HOW DOES SCAFFOLDING FUSED DIGITAL GAME-BASED LEARNING HELP PRIMARY SCHOOL STUDENTS TO LEARN MATHEMATICS?

B. William Dharma Raja[1*], T. Sahaya Mary[2]

Abstract

The significance of interactive media technology has experienced a notableincrease in contemporary society and its influence on the field of education is inevitable. Digital games have the potential to serve as educational entertainment through the incorporation of learning resources.This study intends to evaluate the effectiveness of scaffolding fused digitalgame-based learning on the learning achievements of primary school students in mathematics. This true experimental research uses a pretest- posttest equivalent group design involving a total of 48 students of Standard II. Students' analysis of the collected data revealed the experimental group gained more learning in Mathematics than the controlgroup.

Keywords: Digital Games, Digital Game-based Learning, Scaffolding, Mathematics, Academic Achievement

[1*]Professor & Head, Department of Education, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India – 627 012, widh07@yahoo.com
[2]Research Scholar, Department of Education, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India – 627 012, sahayamaryj@gmail.com

***Corresponding Author:** B. William Dharma Raja
*Professor & Head, Department of Education, Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India – 627 012, widh07@yahoo.com

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Introduction

Play facilitates relaxation in children, enhances their social aptitude and motor competence, and teaches them to express themselves. Technology is utilised by individuals for various purposes, including engaging in recreational activities such as playing games. The advent oftechnology has significantly transformed the modern living system, including the context ofgaming. A digital game is any form of game that involves utilising a computer or other electronic device, whether played online or offline. A player has the option to engage in gameplay either individually or in a collaborative manner with other individuals. It is aninteractive programme designed to entertain one or multiple players, potentially offering additional benefits beyond mere fun.

Most students require engaging and interactive activities that encourage active participation in the learning process. One primary advantage of integrating technology in educational settings is facilitating interactive instructional methods, which captivate students, promote profound comprehension, and stimulate collaborative efforts. Game- based learning can be an instructional tool to help students learn mathematics more effectively. Digital game- based learning is an educational approach that merges learning content with game activities, effectively blending the concepts with learning in an enjoyable play. Students achieve learning objectives by engaging in problem-solving and completingtasks within the context of games (Squire & Jenkins, 2003). Also, digital learning differs from traditional classrooms, presenting challenges for teachers and learners.

The fundamental concept underlying digital game-based learning in the classroomis that studentslearn content in depth within an interactive framework. Games are commonly developed with varying difficulty levels to facilitate players' retention of acquired knowledge and their subsequent application to other problem-solving scenarios (Peters, 2016). A well-designed game has the potential to serve as a path for students to explore a significantly more comprehensive range of knowledge. They may inspire children to understand rather than memorize. The present educational system heavily prioritizes grades and marks, increasing anxiety and stress among students. Academic achievement would not be a concern for students if they played games.

The concept of scaffolding is derived from the theoretical framework proposed by LevVygotsky, commonly called the "Zone of Proximal Development" (ZPD). How it operates is similar to the usage of scaffolding in construction. The ZPD is a collection of tasks that aretoo challenging for children to master on their own but can be acquired with the assistance of a more skilled person. It is the difference between an individual's actual development level and their potential development level in collaboration with more competent peers (Vygotsky, 1978). Educational scaffolding is a strategy whereby a knowledgeable individual equips a student with all the necessary information and support to learn a particular topic. It helps students achieve their learning objectives by connecting them with a teacher or a moreadvanced student. It allows instructors to assist students as they acquire new knowledge andabilities.

The instructor provides substantial assistance during the initial stages of the scaffolding procedure. Subsequently, the provision of support is gradually reduced. This phase gradually fosters a sense of confidence and comfort with a new concept (What is scaffolding in education, 2020). In this study, the researcher provides support to students by implementing teacher scaffolding techniques, including demonstrations, prior knowledge, questions, and offer explanations within the context of digital game-based learning.

Need and Significance of the study

Discovering innovative methods to captivate learners' attention and actively involve them in acquiring knowledge is currently regarded as one of education's most significant challenges. Teaching aims to develop self-motivated, autonomous, and active learners (Mary & Raja, 2020). Games possess an important potential for providing valuable educational opportunitiesdue to their ability to offer motivation, engagement, and enjoyment among learners (Papa Stergiou, 2009). Digital games that are specifically designed to educate children have the potential to significantly foster the development of self-learning and problem-solving abilities (Dadheech, 2021). It has the potential to create a more collaborative and interactiveclassroom environment.

The potential benefits and advantages associated with digital learning are vast and significant. One of the significant advantages of digital learning tools lies in their capacity to facilitate personalised learning experiences. Digital games can help all students in many ways. In an immersive, engaging, and rewarding digital environment, students can learn and have fun simultaneously with the educational game. Students are expected to take

partin the subject matter in a meaningful way. They can learn, try out, and have fun without boredom with computer games (Çankayaa & Karamete, 2009). Digital games can enhance theconfidence of individuals who engage in gameplay. It is achieved by implementing strategies that enable individuals to attain success consistently and providing constructive feedback to assess their progress (Felcia, 2009).

Digital games can potentially serve as additional tools for classroom instruction in various subjects, including mathematics (Dadheech, 2021). Achieving proficiency in mathematics necessitates cultivating cognitive and metacognitive abilities and the affective domain, encompassing beliefs, attitudes, and emotional states (Mary & Raja, 2021).

Digitalgames that are fun may help students feel less anxious and frustrated and help them get better at mathematics.

Motivation can be a big part of learning through digital games. The player is motivated to keep learning because each learning goal is linked to challenges. Digital games focus on the player and encourage challenges, cooperation, involvement, and ways to solve problems. Also, Scaffolding learning allows pupils to progress more in maths class.

Therefore, this pedagogical strategy necessitates careful judgement based on knowledge of the learner's starting point, potential, and development during scaffolding (Taber, 2018). Flexible and dynamic scaffolding within digital game-based learning will be required to be adaptive to emerging learners (Mary & Raja, 2021).

Objectives

1. To find the effectiveness of scaffolding fused Digital game-based learning onAchievement in Mathematics with respect to the learning objectives of the students of Std II
2. To find the effectiveness of scaffolding fused Digital game-based learning onAchievement in Mathematics with respect to the level of intelligence of the studentsof Std II

Hypotheses

1. There will be a significant difference between the mean achievement scores of control group,and experimental group in learning mathematics at pretest and posttestlevels.
2. There will be a significant difference between the mean achievement scores of control and experimental groups in learning mathematics with regard to learning objectives

There will be significant difference between the mean achievement scores of control and experimental groups in learning mathematics at pretest, and posttest levels withregard to level of intelligence

Methodology

Design and participants

This study employed a pretest-posttest equivalent group design. The participants in this studywere 48 second-grade students enrolled in a senior secondary school in Tenkasi district located in Tamilnadu, India.

Measuring tools

Achievement Test

A total of forty-eight questions, comprising multiple-choice, fill in the blank questions, and matching the following, were created by the researcher and guide and later validated by experts to ensure their validity in relation to the content covered in the game. The Split-halfof the tool's reliability was found as 0.78 using Spearman-Brown Prophecy co-efficient correlation.

The game-based learning system

"A Digital Game for Learning Division" was developed for this study. The game interface are displayed in Fig.1. Fig. 1 shows the opening interface, after which it shows the game levels. The player can attempt to play the game at any level again or can proceed to the next game level. So, totally there are 11 levels in-game, which feature division. Each level includes tutorialmode, demo mode, and game mode. Fig 2 represents each mode respectively.

Also, to supportstudents by implementing teacher scaffolding techniques, including demonstrations, activation of prior knowledge, posing questions, and provision of explanations within the context of digital game-based learning were provided. Fig. 3. Shows the learning scenarios of game-based learning.

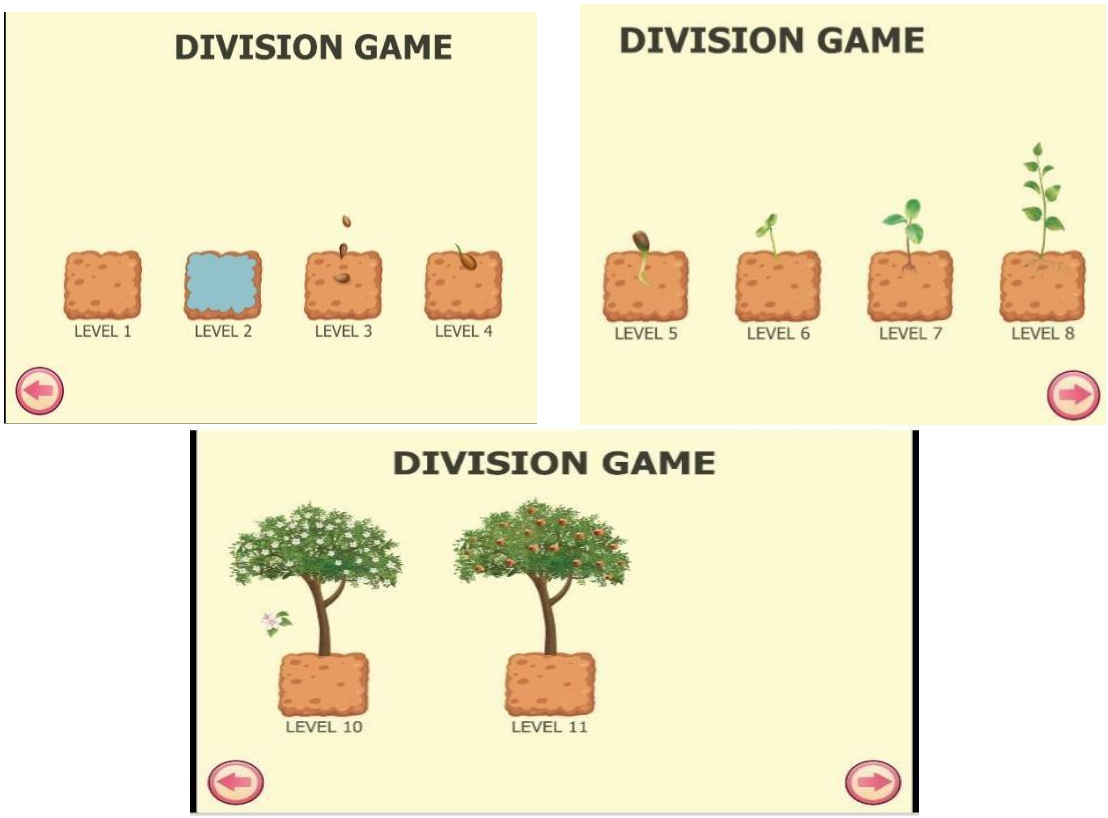

Fig. 1. Game Interface

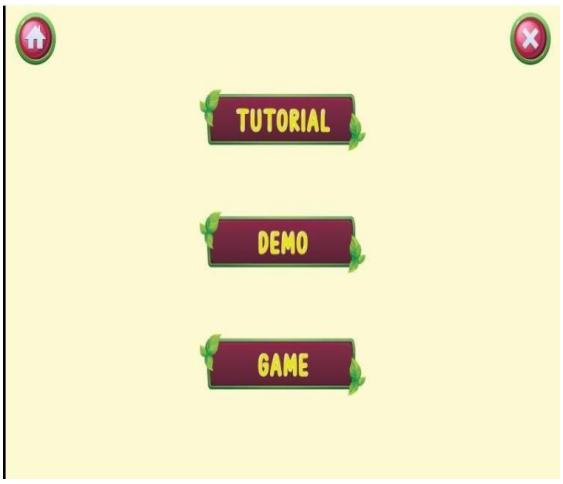

Fig. 2. Beginning of the level

Fig. 3. Learning Scenarios of game-based learning system

Experimental result

Learning Achievement

A pre-test was conducted before the experiment to evaluate the students' mathematicalknowledge of the target course. Table 1 shows the t-test result of the pretest scores. It was found that the achievement did not appear to be significantly different ($p > .05$), implying that two groups presented equivalently mathematical knowledge before the experiment.

Table 1 t-test Result on the Pretest Achievement Scores of the Two Groups

Group	Size	Mean	SD	t	p
Control	24	7.00	2.964		
Experimental	24	7.67	4.280	.627	0. 534^{NS}

NS – Not Significant

After the experiment, a posttest was conducted. Table 2 shows the t-test result of the post-test scores. It was found that there is a significant difference ($p < .05$) in the posttest achievement scores of the two groups.

Table 2 t-test Result on the Posttest Achievement Scores of the Two Groups

Group	Size	Mean	SD	t	p
Control	24	34.88	5.076	3.262	.002**
Experimental	24	39.25	4.173		

** Significant at 1% level

Table 3 ANCOVA Result of the Achievement Scores of the Two Groups

Group	Size	Mean	SD	Adjusted mean	F (1,44)	p
Control	24	34.88	5.076	35.015	1.187	.003**
Experimental	24	39.25	4.173	39.073		

** Significant at 1% level

Table 3 shows the ANCOVA result. ANCOVA was used to compare the post test scores of the students' achievement by excluding the impacts of the pretest scores.

After the experiment, the students' pretest scores were regarded as the covariance of ANCOVA to exclude the effects of the pretest on the students' learning achievement. Table3 shows the ANCOVA result. The adjusted means of experimental group and control groupwere 39.073 and 35.015 respectively. The variance $F = 1.187$ ($p < .05$) indicated the existence of significant differences between the posttest scores of the two groups. This results demonstrates that the scaffolding fused digital game-based learning could better promote pupils' mathematical learning outcomes than the traditional instructional approach.

Educational Implications

The study's findings indicate that integrating scaffolding techniques into digital game-based learning resulted in a favourable effect on academic performance. The experimental group performed highly, demonstrating that scaffolding combined with digital game-based learning may be successfully utilized at the primary education level to acquire mathematical knowledge.The study of mathematics is of significant importance in developing numeracy skills. The Z generation exhibits a strong affinity toward technology. The educational institution must furnish the specifications and prerequisites for implementing smart classrooms. Educators mustunderstand the primary purpose of the educational system is to address and meet the needs of students. Educational institutions have the potential to explore novel approaches to provide students with a highly effective learning environment. The elementary school period is a suitable context for establishing a strong groundwork for these skills. The teacher is pivotal inpromoting digital game-based learning. There are many different online games that can be played for educational purposes. Teachers can use games as an effective tool for imparting knowledge if they have a thorough understanding of how to incorporate them into educationalsettings. The institution may conduct the Faculty Development Programme (FDP) to help teachers make educational games, set short learning goals, and make modules that can be easily added to a school's technological framework. This will improve the quality of teaching and learning. DGL has the potential to provide valuable assistance in facing challenging and unfamiliar topics. This technology will have an impact on the field of education.

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