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Effect of Gamification on Cognitive Development of Students with Intellectual Disabilities

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ABSTRACT

The study aimed to determine the impact of gamification on the cognitive development of the students with intellectual disability. The study assessed the impact of gamification on three various variables i.e. impact of gamification on vocabulary development, problem solving, and concept development. The study was quantitative and experimental in nature. Randomized pretest-posttest control group design was used in the research. All the ID students presently studying in public special education institutes of district Faisalabad made the study population. Researcher selected Shadab Institute for ID students located in city area district Faisalabad for the study. A sample of 10 students was chosen from Grade-1. The student selection was purely randomized based on the fishbowl sampling technique. Sample was again distributed into two groups i.e. Group-A (Treatment Group) and Group-B (Control Group). A random assignment of 5 ID students in each group was made. Researcher visited the Govt. Shadab Institute for ID students Faisalabad, and approached the ID students. Researcher firstly collected the pretest data from the students on the basis of various manual sheets to measure the vocabulary skills (parts of body, fruits), concepts (big & small, color sorting, matching gemstones), and problem solving skills (ocean and maze puzzle). Afterwards, the students of the treatment group underwent the intervention through various computer games for one month, 4 weeks (3 days a week). Researcher provided the intervention for 50 minutes (10 minutes to each child). All the students played the games one by one. After the intervention of one month, again posttest assessment was applied on both of the groups (experimental and control group). Gamification showed a significantly higher effect on vocabulary development (body parts), problem-solving (maze puzzle), and concept development (colour matching and big & small games) in ID students compared to traditional methods. However, it had no significant impact on vocabulary (fruit names), problem-solving (ocean puzzle), or concept development (gemstone game), where both methods were found ineffective.

Keywords: Gamification, cognitive development, intellectual disability.

INTRODUCTION

The term gamification coined in 2008, has not yet reached a consensus from the academic community, and, depending on the considered authors, two categories of definitions are proposed. The term's etymology serves as the basis for the first group of definitions. Applying game principles and utilizing game components like badges, points, bonuses, and leaderboards to transform a nongame situation into a game-like activity is known as "gamification." This definition is predicated on an interpretation of what constitutes a game that is consistent with "essentialism," meaning that a game's functions are determined by a collection of characteristics. Currently, a second group of definitions is developing. According to this group of definitions, gamification is a method that centers on the player experience. This procedure entails using affordances for motivation that are based on game design concepts and are intended to promote (Sanchez et al., 2020).

Intellectual disability is the struggle of someone with general mental abilities. This could affect their intellectual functioning, which includes their learning, judgment, problem-solving, abstract thinking, memory, reasoning, and academic skills; practical functioning, which is the capacity to function and take care of oneself on one's own, including taking care of oneself, managing finances, and performing tasks at work, school, or home; and social functioning, which is the capacity to function normally in society by employing abilities like social judgment, communication, comprehension and adherence to social norms and cues, understanding the consequences of one's actions, and forming friendships (Huizen, 2020).

A research looked at how gamification affected Lahore undergraduate students' vocabulary training in English. In order to increase student motivation and engagement, especially in language learning, gamification—the addition of game aspects to non-gaming contexts—is becoming more and more common. The study used a mixed-method approach and a quasi-experimental design to compare a control group that received traditional instruction with an experimental group that received gamification. It evaluated language ability, vocabulary retention, and acquisition while taking cultural context and Dual Code Learning Theory into account. Teacher comments, pre/post assessments, and demographic data were used to gather the data, which were then analyzed using both descriptive and inferential statistics. The gamified group exhibited better vocabulary growth and retention, according to the results. By demonstrating the value of games like Scrabble and Word Bingo, the study backs active learning strategies (Ain & Ahmad, 2024).

The quality of a child's future life is closely correlated with early identification and repeated learning sessions for children with intellectual impairments. However, because the subjects are still youngsters, putting such ideas into action is difficult. For children with intellectual impairments to engage in ongoing instruction, motivation and interest are crucial. This study presented Neuro-World, a game-based cognitive training program for motivation and interest induction. After professional therapists deployed both programs, the efficiency of Neuro-World and a traditional cognitive training program was compared. The game-based cognitive training program outperformed the traditional method, as evidenced by statistically significant pre- and post-test results. Thus, it is anticipated that the game-based cognitive training program created in this study using digital media will be successful in enhancing cognitive learning capacity (Kim & Lee, 2021).

Innovation in technology has improved the development of a variety of skills in special education settings. Gamification is being utilized more and more to help people with special needs improve their abilities. Although gamification in general and special needs settings in particular have been the subject of a few research and a few systematic reviews, there isn't a

thorough systematic study of gamification design used in special needs settings. In order to determine the effects of gamification in special needs settings and to pinpoint gamification areas, groups, and trends for people with special needs, this article reviews the literature on the topic. Important information has been brought to light on the technological strategies employed to improve the abilities of people with disabilities. To investigate areas where there is a dearth of study in the subject of gamification, further studies are still required. This study's inclusion and exclusion criteria, which include eligibility, screening, dentification, and inclusion and exclusion procedures, were based on the PRISMA standard for recommended reporting items for literature reviews and meta-analyses. The findings showed that gamification design helps people with special disabilities learn a variety of skills. Furthermore, the primary purpose of gamification design was to improve the learning abilities of people with disabilities (Hussain et al., 2023).

Insufficient comprehensive research has been done on the design, implementation, and results of game-based learning for students with impairments. In particular, the implementation of game-based learning applications in special education has not taken into account learner-based and contextual aspects, as well as the crucial responsibilities performed by many stakeholders. Consequently, research on game-based learning for students with impairments was analyzed by a systematic literature review that employed the Activity Theory (AT). Subject (disabled learners), technology (game-based learning applications), object (target skills or behaviors), rules (implementation procedure and performance measures), community (disabled learners, special education professionals, and parents), and division of labor (among learners, professionals, and parents) were all covered in the content analysis of 96 studies, and outcome (performance of target skills or behaviours). Additionally, this study found gaps in the reviewed literature, such as inconsistent parental involvement, the challenge of standardizing performance measures because learner profiles vary, and contradictions (e.g., conflicting opinions among experts regarding the role of educational games in social interactions). Lastly, suggestions were given for every activity component. The study came to the conclusion that in order to support practitioners who want to employ game-based learning with students who have impairments, both general and domain-specific recommendations should be developed for each disability category suggested in this review (Tlili et al., 2022).

In the context of play-based learning, a research looked at the viewpoints and vocabulary development characteristics of kids with mild intellectual impairments. 26 children with moderate intellectual impairments, ages 13 to 14, participated in the study overall (13 in each of the experimental and control groups). Throughout the pedagogical experiment, carefully chosen and planned games, game exercises, and assignments have been employed, depending on the features of their intellectual, mental, and motor development. Using specific play-based activities, scientific investigations and the language development characteristics of children with moderate intellectual disabilities were described using the interpretative data analysis approach. Children with mild intellectual disabilities have learned both passive and active vocabulary as a consequence of games, play-based activities, and tasks, and their overall capacity to understand the semantic field of a word has improved. Children in the experimental group were able to identify the characteristic and quantity words in addition to mastering the terms for the objects and actions. 85% of the research participants have documented progress indicators as a consequence of the scientific experiment (Saratikyan et al., 2024).

A research looked at how gamification may be used as a creative teaching method to help secondary school pupils become more adept at solving problems. The capacity to solve problems is essential for both academic achievement and future employment. Traditional teaching approaches, however, frequently find it difficult to foster these abilities. Gamification, or the

incorporation of game concepts and components into non-gaming environments, has drawn interest as a potentially effective strategy for inspiring and involving students. With a pretest-posttest non-equivalent group design, the study employed an experimental methodology. Two groups are used by the researcher: an experimental group and a control group. The sample was drawn from Holy Cross Higher Secondary School Cherpunkal's ninth-grade pupils following the Kerala state curriculum. According to findings, gamification significantly improves student ability to solve problems (Kogularasu et al., 2024).

Similar to how games may increase student engagement, gamification of education can help students develop certain skills and maximize their learning. However, scientific research has revealed negative consequences depending on user preferences. It's still unclear how the user's traits, actions, and game aspects relate to one another. We have examined how gamification affects students' behavior, learning, and engagement in a web-based programming learning environment based on their personality factors in an effort to get some understanding of this problem. For four months, 40 undergraduate students enrolled in first-year programming classes participated in an experiment run by researchers. The two versions of the programming learning environment—the original non-gamified version and the gamified version with badges, points, and ranking—were allocated to students at random. There is proof that gamification has different effects on users according to various personality types. Our findings suggest that the impact of gamification is contingent upon the individual attributes of users (Khaleel et al., 2020).

Gamification is promoted as a cutting-edge approach to conventional higher education instruction. In this way, the study's goal is to examine the scientific literature to analyze how gamification is being used in higher education. 18 publications from four databases (Web of Science, Scopus, Google Scholar, and Dialnet) were analyzed to determine the effect of gamified instruction on university students' learning. Although it is clear that gamification is a new concept in higher education and offers many advantages to university students' learning, it is still a relatively unexplored field with limited use in specific fields of study. To understand its true effects on university students' teaching-learning processes, more study on its implementation in higher education are advised (Montenegro-Rueda et al., 2023).

The effects of gamified and non-gamified training on the vocabulary growth and motivation of students enrolled in an English language preparation program at a Turkish university were investigated and contrasted in one research. In the study, the participants' opinions on gamified vocabulary learning were further investigated. The study included a sample of 32 intermediate (B1 level) students (16 control group, 16 experimental group). Both quantitative and qualitative data were gathered using semi-structured interviews and pre- and post-motivation questionnaires and vocabulary tests. The results showed that student motivation was positively impacted by the use of gamified education. With the exception of a minor rise in the experimental group's vocabulary, there was no discernible difference in the two groups' vocabulary growth. Lastly, the students thought that gamified education was a good approach to practice and acquire new words. The collected data offers recommendations for gamified training in language classes as well as pedagogical implications (Sadeghi et al., 2022).

REVIEW OF RELATED LITERATURE

A person is said to have an intellectual disability (ID) if they have particular limits in their cognitive functioning and talents, including conceptual, social, and practical abilities including language, social skills, and self-care abilities. A person may develop and learn more slowly or in a different way than a normally developing person as a result of these restrictions. A person may be born with an intellectual handicap or develop one at any point before the age of 22 (Parmenter, 2011).

The World Health Organization (1992) defines intellectual impairment (ID), also known as mental retardation, as "a condition of arrested or incomplete development of the mind," which is typified by poor cognitive, linguistic, motor, and social abilities during development. This is extended by the inclusion of impairment and functional adaptability in the International Classification of Functioning, impairment, and Health (ICF) (WHO, 2001). ID is defined by the American Association on Intellectual and Developmental Disabilities (AAIDD) as limitations in intellectual functioning and adaptive behavior (AAIDD, 2010). This includes social (e.g., interpersonal skills), practical (e.g., everyday living, occupation), and conceptual (e.g., language, money) skills. The term "mental retardation" is used solely in relation to certain sources and has an analogous meaning to "intellectual disability," which is used throughout this text.

In order to boost engagement, gamification involves incorporating game concepts into non-gaming contexts, such as a website, online community, learning management system, or corporate intranet. Engaging customers, staff, and partners in gamification aims to encourage cooperation, sharing, and interaction (Kapp, 2012).

In the 1950s, game research gave rise to game-based learning (GBL), which was first used into teaching in the 1980s. Users started to accept games as teaching aids as educational conceptions changed and electronic games gained popularity (Seaborn & Fels, 2015). Three related terms—serious games, educational games, and digital educational games—are frequently used in GBL research (Pan et al., 2021). Making them clear aids in defining the study's parameters. Apt (1970) used the phrase "serious game" to describe games that are intended more for instructional purposes than for amusement. Educational games can be broadly defined as instruments that combine education with enjoyment, such as software and toys (Vos et al., 2011), or they can be specifically defined as electronic games designed for education (Moreno-Ger et al., 2008). To improve learning, digital educational games make advantage of digital platforms and IT (Lin & Lin, 2014; Aslan & Balci, 2015). GBL in study refers to settings that use games or related components and a variety of technologies to teach particular ideas (Deterding et al., 2011).

The research study's objectives were to create a mobile application that would improve exceptional students' acquisition of English vocabulary and to assess the Exceptional Student Learning English (ESLE) app, primarily from the viewpoints of exceptional students and other specialists. The digital game-based learning instructional design paradigm and multiplatform development were used to create the interactive mobile game known as the ESLE app. In the first phase of the study, 40 outstanding junior high school students in grades 7 through 9 with intellectual and physical impairments were chosen and non-randomly divided into two groups: an experimental group and a control group (20 in each group). The control group received traditional training, whereas the experimental group used the ELSE app to learn vocabulary. Before and after the therapy, the groups were compared. After that, the app was examined using Hubbard's (2011) analytical methodology. Twelve computer specialists and English professors were specifically chosen for this reason. Twelve participants were given open-ended

questionnaires to complete in order to get their opinions on the created app. According to the study's findings, every excellent student's vocabulary increased (Ghobadi et al., 2021).

Intellectual functioning and adaptive behavior are severely limited in those with intellectual disabilities. It is difficult to teach such pupils. Computer-assisted methods, such as digital game-based learning, are relatively new in developing nations. The purpose of this study was to investigate how well digital games can help kids with intellectual impairments understand numbers. The study employed a quasi-experimental approach with a control group before and after the exam. Thirty kids with mild to severe intellectual disabilities, ages 8 to 16, were included in the study. They were split into control and experimental groups at random. Two assessments of mathematical proficiency were employed. Ten sessions of digital gaming were given to the experimental group. IBM version 22 was used to evaluate the data, and the experimental group's scores significantly improved. According to the study, children with intellectual impairments may learn number concepts through digital games (Wajiuhullah et al., 2018).

A research looked at how gamification affected university students' views about the Teaching Principles and Methods course and their academic performance. The study investigated the potential impact of such activities on attitudes and achievement in this field. There were control and experimental groups in this experimental investigation. Each group followed a different curriculum: the experimental group coupled gamification with flipped classrooms and blended learning, whereas the control group utilized both. The purpose of the study was to evaluate the effects of gamification in contemporary teaching paradigms as opposed to conventional ones. Internet utilization supported gamification in this research. Throughout the duration of the study, 48 university students participated, and the unique results demonstrated the efficacy of online gamification in higher education (Yildirim, 2017).

One of the best teaching strategies nowadays, especially for kids with intellectual disabilities (CWID), is computer game-based learning. It can assist with difficulties in understanding and working with abstract ideas. The purpose of this study was to assess how well CWID could acquire time concepts using computer game-based learning. With IQs ranging from 55 to 60 and mental ages of 3 to 5, as well as chronological ages ranging from 8 to 16, the sample comprised 30 children from special schools in Lahore. A quasi-experimental design was employed, along with a well-defined inclusion criterion. A validated computer game on time concepts was utilized in a 10-session, two-week intervention with participants who were randomly assigned to one of two groups. Results were tested using a curriculum-based test. The findings showed that learning time concepts was well facilitated by computer game-based training. In addition to discussing its drawbacks and potential avenues for further research, the paper suggests this approach for teaching CWID (Wajihullah et al., 2020).

In order to provide suggestions for further study, the systematic literature review set out to investigate the field of digital game-based learning (GBL) for students with intellectual impairments as a tool that facilitates positive learning and mastery of certain skills. A total of twenty-one studies were chosen from various databases. According to the findings, serious games were the most popular gaming genre, and personal computers with extra hardware were the most regularly utilized technology, however tablets were also often used. Furthermore, the research was more concerned with the growth of cognitive skills than with the development of adaptive skills (Stancin et al., 2020).

A study assessed how well a problem-based interactive digital storytelling learning model in a gamified setting improved students' ability to solve problems. The study was conducted in two stages: (1) model construction through literature review, and (2) expert evaluation through focus groups conducted by nine computer and education professionals. The three parts of the

model were evaluation, learning activities, and preparation. The learning exercises included gamification, interactive digital storytelling, reflection, and problem-based learning. Experts gave the model an average score of 4.56 (S.D. = 0.60), indicating that it was extremely suitable. According to the results, this learning approach is appropriate for developing the intended learner goals and competencies and successfully fosters problem-solving abilities (Poonsawad et al., 2020).

Statement of the Problem

Intellectual disability is a term used when a person has certain limitation in cognitive functioning and skill, including conceptual, social and practical skills, such as language, social and self-care skills. Games play very effective role in boosting the cognition and educational performance of the students with intellectual disabilities. Therefore, investigator decided to ascertain the effect of gamification on cognitive development of students with intellectual disabilities.

Objectives of the study

Following were the objectives of the study:

1. To assess the impact of gamification on the vocabulary development among the students with intellectual disabilities.
2. To assess the impact of gamification on the problem-solving skills among the students with intellectual disabilities.
3. To explore the impact of gamification on the development of varied concepts (big/small, coloring sorting and shaping matching) of students with intellectual disabilities.

Research Questions

Following were the research questions:

1. What is the impact of gamification on the vocabulary development among the students with intellectual disabilities?
2. Is there any impact of gamification on the problem-solving skills among the students with intellectual disabilities?
3. What is the impact of gamification on the development of varied concepts (big/small, coloring sorting and shape variations) of students with intellectual disabilities?

Significance of the study

The study will help to create awareness among the teachers and caretakers that how the gamification has impact on cognitive development of students with intellectual disability. The significance of "Impact of Gamification on Cognitive Development of Students with Intellectual Disability" lies in its potential to contribute in understanding the effectiveness of gamification in cognitive development for students with intellectual disabilities, vocabulary and problem solving. The study will help the special education teacher to understand the role of gamification in boosting up the academic performance and effective concept development as well.

RESEARCH METHODOLOGY

Research methodology refers to how research project will be designed, what researcher will observe or measure, and how researcher will collect and analyze data. The methods researcher chooses must be appropriate for his/her field and for the specific research questions he/she is setting out to answer. A strong understanding of methodology will help to apply appropriate research techniques, design effective data collection instruments, analyze and interpret your data and develop well-founded conclusions (Gullford College, 2024).

Nature of Research

The study was quantitative in nature. The data collected from the study respondents was based on demographic variables and experimental result.

Type of Research

The study ascertained the impact of gamification on cognitive development of students with intellectual disabilities. It was an experimental study. Experimental research is a type of scientific examination in which one or more independent variables are changed and then applied to one or more dependent variables to see how they affect the latter. The effect of independent variables on dependent variables is frequently observed and recorded over time to help researchers reach a plausible conclusion about the link between these two types of variables (Pubrica Academy, 2024).

Design of Research

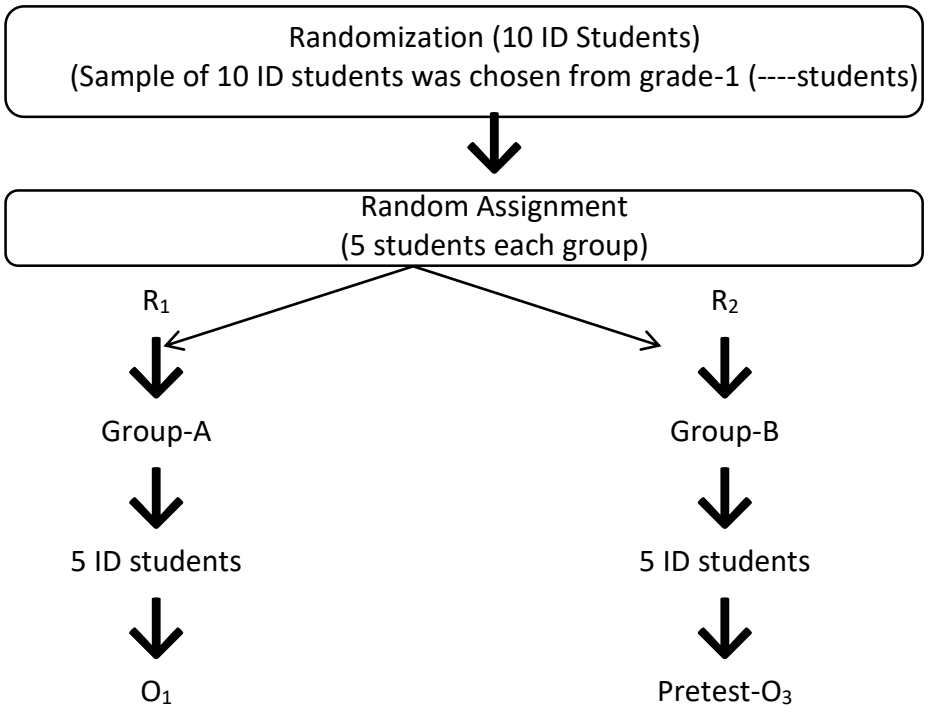
Randomized pretest-posttest control group design was used conduct the research. The pretest-posttest control group design, also called the pretest-posttest randomized experimental design, is a type of experiment where participants get randomly assigned to either receive an intervention (the treatment group) or not (the control group). The outcome of interest is measured 2 times, once before the treatment group gets the intervention — the pretest — and once after it — the posttest (Choueiry, 2024).

Population of the study

All the students of intellectual disabilities presently studying in public special education institutes of district Faisalabad made the study population.

Study sample

Researcher selected Shadab Institute for students with intellectual disabilities located in city area district Faisalabad for the study. A sample of 10 students was chosen from Grade-1. The student selection was purely randomized based on the fishbowl sampling technique. Sample was again distributed into two groups i.e. Group-A (Treatment Group) and Group-B (Control Group). A random assignment of 5 ID students in each group was made. The detail of the group formulation has been represented as under:




X Treatment-C


O_2 Posttest-O_4

Group-A ---Treatment Group
O_1 ---Pretest Group A
O_2 ---Posttest Group A
X ---Treatment Group A
Group-B ---Control Group
O_3 ---Pretest Group B
O_4 ---Posttest Group B
C ---No Treatment Group B
R_1--- Random Assignment to Group A
R_2--- Random Assignment to Group B

Instrumentation

Researcher designed various group of questions to be asked from the respondents for the study. The demography of the respondents contained the biodata of the students incorporating the information regarding their name, gender, age, class and address.

Games

Various games have been selected as under:

Vocabulary Games

The Tinytap games website was used to play the vocabulary games for the students with intellectual disabilities as under:

Table 1

Vocabulary Games

TinyTap-Body Parts Vocabulary	TinyTap-Fruit Names Vocabulary
• Hand	• Apple
• Eye	• Orange
• Nose	• Guava
• Ear	• Banana
• Lips	• Grapes
• Foot	• Pomegranates

Problem Solving Games

National Geographic kid games website was used to play the game for the problem solving:

- National Geographic Kid-Maze
- National Geographic Kid- Ocean

Concepts

Tinytap games and National Geographic Kid websites were used for the playing of games for following concept development for the students with intellectual development:

Table 2

Concept Games

TinyTap-Big & Small	TinyTap-Colour Sorting	National Geographic Kid-Matching Gemstone
• Hand	• Apple	• Tiger-Eye
• Eye	• Orange	• Purple-Saphire
• Nose	• Guava	• Ruby
• Ear	• Banana	• Aquamarine
• Lips	• Grapes	• Jade-Green
• Foot	• Pomegranates	

Experimentation

Researcher visited the Govt. Shadab Institute for Intellectually Disabled Faisalabad, and approached the students with intellectual disability of grade-1. Researcher firstly collected the pretest data from the students on the basis of various manual sheets to measure the vocabulary skills (parts of body, fruits), various concepts (big & small, color sorting, matching gemstones), and problem solving skills (log jump and mazes).

Afterwards, the students of the treatment group underwent the intervention through various computer games for one months, 4 weeks (3 days a week). Researcher provided the intervention for 50 minutes (10 minutes to each child). All the students played the games one by one. After the intervention of one month, again posttest assessment was applied on both of the groups (experimental and control group) and the results were noted.

Data Analysis

The collected data was analyzed using the percentage. The inferential statistics (paired t-test was applied to make a comparison between the pretest and posttest scores of the students in order to analyzed the difference between the game based and typical style of teaching to the students with intellectual disability.

RESULTS

Table 3

Effect of gamification on vocabulary of ID students based on body parts

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.5000	.20412	4	-1.372	0.242
	Posttest	5	1.6333	.13944			
Treatment	Pretest	5	1.3667	.27386	4	-2.997	0.040
	Posttest	5	1.9000	.14907			

Table 3 presented the paired-test analysis showing the effect of gamification on vocabulary development (body parts) of the students with intellectual disabilities. It was inferred that there was no significant effect of the traditional method of vocabulary development as shown $t(4)=-1.372$, $p=0.242$. On the other hand, a significant improvement in the vocabulary development was noted on account of gamification among the students with intellectual disabilities as shown $t(4)=-2.997$, $p=0.040<0.05$.

Thus, it was inferred that gamification revealed a significantly higher effect in the vocabulary development (body parts) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method.

Table 4

Effect of gamification on vocabulary of ID students based fruit names

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.5667	.09129	4	-0.590	0.587
	Posttest	5	1.6333	.18257			
Treatment	Pretest	5	1.6333	.13944	4	-1.372	0.242
	Posttest	5	1.7667	.25276			

Table 4 expressed the paired-test analysis showing the effect of gamification on vocabulary development (fruit names) of the students with intellectual disabilities. It was found that there was no significant effect of the traditional method of vocabulary development as shown t(4)=-0.590, p=0.587. Likewise, no significant improvement in the vocabulary development (fruit names) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-1.372, p=-.242>0.05. There was a slight improvement of vocabulary through fruit names on account of gamification was noted but it was not very significant. Therefore both the traditional method of teaching and gamification couldn't found helpful in the vocabulary development among the students with intellectual disability.

Table 5

Effect of gamification on problem solving of ID students based on playing ocean puzzle

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.00	.001	4	-1.500	0.208
	Posttest	5	1.60	.894			
Treatment	Pretest	5	1.80	1.095	4	-2.064	0.108
	Posttest	5	3.20	1.304			

Table 5 exhibited the paired-test analysis representing the effect of gamification on problem solving (playing of ocean puzzle) of the students with intellectual disabilities. It was found that there was no significant effect of the traditional method of problem solving as shown t(4)=-1.500, p=0.208. Likewise, no significant improvement in the problem solving skills (playing of ocean puzzle) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-2.064, p=0.108>0.05. There was a slight improvement in problems solving skills (playing of ocean puzzle) on account of gamification was noted but it was not very significant. Therefore both the traditional method of teaching and gamification couldn't found helpful in developing the problem solving skills among the students with intellectual disability.

Table 6

Effect of gamification on problem solving of ID students based on playing of maze puzzle

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.80	1.095	4	-1.500	0.208
	Posttest	5	1.20	.447			
Treatment	Pretest	5	2.00	.707	4	-3.500	0.025
	Posttest	5	3.40	.548			

Table 6 exhibited the paired t-test analysis representing the effect of gamification on problem solving (playing of maze puzzle) of the students with intellectual disabilities. It was found that there was no significant effect of the traditional method of problem solving as shown t(4)=-1.500, p=0.208. On the other hand, a very significant improvement in the problem solving skills (playing of maze puzzle) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-3.500, p=0.025<0.05.

Thus, it was inferred that gamification revealed a significantly higher effect in the problem solving skills (playing of maze puzzle) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method.

Table 7

Effect of gamification on concept development of ID students based on colour matching game

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.4000	.09129	4	-2.449	0.070
	Posttest	5	1.6000	.19003			
Treatment	Pretest	5	1.5000	.11785	4	-4.707	0.009
	Posttest	5	1.9000	.09129			

Table 7 showed the paired t-test analysis representing the effect of gamification on concept development (colour matching game) of ID students. It was found that there was no significant effect of the traditional method of concept development as shown t(4)=-2.449, p=0.070. On the other hand, a very significant improvement in the concept development (colour matching game) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-4.707, p=0.0095<0.05.

Thus, it was inferred that gamification significantly contributed in the concept development (playing of colour matching games) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method.

Table 8

Effect of gamification on concept development of ID students based on big and small game

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.4000	.14907	4	-2.746	0.052
	Posttest	5	1.6333	.13944			
Treatment	Pretest	5	1.4667	.13944	4	-6.000	0.004
	Posttest	5	1.8667	.13944			

Table 8 showed the paired t-test analysis representing the effect of gamification on concept development (big & small game) of the students with intellectual disabilities. It was found that there was no significant effect of the traditional method of concept development as shown t(4)=-2.746, p=0.052. On the other hand, a very significant improvement in the concept development (big & small game) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-6.000, p=0.004<0.05.

Thus, it was inferred that gamification significantly contributed in the concept development (playing of big & small game) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method.

Table 9

Effect of gamification on concept development of ID students based on gemstone game

Group		N	Mean	S.D	df	t	Sig
Control	Pretest	5	1.4000	.31623	4	-0.431	0.688
	Posttest	5	1.4800	.22804			
Treatment	Pretest	5	1.5200	.30332	4	-2.449	0.070
	Posttest	5	1.8800	.17889			

Table 9 expressed the paired t-test analysis representing the effect of gamification on concept development (gemstone game) of the students with intellectual disabilities. It was

found that there was no significant effect of the traditional method of concept development as shown t(4)=-0.431, p=0.688. Likewise, no significant improvement in the concept development (gemstone game) was noted on account of gamification among the students with intellectual disabilities as shown t(4)=-2.449, p=0.070>0.05.

There was a slight improvement in concept development skills (playing of gemstone game) on account of gamification was noted but it was not very significant. Therefore both the traditional method of teaching and gamification couldn't found helpful in developing the concept developing skills among the students with intellectual disability.

Findings of the study

The study aimed to determine the impact of gamification on the cognitive development of the students with intellectual disability. The study assessed the impact of gamification three various variables i.e. impact of gamification on vocabulary development, problem solving, and concept development. Following findings were derived from the data analysis of the study:

- The impact of gamification on vocabulary development (body parts game) in students with intellectual disabilities was ascertained. Traditional methods showed no significant effect, $t(4) = -1.372$, $p = 0.242$. However, gamification led to significant improvement, $t(4) = -2.997$, $p = 0.040$.
- The effect of gamification on vocabulary development (fruit names games) in students with intellectual disabilities was assessed. Results showed no significant effect from the traditional method, $t(4) = -0.590$, $p = 0.587$, nor from gamification, $t(4) = -1.372$, $p = 0.242 > 0.05$.
- The effect of gamification on problem solving (ocean puzzle) in students with intellectual disabilities was examined. No significant effect was found for the traditional method, $t(4) = -1.500$, $p = 0.208$, nor for gamification, $t(4) = -2.064$, $p = 0.108 > 0.05$.
- The effect of gamification on problem solving (maze puzzle) in students with intellectual disabilities was assessed. Traditional methods showed no significant effect, $t(4) = -1.500$, $p = 0.208$. In contrast, gamification led to a significant improvement, $t(4) = -3.500$, $p = 0.025 < 0.05$.
- The effect of gamification on concept development (colour matching game) in students with intellectual disabilities was examined. No significant effect was found for the traditional method, $t(4) = -2.449$, $p = 0.070$. In contrast, gamification showed a significant improvement, $t(4) = -4.707$, $p = 0.0095 < 0.05$.
- The effect of gamification on concept development (big & small game) in students with intellectual disabilities was assessed. Traditional methods showed no significant effect, $t(4) = -2.746$, $p = 0.052$, while gamification led to a significant improvement, $t(4) = -6.000$, $p = 0.004 < 0.05$.
- The effect of gamification on concept development (gemstone game) in ID students was evaluated. No significant effect was found for the traditional method, $t(4) = -0.431$, $p = 0.688$, or for gamification, $t(4) = -2.449$, $p = 0.070 > 0.05$.

Conclusions of the study

The study determined the impact of gamification on the cognitive development of the students with intellectual disability. The study assessed the impact of gamification three various variables i.e. impact of gamification on vocabulary development, problem solving, and concept development.

The gamification revealed a significantly higher effect in the vocabulary development (body parts) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method. There was a slight improvement of vocabulary through fruit names on account of gamification was noted but it was not very significant. Therefore both the traditional method of teaching and gamification couldn't found helpful in the vocabulary development among the students with intellectual disability. There was a slight improvement in problems solving skills (playing of ocean puzzle) on account of gamification was noted but it was not very significant. Both the traditional method of teaching and gamification couldn't found helpful in developing the problem solving skills among the students with intellectual disability. Thus, it was inferred that gamification revealed a significantly higher effect in the problem solving skills (playing of maze puzzle) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method. Gamification significantly contributed in the concept development (playing of colour matching games) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method. Gamification significantly contributed in the concept development (playing of big & small game) of the students with intellectual disabilities as compared to respondents dealt with traditional teaching method. There was a slight improvement in concept development skills (playing of gemstone game) on account of gamification was noted but it was not very significant. Both traditional and gamification method couldn't found helpful in developing the concept developing skills among the students with intellectual disability.

Recommendations of the study

The study recommends that special education teachers must adapt their teaching methods and incorporate the games, fun learning activities, technology oriented activities based on the interest, pace, level and needs of the students with intellectual disabilities. Nowadays, artificial intelligence based games are readily available to engage the students with intellectual disability in the classroom activities. Therefore, teachers and school authorities must engage their students with intellectual disabilities in such interventions to improve their learning, vocabulary, problem solving and concept development skills.

Ethical Considerations

Researcher got the permission from the headmistress of the Shadab Institute for students with intellectual disabilities Faisalabad for the purpose of data collection, assessment, experimentation and observed necessary research protocols. The collected data from the study participants was assured to be used only for the research purpose. The worth, prestige, safety and due respect of the participants was kept in consideration during the course of experimentation.

Limitations of the study

A self-made questionnaire was designed by the researcher with the help of her supervisor in order to determine the impact of gamification on cognitive development of students with intellectual disability. While gamification can be a powerful tool for engagement and motivation, it also has limitations: data privacy and security concerns, manipulation or exploitation of players, lack of transparency or informed consent, unintended consequences or harm, conflict with organizational values or mission.

Delimitations of the study

The study was delimited to the special education schools of the district Faisalabad. Researcher confined her research on the students of public schools. Only the category of students with intellectual disability was chosen for the study.

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