



AMERICAN JOURNAL OF INTERDISCIPLINARY RESEARCH AND INNOVATION (AJIRI)

ISSN: 2833-2237 (ONLINE)

VOLUME 3 ISSUE 1 (2024)

**PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA**

Assessment of Educational Digital Game-Based Learning and Academic Performance of Grade Six Pupils

Dianne Mariz N. Obenza-Tanudtanud¹, Brandon N. Obenza^{2*}

Article Information

Received: December 06, 2023

Accepted: January 05, 2024

Published: January 09, 2024

Keywords

*Digital Game-Based Learning,
Academic Performance,
Education, Philippines*

ABSTRACT

Digital games have surpassed the movie box office and are making their way to revolutionize the contemporary teaching methods of today's classrooms. Educators, parents, and policymakers are debating its effect on the students, and more researchers are offshooting to prove its effectiveness and suitability for the recent digital natives. This study, therefore, found empirical evidence underpinning the efficacy of Educational Digital Game Learning on the learners' academic performance, specifically in English concepts, using a quasi-experimental control group and descriptive design. Two classes of grade VI students were involved and labeled as the control and experimental group. During the study, the researcher used a validated test instrument. The researcher also filmed how EDGBL was conducted in the classroom and recorded interviews with experienced students. Frequency counts, percentages, weighted mean, and t-tests for independent samples were used to investigate the aims and establish the results. The findings revealed that students who underwent Educational Digital Game-Based Learning had improved their academic performance in learning English concepts. It was also found that those students who were exposed to EDGBL developed more positive habits in learning English. In contrast, those exposed to the traditional method tended to misbehave and have a monotonous learning environment. Moreover, conducting EDGBL as a method requires teachers to have practical facilitating skills to maintain solid work coordination throughout the implementation of EDGBL.

INTRODUCTION

Today's student generations differ significantly from those of previous decades. Therefore, developing the skill sets required to create holistic learners is impossible using some out-of-date teaching approaches. Contextually, the learners of Absalon L. Padronia Memorial Elementary School are considered "digital natives," a term coined by Prensky (2001) which describes students who have grown up in a technologically advanced environment, have been exposed to smartphones, the Internet, gaming and any other Apps. Due to these shifts, pupils found it more challenging to succeed academically when employing outdated teaching strategies. Further, a University.com article supported that lectures are helpful for tactile/kinesthetic and visual/nonverbal learners, but they are less effective for auditory/verbal and visual/verbal learners. Moreover, they added that since the teacher is the only source of the information, the student also gets it, ending the discussion and stifling his ideas and opinions. This undermines critical thinking and promotes memorization. Thus, focusing on more valuable learning skills such as creativity, critical thinking, analysis, and problem-solving is necessary.

The two people credited with developing the theory, Gee (2007) and Prensky (2007), are the proponents of digital game-based learning in K-12 education (p.78). According to Klaila (2007), "Gaming illustrates lengthy, typically dull, and challenging jobs that may be entertaining and enjoyable while also contributing to an engaging learning experience." Furthermore, according to Green and

McNeese (2007, p. 5), players' physical, psychological, and cognitive development may be impacted by digital games.

"A system in which players participate in simulated conflict by predetermined rules, with quantifiable outcomes" is how Salen and Zimmerman (2004) define games. According to Connolly and Stansfield (2007, p. 188), which Sampson (2012, p. 15) cites, "game-based learning is an area within the broader domain of serious games that focuses on utilizing applications with predetermined learning objectives" (Game-Based Learning, 2016, p. 4). "Implementing a computer game-based methodology to facilitate, reinforce, and augment the processes of instruction, learning, evaluation, and assessment." Generally speaking, their design seeks to improve player retention and application of the material in real-world scenarios while also finding a balance between the gameplay and the subject matter.

Prensky (2001) claims that teachers must now adapt their methods of instruction and language preferences to those of digital natives. He also recommends that teachers use computer- or digital-based educational games as teaching tools to better meet their students' needs. These games can be applied in many different contexts and ways to a wide range of disciplines.

There has been a consistent rise over the last several decades in the utilization of digital game-based learning in educational settings, and a large number of studies have proved the benefits that this method provides for the students who participate in it. Despite the fact that

¹ Department of Education, Cotabato Division, Province of Cotabato, Philippines

² University of Mindanao, Davao City, Philippines

* Corresponding author's e-mail: bobenza@umindanao.edu.ph

educational digital game-based learning (EDGBL) has become more and more popular over time and is being used to support learning in a variety of subjects, including English, some parents are still hesitant and constantly oppose its use. This is despite the fact that EDGBL is being used to support learning in a variety of subjects, including English. In addition, only a few of the studies focused on the utilization of Compare, Spell Off, PreSuf, Dependent or Independent Clause Billionaire Game, and Sentence Power as digital games in their research works. Thus, engaging this population of students would give both researchers and parents a first-hand experience and evidence of the effectiveness of EDGBL in the school context. This study assessed the effectiveness of EDGBL in developing elementary learners' academic performance in English classes. Further, this investigation may contribute to the improvement of pedagogical practices in teaching English at the elementary level.

Research Objectives

The goal of the study was to assess the significant change in the achievement of students when Educational Digital Game Based Learning (EDGBL) versus the conventional method of instruction used.

Specifically, it aimed to:

1. Determine the difference of pre-test scores of the control and experimental groups;
2. Determine the difference of post-test scores of students exposed in Educational Digital Game Based Learning and conventional method of teaching;
3. Determine the difference of gain scores of the control and experimental groups; and
4. Discuss the class dynamics when EDGBL is integrated in the classroom.

LITERATURE REVIEW

To better prepare students for a world that is becoming more technologically driven, connected, and competitive, educators and the government alike are calling for educational reform (Reimers, 2008; Burke, 2010, para. 1). The rapid pace of technological advancement raises significant societal issues. As a result, teachers must create learning activities that foster the proficient skill sets that are vital in this rapidly changing world. As a result of the proliferation of taxonomies and frameworks about "21st-century talents," according to Levy and Murnane (2013), the workforce of the future will be characterized by an increased dependence on technology, extensive problem-solving skills, sound judgment, and complex communication. Therefore, educators need to use a practical and efficient method to make sure that students are ready to meet global standards.

Students have improved their reading, math, reasoning, and collaborative skills, as well as their understanding of world history, by using Civilization and The Sims (Weigel, 2013, para. 3). Furthermore, computer games may improve motivation and learning, according to experimental research (Whitton, 2012, p. 249) (Kambouri

et al., 2006, p. 405; Hamalainen *et al.*, 2006, p. 48).

Educational Digital Game-Based Learning

Digital learning games promote mental and comprehension habits that are applicable in an academic setting, according to Klopfer (2009). Another study by Prensky (2007) highlights that this approach—which entails embedding instructional content into video games—delivers better results than traditional teaching techniques. Furthermore, Chen and Wang (2009) emphasize how important digital games are for motivating players and how they can facilitate active knowledge development (p. 282).

According to Saulter (2007), digital games are the primary source of people's motivation and engagement in the learning process, as mentioned by Panoutsopoulos and Sampson (2012, p. 15). Additionally, games can put player actions in meaningful and authentic contexts by simulating real-world scenarios and implementing ill-defined problems (Winn, 2007; Klopfer, 2008; Whitton, 2010). (Prensky, 2007; Gee, 2007, p.77; Whitton, 2010, p.46). By using trial-and-error techniques, they also offer learning opportunities (Oblinger, 2004, p. 18; Prensky, 2007 Chen & Shen, 2010, p. 747).

The methods in which games can be included into the educational process are the subject of additional research that is now being carried out. Mobile Assisted Language Learning in Mongolia, for example, mixes gamification, social media, and mobile devices to eliminate temporal and spatial barriers to language learning (Miangah T. & Nezarat A., 2012, p. 315). According to the Norwegian Agency for Development Cooperation, EduApp4Syria, an international innovation competition, is creating open-source smartphone applications that aim to enhance Syrian refugee children's psychosocial well-being by fostering foundational reading skills in Arabic (para. 2-3). ELLN Digital-Technology-Supported Early Language, Literacy, and Numeracy Teacher Professional Development for K-3 Teachers: According to a summary in An Evaluation (Philippines) (2016, para. 1), the Early Language, Literacy and Numeracy Digital project being executed in the Philippines aims to construct and assess a technology-supported teacher professional development framework for early literacy and numeracy across the K-12 curriculum that is sustainable, flexible, scalable, and cost-effective.

Standardized testing revealed that the mathematical ability of 193 students who utilized Dimenxian/Evolver increased by 40% in high school algebra and college-level numerical approaches, according to research by Mayo (2009). Smith and Okolo (2010) reported that they observed good impacts in forty-one special needs children with high accomplishment motivation through the use of the simple game Math Masters (p. 258). Gillispie (2008) demonstrated that students who utilized Dimension-M, an immersive gaming platform with a highly immersive nature, achieved much higher levels of math achievement than their nongaming classmates (p. 28).

Games and Learning

Play is crucial for both healthy child development and the advancement of learning (Ginsburg, 2007, p. 5). Virtual environments that support gameplay are one of the potential benefits of digital games, so they are not necessarily bad for learning. Conversely, they might even act as a spur for the development and advancement of intellect (Ke, 2009, pp. 28). Games can be used as a cover for progressive pedagogy, even though they shouldn't be used as a learning diversion (Steinkuehler, 2013). There was excitement that games could offer an engaging and proper new learning technique because players could gain valuable skills and the attractive qualities of digital games to inspire motivation (Subrahmanyam & Greenfield, 2007; De Freitas, 2006).

Digital games provide an easy way to combine readings and learning activities within an engaging environment (Featherstone, Perrotta, Aston, Houghton, 2013, p. 21). This combination is more valuable and worthwhile than "outdated" forms of knowledge received through traditional education because it combines a variety of perspectives and perspectives. In addition, O'Neill *et al.* contend that the length and level of student engagement with the game and the learning and skill development that results from the game's use as a teaching tool can all be considered when evaluating the effectiveness of DGBL.

EDGBL as a Learner-Centered Approach

As Einstein said, "I make no effort to instruct my pupils on any subject. My first goal is to create an environment that will support their learning". The students find the digital game-based approach to be more engaging than a traditional teaching strategy. Competition, rules, goals, and measurable targets are all components of games that work together to create an exciting experience that gives players a sense of success (Peters, 2016, para. 6).

In an interview, Wisconsin University professor Constance Steinkuehler, who spent ten years studying the educational uses of games, said, "Games are interactive spaces for children to construct meaning; the objectives are explicit; and the learner's interest is not disregarded or overlooked." She also mentioned that when kids are actively involved in a subject, they become more engaged with it. Active or hands-on learning options that encourage students to continue playing and learn further foster motivation. Thus, learning, strategic planning, and ongoing decision-making are practiced continuously inside a game setting, which is readily applicable to real-world scenarios.

Skill Development through EDGBL

It has been discovered that using instructional innovations supported by games can be beneficial to the growth of mathematical skills and competences. It has been discovered that the utilization of instructional innovations that are supported by games can be beneficial to the growth of mathematical skills and competences. Specifically, it was discovered that playing puzzle games

can enhance students' mental computation skills, including their ability to perform arithmetic calculations quickly and accurately at the primary level (Robertson & Miller, 2009). "Playing historical games such as Civilization with raw world maps not only improves understanding of the events themselves, but also the underlying circumstances that led to such events" (Steinkuehler, 2013, p. 1). "Schools have already begun using video games similar to Minecraft to teach disciplines such as chemistry, physics, and ecology" (Steinkuehler, 2013, p. 1). According to Bottino (2007), effective instructional designs reinforced by the inclusion of educational games can help students develop their critical thinking skills by creating and testing hypotheses, engaging in reflection exercises, and drawing conclusions (pp. 1285).

Theoretical Framework

The constructivist viewpoint, upon which this study is theoretically based, holds that learning is best achieved when students actively investigate real-world situations and gain personal meaning from first-hand encounters. This viewpoint has that people create their own perspectives by solving problems and going on unique adventures, which helps them to form their own understanding of the world. Constructivist principles, which emphasize active engagement and experiential learning, have significantly impacted the design of online learning environments that are student-centered, including interactive learning objects and digital games (Land and Hannafin, 1998, p.239).

Jerome Bruner, who is recognized as a pioneer in this field, argues that within the constructivist paradigm, learning is an active process in which students actively engage with the material, drawing from prior knowledge and experiences (McLeod, 2023, para. 22). Furthermore, according to Becker (2005, para. 7), Robert Gagné's theoretical framework suggests that nine mechanisms through which games induce cognitive change — reception, expectancy, retrieval, selective perception, semantic encoding, responding, reinforcement, retrieval, and generalization.

Building on this foundation, Lev Vygotsky asserts that effective learning occurs when it is social, active, and situated (Qian & Clark, 2016, p. 51). Becker (2005) supplements this perspective by emphasizing that well-designed games offer diverse approaches to learning, providing players with opportunities to explore immersive virtual environments and authentic contexts for skill practice that can be applied in the real-world scenarios.

Furthermore, the "law of exercise" states that repetition increases the likelihood of a correct response. Edward Thorndike's connectionism, as Weibell (2011) explained, posits a relationship between stimulus and response (S-R) that is positive. According to Weibell (2011), para. 2, 6). In gaming, the more players interact with the game, the higher the likelihood of obtaining an accurate response. This is consistent with the constructivist framework's active learning and reinforcement principles.

This theoretical synthesis provides a robust foundation

for understanding the pedagogical underpinnings of EDGBL, affirming its alignment with constructivist principles and highlighting its potential to facilitate active, experiential, and socially situated learning.

Hypothesis

$H_0: \mu_1 = \mu_2$, There is no significant difference between the students’ average test scores before and after the application of Educational Digital Game-Based Learning.

MATERIALS AND METHODS

This investigation examined the impact that EDGBL had on the academic performance of kids in sixth grade by employing a quasi-experimental methodology, more precisely, a control group design that consisted of a series of pre-and post-tests. In total, 54 children from two different classes at Absalon L. Padronia Memorial Elementary School in the Alamada East District of the Cotabato Division participated in the study. The school is located in the Alamada East District of the Cotabato Division. The participants were split into two groups with an equal number in each. One of the groups was designated as the experimental group and was taught using EDGBL. The other group served as the control group and was trained using more conventional methods. Aligned with the K–12 modules, the assessment instrument utilized in this research was a fourth-grade examination encompassing material from the fourth grading period. English professors performed thorough analysis, validation, and verification of the questionnaire in order to ascertain its validity. After the initial test, the instrument’s internal consistency was evaluated using Cronbach’s Alpha after it was revised based on the results of the pilot test. According to the findings, the reliability of the questionnaire was determined to have a coefficient of 0.82, which can be interpreted as a sign of its accuracy. In order to ensure adherence to ethical principles, prior authorization was obtained from the district supervisor, the division superintendent, and the school head prior to initiating the research. Following this, the software games were successfully installed on the P.C.s under the supervision of a computer specialist. The process of choosing student respondents was conducted inconspicuously in order to mitigate the risk of performance bias.

The experimental procedure was initiated by administering a pretest to both groups in order to provide a foundation

for comparison in their subject knowledge. After that, standard lessons from the K–12 curriculum were carried out, during which the experimental group was taught using EDGBL, while the control group received traditional instruction. English classes were held for a duration of sixty minutes on five days of the week. During this designated period, preparation exercises, presentations, discussions, and lesson evaluations were allotted forty minutes. The remaining twenty minutes were devoted to EDGBL games. The program incorporated the chosen EDGBL titles, including Compare, Spell off, PreSuf, Dependent or Independent Clause Billionaire Game, and Sentence Power, which provided students with skill-building exercises, drills, and practice.

During the course of the experiment, the instructor oversaw the gaming sessions while responding to student inquiries and reviewing previously discussed information. It is worth mentioning that the game developer, Professor Owen Dwyer, granted specific consent to the researcher about the utilization of these games in the research. The control group was exposed to traditional pedagogical approaches, which consisted of classroom discussions and lectures supported by readily available textbooks. Posttests were provided to both groups for a complete evaluation after the eight-week experimental period. These posttests consisted of identical items to the pretests but were presented in an alternative order.

RESULTS AND DISCUSSION

Pre-test Scores of the Control and Experimental Groups

Before the beginning of the experimental intervention, a pretest was routinely given to both the control group and the experimental group to achieve the goal of maintaining initial comparability between the two sets of participants. The ensuing distribution of scores within each group is graphically depicted in Figure 1 through a box and whisker plot. It can be seen from the table that the scores that were recorded for both the experimental group and the control group were anywhere from 5 to 39. It is important to note that the median values for the control group and the experimental group were both found to be 13, while the experimental group’s median value was 14. This visual depiction provides a nuanced insight into the central tendency and spread of the pretest scores, forming a foundational understanding of the groups’ equivalence at the outset of the study.

Control Group
 Max= 35
 Min= 5
 Median = 13

Experimental Group
 Max= 39
 Min=8
 Median = 14

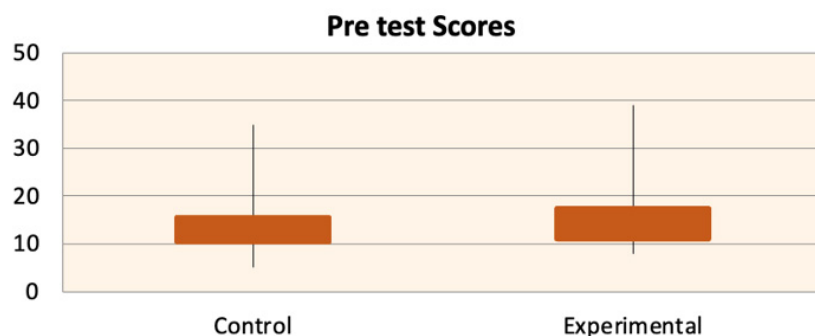


Figure 1: Distribution of the pretest scores in the control and experimental group

The results of a detailed comparison of the pre-test scores of the experimental group and the control group are presented in Table 1. The mean scores reveal that the experimental group performed somewhat better on the pre-test than the control group. In particular, the group that was subjected to the experiment had a mean score of 14.89 (29.78 percent), whereas the group that served as a control recorded a mean score of 14 (28 percent). This produced a marginal mean difference of 0.89. (1.78 percent).

The independent samples t-test was used to determine whether or not there was a statistically significant difference between the control group and the experimental group in terms of the observed variance in mean pretest scores. The t-value that was calculated to be 0.49 resulted in a probability that was correspondingly 0.62, which was higher than the traditional significance

threshold of 0.05. This conclusion is not statistically significant, which means that the null hypothesis, which states that there is no significant difference in the mean pretest scores of the control and experimental groups, is correct. Consequently, the data convincingly substantiates the two groups' equivalence and comparability at the study's onset.

This shows that the levels of knowledge relevant to English concepts covered in the fourth grading period were practically identical for students in both the control group and the experimental group. The absence of a significant distinction in pretest scores establishes a robust baseline, reinforcing the experimental design's success in achieving comparable groups, thereby facilitating a valid assessment of the subsequent impact of EDGBL on the academic outcomes of the experimental group.

Table 1: Test of difference between the mean pretest scores of the control and experimental group

Group	n	Mean	Standard Deviation	Mean Difference	t-value	df	p-value
Experimental	27	14.89	6.59	0.89	0.49 ^{ns}	52	0.62
Control	27	14.00	6.61				

ns - not significant at 0.05 level

Post-test Scores of the Control and Experimental Groups

In Figure 2, the posttest scores for both the control group and the experimental group are visually shown using a box-and-whisker plot to clarify the distribution characteristics. The control group received the same treatment as the experimental group. The observed range of posttest scores for the control group spanned from 12 to 45, while the experimental group exhibited a range from 18 to 47. Notably, the control group displayed a broader score range, recording 33, in contrast to the experimental group's range of 29. Nevertheless, despite the control group's wider range, the experimental group outperformed in terms of both average and median scores.

Specifically, the average posttest score for the experimental group, standing at 28, surpassed the corresponding average score of 21.81 for the control group. The significant gap between the two groups' average scores

draws attention to the exceptional performance of the experimental group. Akin to the average scores, the median score for the experimental group, denoting a value of 28, significantly exceeded the median score of 21 for the control group. This observation collectively implies that, on the whole, students in the experimental group demonstrated superior performance in comparison to their counterparts in the control group.

The fact that the two groups' post-test results were significantly different demonstrates that the EDGBL intervention may have the ability to improve students' academic outcomes. The discernible higher average and median scores in the experimental group point towards the positive impact of EDGBL on reinforcing and augmenting the acquisition of English concepts covered in the fourth grading period. These findings contribute valuable insights into the efficacy of EDGBL as a pedagogical tool, meriting further consideration and exploration in the realm of educational practices.

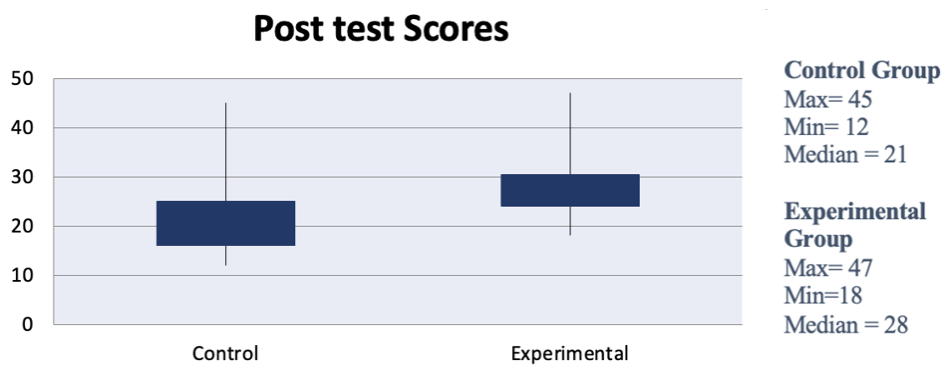


Figure 2: Distribution of the post-test scores in the control and experimental group

Table 2 comprehensively depicts the comparative analysis between posttest scores attained by students subjected to the Traditional Method and those exposed to Educational Digital Game-Based Learning (EDGBL).

The mean scores outlined in Table 2 underscore a noteworthy divergence, with the experimental group registering a higher mean score of 28 (approximately 56%) in contrast to the control group's mean score of 21.81 (43.6%). This substantial mean difference, calculated at 6.2 (12.4%), accentuates the superior performance of the experimental group. In addition, considering the values of the standard deviation, which were 6.34 for the experimental group and 8.04 for the control group, we can see that the scores in the experimental group displayed a greater degree of dispersion in comparison to those in the control group.

The significance of the observed discrepancy in post-test mean scores between the control group and the experimental group was evaluated using statistical analysis in the form of an independent samples t-test. This was done in order to determine whether or not the disparity was significant. The t-value that was calculated as a consequence of the experiment was 3.14, and when

combined with the probability that was calculated, it indicated that there was a statistically significant difference at the 1% level of significance. Therefore, the rejection of the second null hypothesis, which posited that there would be no significant difference in posttest mean scores between the control and experimental groups, provides support for the finding that students who are exposed to EDGBL perform better than their counterparts who are subjected to the conventional method.

This outcome aligns with Klopfer *et al.*'s (2008) asserting that digital learning games are strategically designed to target knowledge acquisition while fostering habits of mind and understanding applicable within academic contexts (p. 21). Julie *et al.* (2022) also found the effectiveness of Kumospace, an immersive online virtual office/events software, in improving students' Physics academic performance. Similarly, Cristobal *et al.* (2022), revealed that the utilization of interactive games was found to increase students' engagement in online English classes. The congruence of our findings with existing literature underscores the potential of EDGBL as an effective pedagogical tool for optimizing student learning outcomes.

Table 2: Test of difference between the mean post-test scores of the control and experimental group

Group	n	Mean	Standard Deviation	Mean Difference	t-value	df	p-value
Experimental	27	28	6.34	6.19	3.14**	52	0.00
Control	27	21.81	8.04				

**-significant at 0.01 level

Gain Scores Analysis

Examining students' development from the beginning of the experiment to its conclusion while they were under the influence of EDGBL enables us to have a better grasp of the efficacy of this instructional method. Gain scores are an indicator of how far students have come throughout this time period.

A graphical representation of the distribution of gain scores for both the control group and the experimental group is provided in Figure 5. Notably, the trend that was discovered highlights a distinct advantage in the experimental group, whose gain scores varied from 8 to 19. The gain scores of the control group, on the other hand, ranged from -2 to 14, indicating a less uniform improvement in comparison to the scores of their counterparts who were exposed to EDGBL.

The medians, serving as a robust measure of central tendency, further illuminate the positive impact of EDGBL. Specifically, the median gain score for the experimental group stands at 13, outpacing the corresponding median score of 8 for the control group. This findings suggests that, on average, students who were a part of the experimental group experienced a more significant improvement in their performance than those who were a part of the control group.

The pronounced positive effect of EDGBL on gain scores aligns with the overarching aim of fostering enhanced learning outcomes. This result underscores the potential of EDGBL in not only facilitating knowledge acquisition but also in cultivating a more substantial and consistent improvement in student's performance throughout the duration of the experiment. The graphical

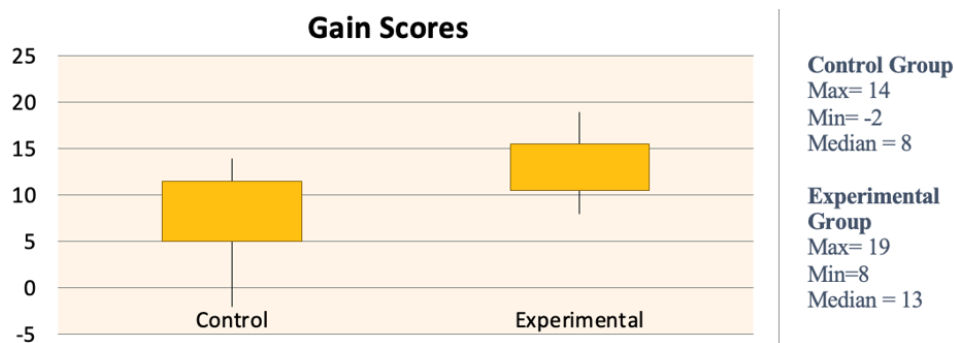


Figure 3: Distribution of gain scores of the experimental and control groups

representation and statistical summaries contribute a nuanced understanding of the differential impact of EDGBL on students' progress, reinforcing the rationale for integrating this innovative pedagogical tool.

Table 3 gives a complete review of the mean gain scores produced from both the control and experimental groups, illustrating the nuanced impact that Educational Digital Game-Based Learning (EDGBL) had on the progression of students throughout the course of the study.

A clear disparity can be seen in the mean gain scores between the groups who were subjected to the experiment and those that served as controls, as shown in the table. Experimental group, exposed to EDGBL, exhibited a mean gain score of 13.11 (26.22%), while the control group, subjected to the Traditional Method, recorded a mean gain score of 7.81 (15.62%). This substantial mean difference, quantified at 5.3 (10.6%), accentuates the superior progress demonstrated by students in the experimental group.

A significant difference can be seen between the experimental group and the control group when looking at the mean gain scores, as shown in the table. This dispersion metric suggests a more consistent and homogenous improvement among students who underwent EDGBL, contributing to the overall

understanding of the intervention's impact.

A t-test on independent samples was carried out in order to conduct a comprehensive statistical analysis of the observed variations in mean gain scores and determine whether or not they are significant. The statistical significance of the difference in gain scores between the two groups is demonstrated by the fact that the calculated t-value is 5.01, and the p-value is 0.00. This indicates that the difference is significant at the 0.01 level of significance. Consequently, rejecting the third hypothesis is warranted, affirming that students exposed to EDGBL outperform their counterparts undergoing traditional instructional methods.

These findings align with Prensky's (2007) assertion that integrating educational content into digital games yields superior results compared to traditional instructional approaches (p. 158). Likewise, Sumandal (2023) revealed that educational games using Lumi education in Biology class were perceived positively by the students and have helped them significantly in understanding lessons. The convergence of our results with established literature underscores the robust impact of EDGBL on enhancing students' academic progress, advocating for its integration as a potent instructional tool.

Table 3: Test of difference between the gain scores of the control and experimental group

Group	n	Mean	Standard Deviation	Mean Difference	t-value	df	p-value
Experimental	27	13.11	3.14	5.30	5.01**	52	0.00
Control	27	7.81	4.51				

**-significant at 0.01 level

CONCLUSIONS

The application of EDGBL has exhibited a significant influence on the scholastic performance of students with respect to subjects related to the English language. The correctness of the theory proposed about academic accomplishment is confirmed by empirical evidence. As an essential instructional method, EDGBL should absolutely be incorporated into the English curriculum taught at the elementary level. This is strongly recommended. To promote this integration, educational administrators may take the initiative to encourage and arrange opportunities for instructors to participate in specialized training designed to enhance their proficiency in utilizing EDGBL as an instructional approach. In light of the wider paradigm shift towards utilizing digital technology tools in educational environments (Daggett *et al.*, 2013), it is crucial that educational leaders actively support and advocate for the integration of EDGBL, recognizing its transformative capacity. In addition, it would be helpful for future research to investigate the efficacy of EDGBL across a wide range of academic fields. This is something that might be done in the future. Although the enduring significance of conventional pedagogical approaches is acknowledged, it is highlighted that EDGBL need not merely be regarded as a substitute but rather be given a

prominent position within the realm of education. The considerable results obtained from EDGBL research emphasize its potential to improve students' academic achievement greatly, therefore offering promising prospects for progress in education.

REFERENCES

- Becker, K. (2005). How are games educational? Learning theories embodied in games. *Digital Games Research Association Conference*, 3. <https://doi.org/10.11575/prism/30342>
- Bottino, R. M., Ferlino, L., Ott, M., & Tavella, M. (2007). Developing strategic and reasoning abilities with computer games at primary school level. *Computers & Education*, 49(4), 1272–1286. <https://doi.org/10.1016/j.compedu.2006.02.003>
- Burke, A. (2010). Teacher as Leader in a “Flat World”: Preparing Students in a Global Community. *Language Arts Journal of Michigan*, 25(2), Article 4. <https://doi.org/10.9707/2168-149X.1071>
- Chen, M., & Shen, C. (2010). Game-play as Knowledge Transformation Process for Learning. *2010 10th IEEE International Conference on Advanced Learning Technologies*, 746-747.
- Chen, M. P., & Wang, L. C. (2009). The effects of type

- of interactivity in experiential game-based learning. In *Learning by Playing. Game-based Education System Design and Development: 4th International Conference on E-Learning and Games, Edutainment 2009, Banff, Canada, August 9-11, 2009. Proceedings 4* (pp. 273-282). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-03364-3_33
- Connolly, T.M. and Stansfield, M.H. (2007). From eLearning to games-based eLearning: Using interactive technologies in teaching an I.S. course. *International Journal of Information Technology Management*, 26(2/3/4), 188–208.
- Cristobal, J., Hermano, C., Ibana, J. B., James, M. G., Ligo, M. L., & Lampitoc, D. (2022). Improving the Grade 9 students' engagement in online synchronous classes in English through interactive games. *American Journal of Education and Technology*, 1(1), 18–25. <https://doi.org/10.54536/ajet.v1i1.326>
- Featherstone, G., Perrotta, C., Aston, H. and Houghton, E. (2013). Game-based Learning: Latest Evidence and Future Directions (NFER Research Programme: Innovation in Education). Slough: NFER. http://ocw.metu.edu.tr/pluginfile.php/10919/mod_resource/content/1/GAME01.pdf
- De Freitas, S. I. (2006). Using games and simulations for supporting learning. *Learning, Media and Technology*, 31(4), 343–358. <https://doi.org/10.1080/17439880601021967>
- Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*, 1(1), 20. <https://doi.org/10.1145/950566.950595>
- Gillispie, L., Martin, F., & Parker, M. A. (2010). Effects of a 3-D video game on middle school student achievement and attitude in mathematics. *Electronic Journal of Mathematics and Technology*, 4(1), 68+.
- Ginsburg, K. R., American Academy of Pediatrics Committee on Communications, & American Academy of Pediatrics Committee on Psychosocial Aspects of Child and Family Health (2007). The importance of play in promoting healthy child development and maintaining strong parent-child bonds. *Pediatrics*, 119(1), 182–191. <https://doi.org/10.1542/peds.2006-2697>
- Green, M. & McNeese, M.N. (2007). Using Edutainment Software to Enhance Online Learning. *International Journal on E-Learning*, 6(1), 5-16. Waynesville, NC USA: Association for the Advancement of Computing in Education (AACE). <https://www.learntechlib.org/primary/p/6317/>.
- Julie, S. B., Minie, L. B., Rissa, L. M., Carlo, P. C., Romel, A. D., Caroline, A. G., & Maricar, P. N. (2022). Effectiveness of Kumospace Apps on the Academic Performance of Grade 9 Students in Online Physics Class. *American Journal of Education and Technology*, 1(3), 1–8. <https://doi.org/10.54536/ajet.v1i3.767>
- Kambouri, Maria & Thomas, Siobhan & Mellor, Harvey. (2006). Playing the literacy game: A case study in adult education. *Learning, Media and Technology*. 31. 395-410. 10.1080/17439880601022015.
- Ke, F. (2011). A qualitative meta-analysis of computer games as learning tools. *Gaming and simulations: Concepts, methodologies, tools and applications*, 1619-1665. <https://doi.org/10.4018/978-1-59904-808-6.ch001>
- Klaila, D. (2001). Game-based E-learning gets real. *Learning Circuits*(Feb 2001). <http://www.learningcircuits.org/2001/jan2001/klaila.html>
- Klopfer, E., Osterweil, S., Salen, K. (2009). Moving Learning Games Forward. The Education Arcade Paper. Massachusetts Institute of Technology.1-58. <https://hal.science/hal-00593085>
- Land, S. M., & Hannafin, M. J. (1998). Learning in Open-Ended Technology Environments: Problems and Issues. <https://eric.ed.gov/?id=ED423846>
- Levy F. and Murnane R. (2013). Dancing with Robots: Human Skills for Computerized Work. <https://dusp.mit.edu/uis/publication/dancing-robots-human-skills-computerized-work>.
- Mayo M. J. (2009). Video games: a route to large-scale STEM education?. *Science (New York, N.Y.)*, 323(5910), 79–82. <https://doi.org/10.1126/science.1166900>
- McLeod, S. (2023). Jerome Bruner's Theory of Learning and Cognitive Development. *Simply Psychology*. <https://www.simplypsychology.org/bruner.html>
- Miangah, T. M., & Nezarat, A. (2012). Mobile-Assisted Language Learning. *International Journal of Distributed and Parallel Systems (IJDPS)*, 3, 309-318. <https://doi.org/10.5121/ijdps.2012.3126>
- Norwegian Agency for Development Cooperation (n.d.). EduApp4Syria. <https://www.norad.no/eduapp4syria>
- Oblinger, D. G. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education*, 2004(1), 10. <https://doi.org/10.5334/2004-8-oblinger>
- Smith, S.J., & Okolo, C. (2010). Response to Intervention and Evidence-Based Practices: Where Does Technology Fit? *Learning Disability Quarterly*, 33(4), 257-272. <https://doi.org/10.1177/0731948711003300404>
- O'Neil, H. F., Wainess, R. and Baker, E. L. (2005). Classification of learning outcomes: evidence from the computer games literature. *The Curriculum Journal*, 16, 455-474. <https://doi.org/10.1080/09585170500384529>
- Panoutsopoulos, H., & Sampson, D. G. (2012). A study on exploiting commercial digital games into school context. *Journal of Educational Technology & Society*, 15(1), 15–27.
- Peters, J. (2016). 5 Main Advantages of Game-Based Learning. Bright Hub Education. <https://www.brighthubeducation.com/teaching-methods-tips/129304-advantages-of-game-based-learning/>
- Prensky M. (1998). Reaching Younger Workers who think differently. *Conference Board's Magazine*. <https://www.marcprensky.com/writing/Prensky%20-%20Twitch%20Speed.html>
- Prensky, M. (2003). *Digital game-based learning. Computers in Entertainment*, 1(1), 21. <https://doi.org/10.1145/950566.950596>
- Prensky, M. (2001), Digital Natives, Digital Immigrants Part 1. *On the Horizon*, 9(5), 1-6. <https://doi.org/10.1145/950566.950596>

- org/10.1108/10748120110424816
- Qian, M., & Clark, K. R. (2016). Game-based Learning and 21st century skills: A review of recent research. *Computers in Human Behavior*, 63, 50–58. <https://doi.org/10.1016/j.chb.2016.05.023>
- Reimers, F. M. (2008). Preparing students for the flat world. *Education Week*. <https://www.edweek.org/education/opinion-preparing-students-for-the-flat-world/2008/10>
- Robertson, D. M., & Miller, D. (2009). Learning gains from using games consoles in primary classrooms: a randomized controlled study. *Procedia - Social and Behavioral Sciences*, 1(1), 1641–1644. <https://doi.org/10.1016/j.sbspro.2009.01.289>
- Salen, K., & Zimmerman, E. (2003). Rules of Play: Game Design Fundamentals. <http://ci.nii.ac.jp/ncid/BA63865022>
- Panoutsopoulos, H., & Sampson, D. G. (2012). A study on exploiting commercial digital games into school context. *Journal of Educational Technology & Society*, 15(1), 15–27.
- Saulter, J. (2007). Introduction to video game design and development. New York, NY: McGraw-Hill/Irwin.
- Steinkuehler C. (2013). Constance Steinkuehler on Interest-Driven Learning (Big Thinkers Series). <https://www.youtube.com/watch?v=3wMk8SqFoEk>
- Subrahmanyam, K., & Renukarya, B. (2015). Digital Games and Learning: Identifying Pathways of Influence. *Educational Psychologist*, 50(4), 335–348. <https://doi.org/10.1080/00461520.2015.1122532>
- Sumandal, A. H. (2023). Development and Evaluation of Educational Games using LUMI Education in General Biology 1 for STEM students: Basis for recommended supplementary teaching materials. *American Journal of Education and Technology*, 1(4), 13–23. <https://doi.org/10.54536/ajet.v1i4.1089>
- Vygotsky, L. S. (1980). Mind in society: The development of higher psychological processes. Harvard university press.
- Weibell, C. J. (2011). Principles of learning: 7 principles to guide personalized, student-centered learning in the technology-enhanced, blended learning environment. [<https://principlesoflearning.wordpress.com>].
- Weigel, M. (2013). Outcomes of game-based learning: Research roundup - The Journalist's Resource. The Journalist's Resource. <https://journalistsresource.org/education/outcomes-of-game-based-learning-research-roundup/>
- Whitton, N. (2010). Learning with Digital Games: A practical guide to engaging students in higher education. New York, NY: Routledge. pp. 46. <http://ci.nii.ac.jp/ncid/BB10973024>
- Whitton, N. (2012). The place of Game-Based Learning in an age of austerity. *Electronic Journal of e-Learning*, 10(2), 249–256. <http://files.eric.ed.gov/fulltext/EJ985426.pdf>
- Winn, W. (2002). Current trends in educational technology research: The study of learning environments. *Educational Psychology Review*, 14(3), 331–351. <https://doi.org/10.1023/A:1016068530070>