a mobile application as an alternative assessment tool in Aircraft Powerplant II: Turbo Prop and Jet Engine

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A B S T R A C T

This study aimed to analyze the utilization of a mobile game application as an assessment tool in the subject Aircraft Power plant II: Turbo Prop and Jet Engine and its impact on boosting students' test results, learning retention and engagement. The study investigated the demographic profile of students, their level of knowledge retention, engagement with the gaming application, and the relationship between knowledge retention and engagement. The study found that the sample consisted of a higher representation of male participants, indicating a potential gender imbalance. The majority of participants fell within the 18-19 age range, reflecting the age distribution of the sample. Regarding student engagement, the findings showed high levels of engagement with the mobile game application. Students reported positive perceptions of the application, finding it easy to use, interesting, and relevant to the subject matter. The application enhanced their interest in the subject and made the learning process more enjoyable. The pre-test results revealed no significant difference in knowledge levels between the controlled and experimental groups, indicating similar baseline knowledge. However, the post-test scores demonstrated a significant improvement in knowledge acquisition in the experimental group compared to the controlled group, suggesting the positive impact of the mobile game application on students' knowledge retention. Although student engagement with the mobile game application was high, no significant correlation was found between engagement and knowledge retention. This implies that factors other than engagement might have influenced students' ability to retain knowledge.

ARTICLE INFORMATION

Article process:
Submitted: 10/14/2024
Approved: 11/01/2024
Published: 02/24/2025

Keywords:
aviation, assessment tool, mobile application, gamified learning, knowledge retention

RESUME

Este estudo teve como objetivo analisar a utilização de um aplicativo de jogo móvel como ferramenta de avaliação na disciplina Usina de Aeronave II: Turbo Hélice e Motor a Jato e seu impacto na melhoria dos resultados dos testes, retenção de aprendizagem e engajamento dos alunos. O estudo investigou o perfil demográfico dos alunos, seu nível de retenção de conhecimento, engajamento com o aplicativo de jogo e a relação entre retenção de conhecimento e engajamento. O estudo constatou que a amostra consistia em uma maior representação de participantes do sexo masculino, indicando um potencial desequilíbrio de gênero. A maioria dos participantes estava na faixa etária de 18 a 19 anos, refletindo a distribuição etária da amostra. Em relação ao envolvimento dos alunos, os resultados mostraram altos níveis de envolvimento com o aplicativo de jogo móvel. Os alunos relataram percepções positivas do aplicativo, achando-o fácil de usar, interessante e relevante para o assunto abordado. O aplicativo aumentou o interesse pelo assunto e tornou o processo de aprendizagem mais prazeroso. Os resultados do pré-teste não revelaram diferenças significativas nos níveis de conhecimento entre os grupos controlado e experimental, indicando conhecimentos de base semelhantes. No entanto, os resultados do pós-teste demonstraram uma melhoria significativa na aquisição de conhecimento no grupo experimental em comparação com o grupo controlado, sugerindo o impacto positivo da aplicação do jogo móvel na retenção de conhecimento dos alunos. Embora o envolvimento dos alunos com a aplicação de jogos para dispositivos móveis tenha sido elevado, não foi encontrada nenhuma correlação significativa entre o envolvimento e a retenção de conhecimento. Isto implica que outros fatores além do envolvimento podem ter influenciado a capacidade dos alunos de reter conhecimento.

Keywords:
aviação, ferramenta de avaliação, aplicativo móvel, aprendizagem gamificada, retenção de conhecimento

DOI: 10.48017/dj.v10ispecial_1.3174

Introduction

Mobile game apps have gained popularity as a form of entertainment and education. Mobile games have been utilized for educational purposes, serving as a means for instruction and evaluation. Aircraft Powerplant II: Turbo Prop and Jet Engine is a technically advanced course that demands a profound comprehension of the mechanics and principles of aircraft engines. Conventional pedagogical approaches, such as didactic instruction and written evaluations, may not be efficacious in facilitating knowledge retention among students. This holds particularly true for students who face challenges attending all lectures or maintaining focus during class. Many students may lack interest or motivation, leading to disengagement in their learning. This may result in suboptimal academic achievement and reduced prospects for professional advancement. Innovative and engaging teaching methods are necessary to enhance students' participation and retention in this subject.

The aviation sector is encountering several obstacles, such as a deficiency of proficient personnel. The International Air Transport Association (IATA) reported in 2019 that the aviation sector must train and hire more than 600,000 pilots by 2035 to satisfy the increasing need for air transportation. Apart from the shortage of pilots, there is also a demand for proficient aviation maintenance technicians, particularly those specialized in aircraft powerplant technology. Conventional teaching and assessment approaches may not adequately equip students for the practical obstacles they will encounter in their professions. Written exams may not effectively assess a student's practical application of course material despite testing their knowledge.

Furthermore, there is an increasing demand for novel and captivating pedagogical approaches. Organization for Economic Co-operation and Development or OECD's (2020) survey revealed that students expressed disengagement from their learning experiences. The survey revealed that conventional pedagogical approaches, such as didactic instruction and written assessments, were not consistently efficacious in sustaining students' involvement and enthusiasm. Mobile apps are popular and effective educational tool that offer advantages over traditional assessment methods.

The Philippine Normal University or PNU's (2018) study revealed that conventional teaching techniques, such as lectures and written assessments, were inadequate in maintaining student engagement and motivation. Moreover, the aforementioned study revealed that students exhibited a preference for interactive and tactile learning opportunities.

The COVID-19 pandemic has caused a disruption in the education system, resulting in schools and universities transitioning to online learning. Online learning has enabled educational continuity, but has also introduced challenges, including the provision of effective assessment methods. Mobile game apps offer an interactive and engaging learning experience that can enhance students' motivation and retention of the subject matter. Ateneo de Manila University or ADMU's (2021) study revealed that employing mobile game applications as an

assessment tool notably enhanced student engagement and motivation. The mobile game application can offer tailored learning, enabling students to learn at their preferred speed and obtain extra assistance for challenging topics. The mobile game application's prompt feedback can assist students in recognizing their weaknesses and adapting their learning approaches accordingly.

Conceptual Framework

The figure displays the study's conceptual framework comparing the impact of a mobile application vs. standard assessment techniques on first-year Aircraft Maintenance students' knowledge retention and engagement levels. The research included 140 students from the Philippine State College of Aeronautics - Villamor Air Base Campus sections 2, 5, 6 and 7. The study included 140 participants divided into two groups: the experimental group and the control group, each with 70 students. The experimental group was exposed to and used a mobile gaming application for assessment, whereas the control group was taught using traditional lecture techniques and traditional assessment methods. Prior to the intervention, a pre-test was administered to all participants, encompassing both the experimental and control groups.

The pre-test evaluated the participants' initial knowledge and comprehension of the topic that covered Aircraft Powerplant II: Turboprop and Jet Engine subject only. The treatment group is instructed through a mobile application that was tailored for Aircraft Powerplant II. This mobile app functions as an alternative assessment educational tool that provides interactive exercises to test the students' knowledge and to aid with the familiarization of the basic parts and components of Aircraft Powerplant II. In contrast, the control group is instructed using the conventional lecture approach, which entails in-person classroom instruction and traditional assessment method. Following the intervention, a post-test was administered to both the experimental and control groups.

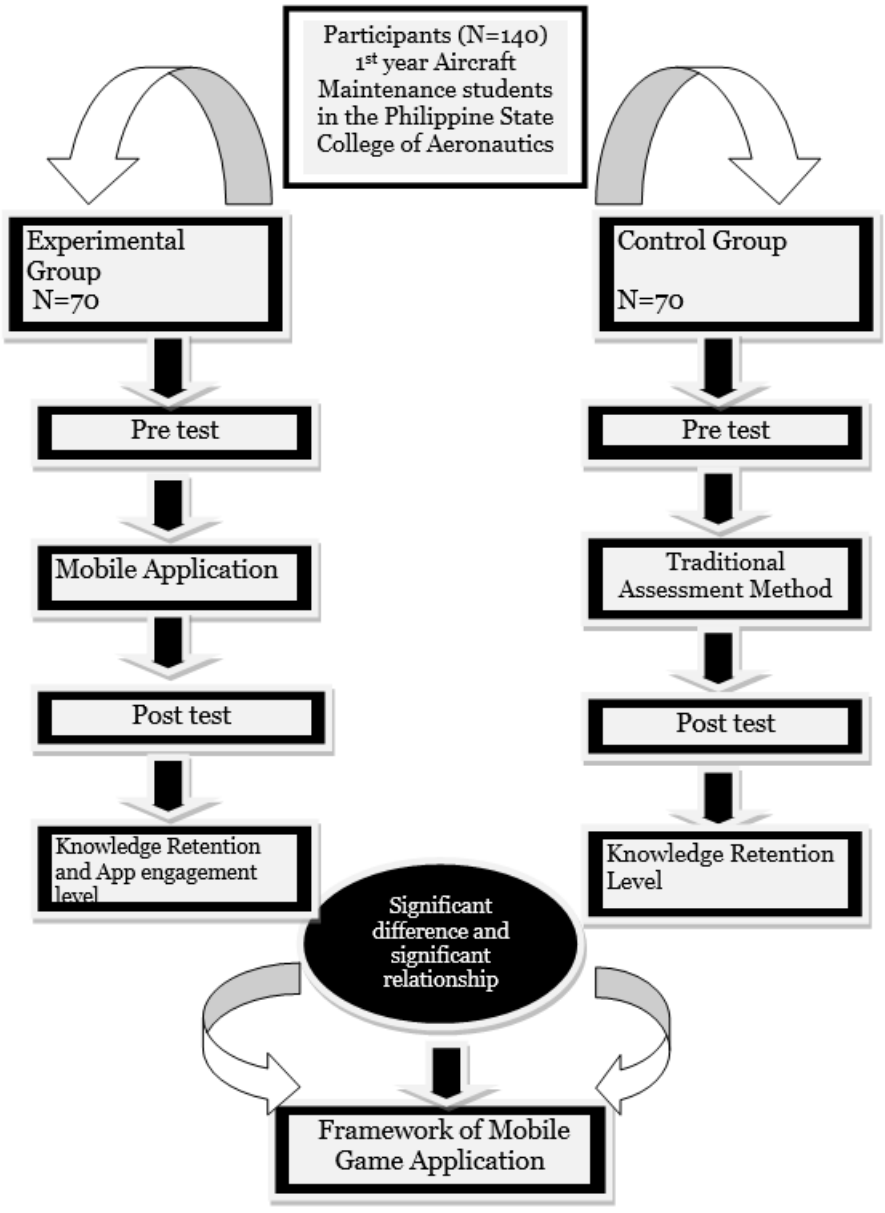
The post-test assessed participants' understanding and recall of the material after the instructional intervention. After the post-test, the treatment group got an application engagement survey to gauge their level of engagement with the app. The pre-test, post-test and app engagement level data was reviewed and evaluated. Statistical analysis was used to analyze test results, level of retention and engagement, significant differences and correlation of both experimental and control group. The findings were analyzed and interpreted in relation to the research goals and pertinent scholarly works.

A framework was proposed for using mobile applications as a learning tool for aircraft maintenance education based on the analysis and findings. The framework offered recommendations for integrating the mobile game application in Powerplant II for a more

interactive and fun learning, considering instructional design, technological pre-requisites and continuous support.

Figure 1.

Conceptual Framework Research Paradigm



Materials and Methods

For this study, a quasi-experimental design was used, with one class acting as the experimental group and the other as the control group. The experimental group received lessons that incorporated utilizing a mobile game application, whereas the control group received lessons that integrated the traditional way of teaching and assessment. The researcher then evaluated the effectiveness of mobile game application as an assessment tool in the subject Aircraft Power plant II.

Simple random sampling was used by the researcher. This is a probability sampling approach for selecting a sample from a population for research purposes. In simple random sampling, every individual or element in the population has an equal probability of being chosen for the sample (Kadam & Bhalerao, 2017). This means that each member of the population is chosen independently and arbitrarily, without favoritism or preference for individuals or groups.

This study used a pre and post-test for determination whether a mobile game application can significantly improve students' learning retention and engagement in the subject Aircraft Power Plant II: Turbo Prop and Jet Engine as an assessment tool. The questionnaire underwent content and face validity by qualified experts from the academe and from aircraft mechanic who is currently working in the field of Aviation. The instrument was pilot tested to determine reliability of the tool. In addition, it experienced a test-retest to check for reliability.

The researcher conducted the pretest questionnaires using a traditional assessment method and for the post-test, the researcher utilized a mobile game application in the experimental group. The survey also gathered accurate and significant data on the respondent's demographics and app engagement feedback to answer to the questions and hypotheses provided in this study. A survey questionnaire on the engagement feedback of the students on the mobile game application was use and underwent validation from expert personnel.

The research was carried out in the AMT Department of the Philippine State College of Aeronautics Villamor Air Base Campus during the second semester of the academic year 2022-2023. Data needed for this research were gathered using an adopted 30 item Aircraft Powerplant II: Turboprop and Jet Engine. The control group was taught and evaluated in the usual method, whereas the experimental group was evaluated using a mobile gaming application. Both the pre and post-tests contain the same set of questions. The questions in the post exam were randomized to comprehensively assess the students' knowledge retention based on their real test results. The mobile game application was distributed in both Android and IOS users. After taking the post-test, a mobile game application engagement survey was conducted. This survey was also validated through the evaluation of the qualified personnel/s.

Results and Discussions

Table 1 presented the distribution of participants in the treatment and control groups based on sex. The data indicated a higher proportion of male participants in both groups relative to female. The male participants comprised the majority, representing more than 75% of the participants in each group. The study's results emphasized the importance of

considering potential gender differences in the outcome and implications of interventions or strategies.

Table 1.
Frequency & Percentage Distribution of Control Group and Experimental Group in Terms of Sex

Sex	Controlled Group		Experimental Group	
	Frequency	Percent	Frequency	Percent
Female	16	22.9	13	18.6
Male	54	77.1	57	81.4
Total	70	100.0	70	100.0

Table 2 provided the breakdown of participants in the experimental and control groups by age. It showed that most participants fell into the 18-19 age range, followed by the 20-21 age group. The study primarily focused on young adults within specific demographic characteristics. This allowed the researcher to better understand how these factors may impact the study's outcomes and findings.

Table 2.
Frequency & Percentage Distribution of Control Group and Experimental Group in Terms of Age

Sex	Controlled Group		Experimental Group	
	Frequency	Percent	Frequency	Percent
18-19	44	62.9	54	77.1
20-21	24	34.3	16	22.9
22-23	2	2.9	0	0
Total	70	100.0	70	100.0

Table 3 illustrates the frequency and percentage distribution of the treatment and control groups in terms of gaming frequency. The table presents the responses of participants in the controlled and experimental groups regarding their engagement in gaming activities.

In the controlled group, 37.1% of the participants reported gaming "Most of the Time" (4x-6x per week), while 52.9% mentioned gaming "Sometimes" (2x-3x per week). A smaller proportion, 10.0% of the controlled group, stated that they never engaged in gaming. In the experimental group, 31.4% reported gaming "Most of the Time" (4x-6x per week), with a majority of 64.3% stating they gamed "Sometimes" (2x-3x per week). A small percentage, 4.3% of the experimental group, reported never engaging in gaming.

Table 3.

Frequency and Percentage Distribution of Control Group and Experimental Group in terms of Gaming Frequency

Gaming Frequency	Controlled Group		Experimental Group	
	Frequency	Percent	Frequency	Percent
Most of the time (4x-6x per week)	26	37.1	22	31.4
Sometimes (2x-3x per week)	37	52.9	45	64.3
Never	7	10.0	3	4.3
Total	70	100.0	70	100.0

Table 4 exhibited the outcome of the control and experimental groups' pre-tests, as well as the starting knowledge levels of both groups prior to the intervention. The controlled group obtained an average score of 18.2857, whereas the experimental group attained a mean score of 19.3000.

Table 4.

Mean and Standard Deviation Result on the level of student knowledge retention of Control and Experimental Group Pre-Test Result

	Group	N	Mean	Std. Deviation	Interpretation
Pre-Test	Control Group	70	18.2857	4.60354	Average
	Experimental Group	70	19.3000	3.13165	High

Legend: 0-6 (Very Low), 7-12 (Low), 13-18 (Average), 19-24 (High), 25-30 (Very High)

According to the data presented in Table 5, the control group's pre-test results yielded a mean score of 18.2857 (SD = 4.60354), indicating their performance prior to the lecture and assessment. Following the lecture, a post-test was administered and the control group's results showed a mean score of 19.8143 (SD = 3.89088), which fell within the "High" level. The results indicated an improvement in the mean scores for both groups after implementing the methods, which suggested an increase in knowledge retention for the study.

Table 5.

Mean and standard deviation results on the level of student knowledge retention on comparison of control group test results

		N	Mean	Std. Deviation	Interpretation
Control Group	Pre-Test	70	18.2857	4.60354	Average
	Post-Test	70	19.8143	3.89088	High

Legend: 0-6 (Very Low), 7-12 (Low), 13-18 (Average), 19-24 (High), 25-30 (Very High)

Interpreting Table 6, the pre-test results for the experimental group indicated a mean score of 19.3000 (SD = 3.13165), demonstrating their initial knowledge on the subject prior to the intervention. In terms of the post-test results, the data revealed that the experimental group achieved a mean score of 29.5857 (SD= 0.75167), signifying a higher level of consistency and knowledge retention that was within the "Very High" interpretation. This clearly revealed that the experimental group experienced an increase in their knowledge retention following the intervention.

Table 6.

Mean and standard deviation results on the level of student knowledge retention on comparisonof experimental group test results

		N	Mean	Std. Deviation	Interpretation
Experimental Group	Pre-Test	70	19.3000	3.13165	High
	Post-Test	70	29.5857	.75167	Very High

Legend: 0-6 (Very Low), 7-12 (Low), 13-18 (Average), 19-24 (High), 25-30 (Very High)

Table 7 showed descriptive statistics of the students' engagement with the mobile game application in the subject. It included the mean and standard deviation for each item, as well as the general weighted mean, which represented the overall level of engagement among the students.

The highest mean score was found in Item 4: "I like the idea of the game and how it relates to our subject" with a mean of 3.8714. This implied that students appreciated the concept of the game and its relevance to the subject matter. It suggested that the integration of the mobile gaming application was well received by the students and was regarded as significant and beneficial in terms of increasing their learning experience.

Numerous studies have been conducted to demonstrate the value of game-based learning and its good benefits on student engagement and motivation. According to Mamolo et al. (2023), game-based learning can increase learners' enjoyment, motivation and immersion in the learning process. The atmosphere encouraged interaction, involvement and the development of critical thinking and problem-solving skills. Furthermore, study by Kuhail

et al. (2023) showed that game-based learning can improve interest, attention and long-term information retention.

On the other hand, the lowest mean score is observed in Item 10: "I often interact and engage with educational content on mobile applications" with a mean of 3.6429. This suggested that students, on average, reported a moderate level of interaction and engagement with educational content on mobile applications. It implied that there is room for improvement in terms of encouraging students to actively interact with educational materials beyond the specific mobile game application used in the study.

Julie et al. (2022) found that various factors, including design features, usability and the presence of interactive elements, can influence students' engagement with educational apps. This featured the significance of developing mobile applications that prioritize user-friendliness, intuitiveness and active engagement and interaction.

Tapingkae et al. (2020) emphasized the importance of personalization and customization features in mobile applications for improving student engagement. It customized educational content to suit individual needs and interests enhances students' sense of ownership and motivation to engage with the app.

Table 7.

Mean and standard deviation on the level of student mobile application engagement

Student's Engagement	N	Mean	Std.	Student's Engagement
1. It is easier to remember the topics that were discussed during the learning process with the mobile game application.	70	3.8571	.39142	Highly Engaged
2. I am able to reflect on the ideas and insights I have developed as a result of playing the mobile game application.	70	3.8429	.40417	Highly Engaged
3. It helped me increase my interest in the subject.	70	3.7286	.56264	Highly Engaged
4. I like the idea of the game and how it relates to our subject.	70	3.8714	.37769	Highly Engaged
5. I find the mobile game application easy to use, interesting and satisfying.	70	3.8143	.42709	Highly Engaged
6. It made the overall learning process a fun and exciting experience.	70	3.7571	.43191	Highly Engaged
7. I feel more enthusiastic to the subject while using the mobile game application.	70	3.7429	.52985	Highly Engaged
8. I find myself frequently using mobile applications for educational purposes.	70	3.7000	.49196	Highly Engaged
9. I feel motivated to explore and discover new mobile applications related to my studies.	70	3.7000	.46157	Highly Engaged

10. I often interact and engage with educational content on mobile applications.	70	3.6429	.61469	Highly Engaged
General Weighted Mean		3.7657	.29630	Highly Engaged
Valid N (listwise)	70			

Legend: 1.00-1.50 (Not Engaged), 1.51-2.50 (Less Engaged), 2.51-3.50 (Moderately Engaged), 3.51-4.00 (Highly Engaged)

An independent sample t-test was conducted to test the significance between the controlled and experimental group on the student's Pre-Test Results for Aircraft Powerplant II exhibited in Table 8. The results demonstrated that there was no significant difference in Pre-test scores between the controlled group (M=18.286, SD=4.603) and the experimental group (M=19.300, SD=3.132) (t121.598=-1.524, p=.130). Since the p-value is greater than .05 alphas, therefore we failed to reject the null hypothesis. This implied that in the subject for Aircraft Powerplant II, the student's knowledge retention of both groups was almost identical result to each other.

Numerous studies have examined the efficacy of various teaching methods and interventions in enhancing students' knowledge retention in technical subjects such as Aircraft Powerplant II. Syathroh (2022) performed research to explore the impact of interactive learning techniques on engineering students' knowledge retention. According to the findings, interactive learning approaches such as practical demonstrations, simulations and hands-on activities have a considerable favorable influence on students' knowledge acquisition and retention in technical courses. Orbon and Sapin (2022) conducted a study to examine the efficacy of blended learning methods in enhancing students' knowledge retention in engineering courses. Blended learning is an instructional approach that integrates in-person teaching with online learning elements, enabling students to interact with course content using different methods. According to the study, using blended learning strategies improved students' capacity to retain knowledge and their overall academic accomplishment.

Kabilan et al. (2023) investigated the impact of multimedia-enhanced learning on students' knowledge retention in technical areas. The incorporation of multimedia elements, including videos, animations and interactive simulations, were discovered to improve students' comprehension and retention of information.

Table 8.
Significant difference of pre-test results of experimental and control group

	Group	**N**	**Mean**	**Std. Deviation**	**t-value**	**p-value**	**Interpretation**
Pre-Test	Control Group	70	18.2857	4.60354	-1.524	.130	Not Significant
	Experimental Group	70	19.3000	3.13165			

A paired-sample t-test was conducted to test the significance on the Pre- Test and Post-Test Results on the utilization of Mobile Game Application for the subjectAircraft Powerplant II shown in Table 9. The result showed that there was a significant difference between the Pre-Test (M=19.300, SD=3.132) and Post-Test (M=29.586, SD=.752) results after utilizing the Mobile Game Application (t69=-27.611, p=.000). Since the p- value is less than .05 alphas, therefore we failed to accept the null hypothesis. This implied that the Post-Test results of experimental group gained an increment in mean scores after utilizing the utilizing the Mobile Game Application compared to their Pre-Test results.

Elbasyouny (2021) investigated the effect of game-based learning on students' academic performance. The study found that using game-based learning approaches had a positive influence on students' knowledge acquisition, information retention and motivation levels.

Additionally, Kuhail et al. (2023) conducted a study to investigate the efficacy of mobile applications in improving learning outcomes. The researchers discovered that incorporating mobile applications in educational environments facilitated active learning, engagement, and knowledge retention among students. Mobile applications offer personalized learning experiences and enhance student motivation due to their interactive nature, accessibility, and flexibility.

Dahri et al. (2023) conducted research that highlighted the advantages of game-based mobile learning in enhancing student engagement and knowledge acquisition. The study found that mobile games can improve problem-solving skills, critical thinking, and subject comprehension.

Table 9.
Significant difference of pre-test and post test result in experimental group

Experimental Group		N	Mean	Std. Deviation	t-value	p-value	Interpretation
Pair 1	Pre-Test	70	19.3000	3.13165	-27.611	.000	Significant
	Post-Test	70	29.5857	.75167			

An independent sample t-test was conducted to test the significance between the controlled and experimental group on the student's Post-Test Results for Aircraft Powerplant II in Table 10.

The result showed that there was a significant difference between the controlled group (M=19.814, SD=3.891) and experimental group (M=29.586, SD=.752) on their Post-test results (t74.143=-20.630, p=.00). Since the p-value was less than .05 alpha, therefore the researcher failed to accept the null hypothesis. This implied that the post-test results of those students (controlled group) who did not use the Mobile Game Application has a less mean

score compared to those students (experimental Group) who underwent for testing with -9.771 mean score difference.

Table 10.
Significant difference of post-test results (experimental and control group)

Group		N	Mean	Std. Deviation	t-value	p-value	Interpretation
Post-Test	Controlled Group	70	19.8143	3.89088	-20.630	.000	Significant
	Experimental Group	70	29.5857	.75167			

A Pearson-R Moment Correlation was conducted to test the relationship of the student's engagement in using the Mobile Game Application towards their knowledge retention prowess on the subject for Aircraft Powerplant II (Turbo Prop & Jet Engine) in Table 11. The result showed that there was no significant correlation of the student's engagement towards their knowledge retention prowess after utilizing the Mobile Game Application (r=.098, p=.420) under the experimental group. Since the p-value was less than .05 alphas, therefore the researcher failed to reject the null hypothesis. This implied that if the student's knowledge retention is higher, it does not directly state that the students (experimental group) are fully engaged on utilizing the Mobile Game Application for Aircraft Powerplant II.

Mamolo and Sugano (2023) studied the effects of mobile gaming apps on student engagement and information retention in scientific education. The study's findings revealed that using mobile game-based learning increased student engagement and information retention. Mamolo (2022) conducted a study on the use of mobile game applications in mathematics education. They discovered that students who used these applications exhibited greater knowledge retention than those who did not.

However, other studies have produced conflicting findings. Lozano et al. (2023) conducted a study examining the correlation between student engagement with a mobile game application and knowledge retention in the field of social studies. There was no statistically significant association between student involvement and information retention according to the study. This means that the effect of mobile gaming apps on information retention may differ depending on the subject.

Jansen et al. (2018) conducted a study to assess the efficacy of a mobile game application for language acquisition. Although the application was found to increase student engagement, it did not result in a significant improvement in knowledge retention when compared to traditional instructional methods. This implied that factors other than student engagement, such as instructional design and pedagogical strategies, might impact knowledge retention outcomes. This discovery is congruent with the findings of Kabilan et al. (2023), who

discovered that using mobile gaming apps did not always result in improved information retention across all academic fields.

Table 11.

Correlation of knowledge retention level and level of engagement (experimental group)

		Retention (Post-Test)	**Interpretation**
Student's Engagement	Pearson Correlation	.098	Not Correlated
	Sig. (2-tailed)	.420	
	N	70	

Conclusion

This study explored the impact of a mobile gaming application on student engagement and knowledge retention. It found a higher representation of male participants and a majority within the 18-19 age range. While there was no significant correlation between engagement and knowledge retention, the intervention improved retention levels. The experimental group demonstrated a significant increase in knowledge retention from pre-test to post-test, indicating the app's positive influence compared to the test results of control group. Overall, despite the lack of statistical correlation, the intervention had a beneficial effect on both engagement and knowledge retention.

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