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Enhancement of Academic Performance through Digital Game-Based Learning (DGBL)

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Abstract

Education plays a significant role in human development. For many decades we observed numerous changes in educational practices. Here, the integration of ICT resources into the teaching-learning process transforms the traditional and fundamental nature of education. It helps to provide ample opportunities for independent learning to achieve desired academic goals. During pandemic digital game-based learning draw considerable attention to supplement learners' needs and performances. Digital game-based learning (DGBL) may have considered an innovative and creative instructional plan that may contribute to the knowledge construction of an individual at their own pace. It provides plenteous opportunities to engage learners in a meaning-making process to comprehend the phenomena from broader perspectives. Thus, the study aims to explain and explore the prospects of digital game-based learning concerning the teaching of mathematics. It also reflects upon the influence of digital games on the academic performance of learners at the preparatory stage. The paper unfolds new dimensions to realize the significance of digital game-based learning to supplement the formal platforms of learning. It also provides a road map for the successful implementation of digital game-based learning to promote a joyful and healthy environment for mathematics learning.

Keywords: DGBL, Academic performance, Mathematics, Preparatory stage.

INTRODUCTION

We are currently witnessing a paradigm shift in the fundamental nature of education and the teaching-learning process owing to advancing technologies. Conventional classroom practices transform into modern sets of pedagogical practices that provide immense opportunities to engage and explore varied platforms of learning. It helps to develop young minds with critical and logical thinking. It is justified that students may construct their knowledge through the integration and adaption of new and modern technologies to meet the demands and requirements of this modern world. Learners must be considered active participants in the teaching-learning process and teachers must explore considerable possibilities to involve or engage learners in meaningful activities. Active participation, curiosity, and a problem-solving attitude are prerequisites to learning. Learners must be encouraged to think critically, investigate, explore, question, and construct knowledge at their own pace.

Constructivism is based on the assumption that learning is subjective rather than objective. It advocates that learning is contextual based on the learner's beliefs and social realities. Theories of constructivism as suggested by Piaget, Lev S. Vygotsky, and Novak. Vygotsky believed that social interaction is important for the construction of knowledge. Piaget suggests that learners may construct knowledge individually whereas Novak

discussed that classroom interaction is important for the construction of knowledge. The constructive method is initiated with the idea that learning is an active process that provides scope to construct new knowledge based on prevailing ideas and experiences. The teacher must confirm and facilitate maximum engagement of learners in the process of knowledge construction.

The Digital era of education enforced teachers to explore the prospects of technology to meet the demand of this digital world, facilitate interaction, reflection, discussion and experience. Here, constructivism propounds a new theory of teaching and learning that shifted from teacher centred to learner-centred approach. Thus, constructivism advocates those instructional strategies that ensure the active participation of learners in the teaching-learning process. Game-based learning may have considered one of the innovative and creative instructional strategies that may contribute to developing a creative and democratic environment of learning. Here, the advancement of technology shifted its focus from game-based learning to digital game-based learning i.e. (DGBL). In recent years' digital game-based learning has achieved considerable attention to supplement the formal system of education.

Digital game-based learning ensures the active participation of learners by playing. The progression of game initiates with the active participation of learners followed by feedback to discover and accommodate the structure of the game to reach at desired level of learning. “Individuals discover new knowledge in the light of the knowledge they have to achieve learning outcomes in game-based learning environments. In this process, individuals who compare their prior knowledge with their new knowledge add new information on top of their old knowledge to produce different and new solutions. This characteristic of the game-based learning model indicates that the individual can access new knowledge through observation, research, and questioning in a way that is far from memorizing” (Türkmen, 2017).

Digital game-based learning has the potential to draw the attention of educators and educationists to analyze the significant impact of DGBL in an educational setting. To draw out substantial results from digital game-based learning it is significant to integrate games with seemly pedagogical processes and practices. There is a need to adopt an analytical approach to assess the potentialities of digital games to achieve desired levels of learning outcomes. Innovative pedagogical techniques and mechanisms need to be enforced to bring out the prospect of digital game-based learning.

Review of Related Literature:

During the planning and conducting the study the researchers have gone through a number of studies. Some of the ideas derived and noted from the studies are being described as under:

- Tsekleves (2014) highlights the barriers and advantages of using serious games in education. Concerning benefits, mentioned performance, rewards, interactivity, motivation, playfulness, collaborative and problem-based learning, progression, realism, and immersion.

- Bellotti (2013) suggested guidelines for the assessment of serious games and discussed the effectiveness of serious games concerning learning outcomes. The findings revealed the effectiveness of serious games in motivating learners to achieve learning goals and also mentioned that new games can be deployed through proper instruction and guidance.

- Young et.al. (2012) reflected upon the use of traditional games versus video games for academic purposes. Results of the study revealed that there is limited evidence that supports the benefit of educational games in traditional classroom teaching the findings found contrary to the aforesaid studies.

- Thomas & Brown (2011) emphasized that instead of providing content, games may be designed to provide rich and meaningful contexts to reach higher-order thinking and social skills.

❖ McLoughlin & Lee (2008) mentioned that with the explosion of Web 2.0 technology, increased opportunities to engage with technological applications in a collaborative and participatory way have emerged, promoting information access, shared ideas, knowledge exchange, and content production.

❖ Connolly and Stansfield (2006) explained that game-based E-learning as a digital approach that delivers, supports, and enhances teaching, learning, and evaluation. Game-based e-learning is differentiated from GBL, which tends to cover computer and non-computer games both.

❖ Squire (2004) mentioned that game-based learning as a learning approach driven by game technologies is more suitable for learning initiated by players themselves. When a player plays a complex problem-solving game they may develop a deep understanding of how a complex system works at their own pace and style.

❖ Prensky (2001) mentioned that game-based learning provides interactive learning opportunities and is found to be interesting and motivating and also suggests teachers need to adapt their instruction to meet the various kind of academic needs of students and digital games can be used as a learning tool in a variety of ways.

❖ Malon, T. (1981) revealed that games motivate players with elements of fantasy, challenge, and curiosity and also focused on what games are fun rather than what makes them educational.

However, many studies consistently revealed a positive impact to create an interactive learning environment. Despite some convincing results, limited literature was found to acknowledge the adverse consequence of game-based learning concerning behavior modification and adjustment.

Need of the study:

In the era of digital education, digital game-based learning helps to produce an interactive virtual environment of learning. Many studies revealed that DGBL helps to develop curiosity and interest among learners through self-paced learning. The research field of study in this area is too extensive that can be extended to technology-infused experiences that encourage active and joyful mathematics learning. Learning mathematics is often considered a challenging and tedious subject in the school curriculum. Students are not able to establish the relationship between human culture and mathematical facts and theories. Memorization of facts without understanding stimulates an isolated and absurd form of mathematics. Interactive instructional methods of teaching may contribute to developing interest and motivation among learners toward mathematics. Digital games as an instructional tool of teaching have the potential to address these challenges. It may help to develop interest, and motivation to facilitate conceptual understanding of mathematical concepts. A logical and purposeful selection of digital games is a prerequisite to realizing desired sets of mathematical skills among learners. Thus, the study aims to realize the effectiveness of digital games in the academic performance of learners at the preparatory stage. It will be helpful to realize the empirical findings focusing on the application of games as a digital tool to promote healthy and joyful mathematics learning.

Objectives of the Study:

The present study has been conducted in order to fulfil the following objectives:

❖ To study and describe the effectiveness of DGBL in relation to academic performance of students at Preparatory stage.

❖ To find out the significance of difference between mean pre-test scores of control and experimental group.

❖ To find out the significance of difference between mean post-test scores of control and experimental group.

❖ To find out the significance of difference between mean pre-test scores and mean post-test score of experimental group.

Hypotheses Tested during the Study:

The following hypotheses were formulated and tested during the study.

❖ Ho1: There is no significant difference between mean pre-test scores of control group and experimental group in terms of their academic performance.

❖ Ho2: There is no significant difference between mean pre-test and post-test scores of control group in terms of their academic performance.

❖ Ho3: There is no significant difference between mean pre-test and post-test scores of experimental group in terms of their academic performance.

❖ Ho4: There is no significant difference between mean post-test scores of control group and experimental group in terms of their academic performance.

Methodology Adopted for the Study:

The present study has been conducted by adopting Quasi experimental design to study the effectiveness of digital games based on the academic performance of the learners. Pre-test post-test experimental design was adopted and deployed over the control group and experimental group selected for the study. After the selection of the groups, a pre-test was administered and the mean scores were calculated. The experimental group was taught two different concepts of mathematics with the help of digital games. After the intervention post-test was conducted and the mean scores were calculated to study the significance of difference between the mean score of both groups.

Group (N)	Pre-test Scores	Post-test Scores
Control Group (30 Students)	X_1	X_2
Experimental Group (30 Students)	X_3	X_4

Further a brief description of the experiments is being described in the following steps.

Step-I: In this step two groups viz. experimental and control group were formulated and their equivalency ascertained using pre-test scores obtained through an achievement test in mathematics.

Step-II: In this step the control group was taught daily for 15 days, through conventional method of teaching for one hour. In the same way the experimental group was taught daily for 15 days, through DGBL method of teaching for one hour daily.

Step-III: In this step, an achievement test was administered on both the groups and their individual scores were recorded.

Step-IV: In this step the pre-test and post-test scores were compared according to the objectives framed and hypotheses formulated.

❖ Population: The population of the study was comprised of all the students studying at the preparatory stage with the age group of 8-11 years.

❖ Sample: The sample of the study was selected by a simple random sampling method. The sample of the study comprise of total sixty (60) class five students equally distributed between the control and experimental group.

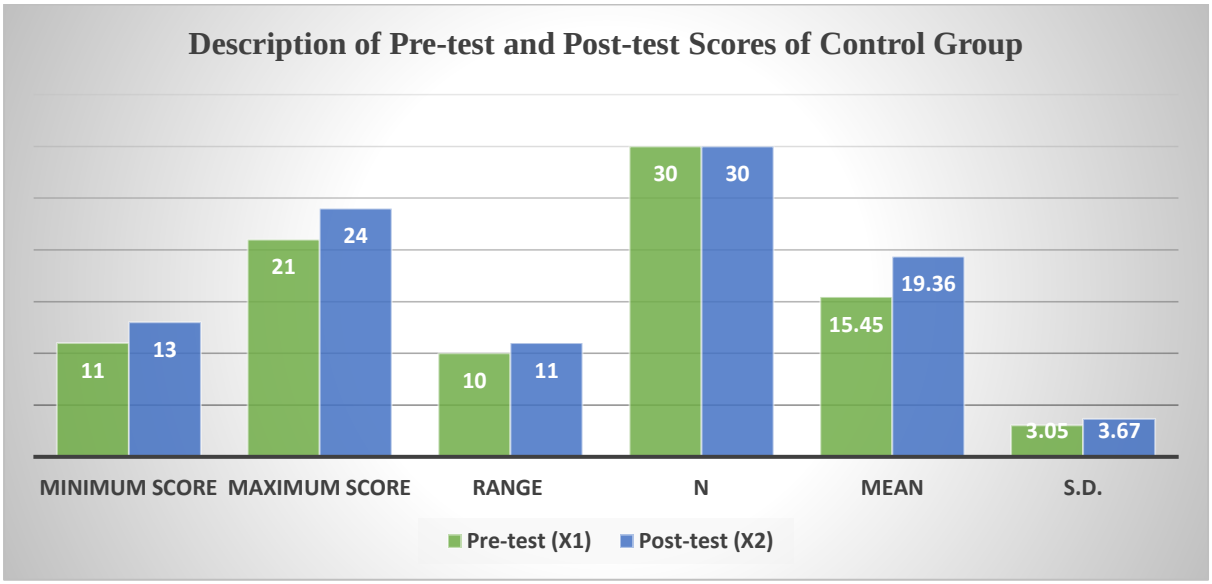
❖ Tools Used: Two parallel form of performance tests were prepared to collect pre-test and post-test data covering two topics Fractions and Mensuration, to study the effectiveness of digital game-based learning in relation to academic performance of the students. Each test contained thirty-two objective type test items.

❖ Analysis and Interpretation: The data has been analysed quantitatively using basic descriptive statistics and t-test.

Analysis of Data: On the basis of the systematic analysis of data following findings may be reported as under:

Table A: Description of Academic Performance of Control Group before and After Intervention

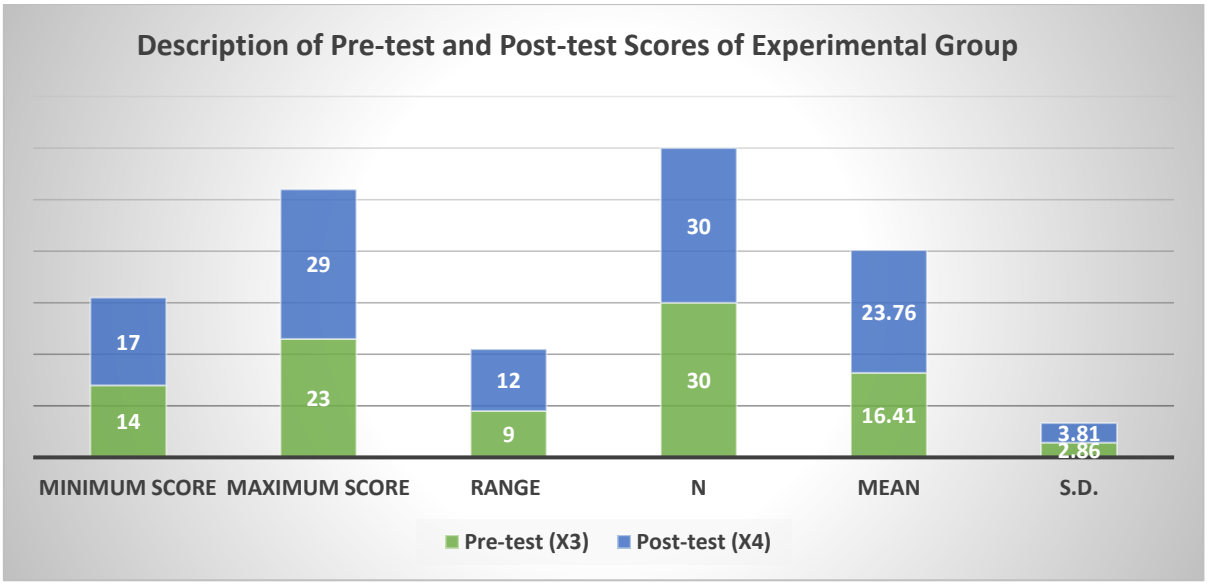
Scores	Minimum Score	Maximum Score	Range	N	Mean	S.D.
Pre-test (X_1)	11	21	10	30	15.45	3.05
Post-test (X_2)	13	24	11	30	19.36	3.67



The above table A and its associated chart, describes the basic descriptive of the Pre-test and Post-test scores of control group i.e. Maximum Score, Minimum Score, Range, Number of students, Mean and Standard Deviation. As is evident from the above table and its associated chart that the Mean Pre-test scores of thirty students of Control Group is 15.45 with a Standard deviation of 3.05. On the other hand, the Mean Post-test scores of thirty students of Control Group is 19.36 with a Standard Deviation of 3.67.

Table B: Description of Academic Performance of Experimental Group before and After Intervention

Scores	Minimum Score	Maximum Score	Range	N	Mean	S.D.
Pre-test (X_3)	14	23	9	30	16.41	2.86
Post-test (X_4)	17	29	12	30	23.76	3.81



The above table B and its associated chart, describes the basic descriptive of the Pre-test and Post-test scores of experimental group i.e. Maximum Score, Minimum Score, Range, Number of students, Mean and Standard Deviation. As is evident from the above table and its associated chart that the Mean Pre-test scores of thirty students of Experimental Group is 16.41 with a Standard deviation of 2.86. On the other hand, the Mean Post-test scores of thirty students of Experimental Group is 23.76 with a Standard Deviation of 3.81.

Table C: Comparison of Mean Pre-test Scores of Control Group and Experimental Group

Source	Mean	S.D.	N	SE_d	t-value	df	Result
Control Group (X_1)	15.45	3.05	30	0.76	1.26	58	Not Significant
Exp. Group (X_3)	16.41	2.86	30				

The above Table C describes the significance of difference between the Mean Pre-test scores of Control Group and Experimental Group. As is evident from the above table that the t-value for the comparison is 1.26 with a degree of freedom 58. This shows that the difference is not significant even at 0.05 Level of significance leading to the non-rejection of our Null Hypothesis, Ho1: There is no significant difference between mean pre-test scores of control group and experimental group in terms of their academic performance. This shows that the control group and experimental group did not differ in terms of their academic performance.

Table D: Comparison of Mean Pre-test and Post-test Scores of Control Group

Source	Mean	S.D.	N	SE_d	t-value	df	Result
Pre-test (X_1)	15.45	3.05	30	0.75	5.21	58	Significant at 0.01 Level
Post-test (X_2)	19.36	3.67	30				

The above Table D describes the significance of difference between the Mean Pre-test and Post-test scores of Control Group. As is evident from the above table that the t-value for the comparison is 5.21 with a degree of freedom 58. This shows that the difference is highly significant at 0.01 Level of significance leading to the rejection of our Null Hypothesis, Ho2: There is no significant difference between mean pre-test and post-test scores of control group in terms of their academic performance. This shows that the Academic Performance of

control group has improved significantly as a result of conventional method of teaching.

Table E: Comparison of Mean Pre-test and Post-test Scores of Experimental Group

Source	Mean	S.D.	N	SE_d	t-value	df	Result
Pre-test (X_3)	**16.41**	**2.86**	**30**	**0.89**	**8.26**	**58**	**Significant at 0.01 Level**
Post-test (X_4)	**23.76**	**3.81**	**30**				

The above Table E describes the significance of difference between the Mean Pre-test and Post-test scores of Experimental Group. As is evident from the above table that the t-value for the comparison is 8.26 with a degree of freedom 58. This shows that the difference is highly significant at 0.01 Level of significance leading to the rejection of our Null Hypothesis, Ho3: There is no significant difference between mean pre-test and post-test scores of experimental group in terms of their academic performance. This shows that the Academic Performance of Experimental Group has improved significantly as a result of DGBL method of teaching.

Table F: Comparison of Mean Post-test Scores of Control Group and Experimental Group

Source	Mean	S.D.	N	SE_d	t-value	df	Result
Control Group (X_2)	**19.36**	**3.67**	**30**	**0.97**	**4.54**	**58**	**Significant at 0.01 Level**
Experimental Group (X_4)	**23.76**	**3.81**	**30**				

The above Table F describes the significance of difference between the Mean Post-test scores of Control Group and Experimental Group. As is evident from the above table that the t-value for the comparison is 4.54 with a degree of freedom 58. This shows that the difference is highly significant even at 0.01 Level of significance leading to the rejection of our Null Hypothesis, Ho4: There is no significant difference between mean post-test scores of control group and experimental group in terms of their academic performance. This shows that the control group and experimental group differs significantly in terms of their academic performance. Which establishes the supremacy of DGBL mode of learning on the conventional mode of learning.

Conclusion:

However, there are a lot of studies that established the positive effects of DGBL on Academic Performance either partially or completely. In the present study also we've seen that DGBL mode of learning resulted in significant improvement in academic performance of students at preparatory stage even in comparison of conventional mode of learning. However, for the effective implementation of DGBL in higher education it is necessary that a sound theory base has to be developed by attending to its' basic underlying principles.

References

[1] Bellotti, F., Kapralos, B., Lee, K., Moreno-Ger, P., & Berta, R. (2013). Assessment in and of serious games: An overview. Advances in Human-Computer Interaction, 2013, 1.

[2] Connolly, T., & Stansfield, M. (2006). Using games-based eLearning technologies in overcoming difficulties in teaching information systems. Journal of Information Technology Education, 5(1), 459–476.

[3] Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. Simulation & Gaming, 33(4), 441-467.

[4] Gee, J. P. (2003). What video games have to teach us about learning and literacy? New York, NY: Palgrave Macmillan.

[5] Gee, J. P. (2007). Good video games and good learning. New York, NY: Peter Lang.
[6] Kapp, K. (2012). The gamification of learning and instruction: game-based methods and strategies for training and education. San Francisco, CA: Pfeiffer.
[7] Malone, T. (1981). What makes computer games fun? Byte, 6(12), 258–277
[8] McLoughlin, C., & Lee, M. J. W. (2008). The three P's of pedagogy for the networked society: Personalization, participation, and productivity. International Journal of Teaching and Learning in Higher Education, 20(1), 10–27.
[9] Prensky, M. (2001). Digital game-based learning. New York: McGraw Hill.
[10] Schaffer, D., Squire, K., Halverson, R., & Gee, J. (2005). Video Games and the Future of Learning. Phi Delta Kappan, 87(2), 105–111.
[11] Squire, K. (2004). Replaying history: Learning world history through playing Civilization III. (Unpublished doctoral dissertation). Indiana University Bloomington, USA.
[12] Thomas, D., & Brown, J. S. (2011). A new culture of learning: Cultivating the imagination for a world of constant change. Lexington, KY: Create Space.
[13] Türkmen, G. P. & Soybaş, D. (2017). The Effect of Gamıfıcatıon Methodology on Students' Performances and Attıtudes towards Mathematıcs. Erciyes University, Kayseri.
[14] Tsekleves, E., Cosmas, J., & Aggoun, A. (2014). Benefits, barriers and guideline recommendations for the implementation of serious games in education for stakeholders and policymakers. British Journal of Educational Technology, 47(1), 164–183. doi:10.1111/bjet. 12223.
[15] Young, M. F., Slota, S., Cutter, A. B., Jalette, G., Mullin, G., Lai, B., Simeoni, Z., Tran, M., & Yukhymenko, M. (2012). Our princess is in another castle a review of trends in serious gaming for education. Review of Educational Research, 82(1), 61–89.