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# Innovative Pedagogies for Mathematics: A NEP-2020Inspired Approach Using Puzzles and Games

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#### Abstract

The National Education Policy (NEP) 2020 is a game-changer and innovative policy aimed at transforming India into a powerhouse of knowledge. The NEP 2020 views the first 3-8 years of a child's life as the critical phase for their entire development. Additionally, research suggests that youngsters between the ages of 4-6 have the mental capacity to learn in a more regulated yet play-based setting. NEP-2020 suggests promoting a range of cutting-edge mathematics teaching techniques, such as the regular use of games and puzzles, which make mathematical thinking more fascinating and engaging, as mathematics is the cornerstone of all science. Research shows that games and puzzles play a critical role in developing the logical and cognitive abilities of students. The main aim of this article is to concentrate on the significance of using games and puzzles to teach mathematics. Additionally, we provide examples of how different arithmetic problems can be presented as games and puzzles to engage children, along with some of the advantages and challenges of using games and puzzles to teach arithmetic.

Keywords: Mathematics, Pedagogy, Games & Puzzles, NEP-2020.

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#### I. Introduction

A policy with roots in ancient Indian ethos, culture, and values may anticipate that it would be the leading factor of India's success in both economics and knowledge. Being the first education policy created in the new century, the National Education Policy of India (NEP) 2020(GoI., 2020) is an important policy document. In 1986, the last NEP was created. In 1992, more adjustments were made. NEP-2020 offers the foundation upon which the goals, objectives, and future of India's young minds will be created (Sengupta, 2021). This policy suggests overhauling every component of the educational system. The development of each person's creative potential is emphasized heavily in this policy. It is founded on the idea that education must foster the development of higher-order cognitive skills like critical thinking and problem solving, as well as the "foundational capacities" of reading and numeracy.

Mathematics is a crucial topic in the curriculum at every level of schooling as it is widely involved in everydaylife. Since India's independence, every commission and policy has acknowledged the value of mathematics. It is acknowledged that mathematics and mathematical thinking will be crucial for India's future and its leading position. "Mathematics should be viewed as the vehicle to teach a kid to think, reason, analyze, and to speak rationally", the National Policy on Education (NPE,1986) declared. Similar to this, the National Education Policy (NEP, 2020) acknowledged the significance of mathematics and logical thinking in forthcoming research-oriented sectors, including artificial intelligence, machine learning, and data science(Walia, 2020). Therefore, throughout the academic years, beginning with the foundational stage, an increased emphasis will be placed on mathematics and computational thinking through a variety of novel methods, such as the regular use of puzzles and games that make mathematical thinking more enjoyable and engaging. Puzzles and games have been shown to benefit preschool and primary school kids and to encourage a

multisensory approach to learning. According to a number of studies, games help students learn new things and have fun while doing so. They also enhance computer skills, provide students with the freedom to work at their own speed, and encourage visual and kinaesthetic learning (Papanastasiou et al., 2017).

## II. Review of Related Literature

Literature shows that games and puzzles play a critical role in developing logical and cognitive abilities. Games like Factor-Reaction and MATHERIAL have been designed in association with various mathematical concepts and gameplay. A study by Plass et al. (2013)shows that students in the experimental group showed significant positive improvement in math performance. Research by(Pan et al., 2022) shows that almost all of the puzzlegames made use of behaviourist principles in the design of their gameplay and that the bulk of these games were created with the intention of enhancing students' low-order cognitive abilities, such as their computational fluency. For sixth-grade children, the game Hit the Target was developed to teach early algebra. The players had to actively engage with the game environment by choosing the right combinations of shooting choices and scoring optionsin order to get a certain overall score. To reach the score objectives, the player had to specifically "build" their own gaming tactics in response to interactions with the game mechanic, which allowed them to develop a mental model of the associated mathematical answers. Research shows a positive impact of this game on student mathematics learning (Kolovou et al., 2013). A role-playing game called The Speedy World used the tale of "Tortoise and the Hare" to teach math multiplication. Students took on the role of the tortoise, and they had to use arithmetic skills that were built into the game mechanics to catch up to the hare. This research discovered that the game had a beneficial effect on both cognitive and non-cognitive learning(Wang et al., 2018). In order to teach 122 students of 5th graders, new knowledge about how fractions, proportions, and percentages were connected to the number line, Riconscente (2013) had them play the game for 20 minutes each day for five days straight in the classroom. Conceptual comprehension was made an inherent part of gameplay by graphically presenting and illuminating the relationship between the fraction and the number line. According to the study's findings, students who participated in the game showed a significant increase in their attitudes toward studying arithmetic as well as their understanding of fractions. It goes without saying that mathematics is present in many aspects of everyday life and may be readily incorporated into various contexts.According to research, math learning games of all genres were utilized, although the puzzle game genre was still the most commonly used(Pan et al., 2022). Similar findings were made by Byun & Joung (2018), who discovered that the puzzle game (also known as a drill and practice game) dominated the 33 empirical studies on digital game-based math learning that they reviewed and examined between the years 2000 and 2014. Furthermore, it is discovered that more than 50% of the puzzle games were used to enhance students' low-order cognitive abilities. Moon et al. (2024) conducted a scoping review on the effect of game-based-learning on mathematics education. Hunt et al. (2025)examined how a game-based supplementary fraction curriculum affects student engagement, fraction knowledge, and STEM enthusiasm in inclusive primary mathematics classrooms. Their results suggest that game-based learning may effectively cover STEM concepts in mathematics education, and they propose future studies on scalability and application. This research of Al-Barakat et al. (2025) indicates that digital gaming apps improve mathematical thinking abilities, contributing to educational technology and mathematics education. It shows how these apps may improve computational abilities, critical thinking, and math problem-solving. As a result, games and puzzles might serve as a dynamic platform to translate abstract mathematical knowledge into real mathematical situations, actual and visual objects, or representations (Pan et al., 2022).

## III. Rationale of the Study

The NEP-2020 seeks the development of critical thinkers who are creative and diverse in their approach, and it seems to be highly promising(Gyananand Maharaj et al., 2021). However, the existing teaching style used in India's primary, secondary, and higher education systems, which emphasizes formal teaching techniques, makes it impossible to realize this objective of NEP-2020. Since mathematics is the foundation of all science, NEP-2020 advises encouraging a variety of innovative teaching strategies for mathematics, such as the frequent use of games and puzzles that make mathematical thinking more interesting and engaging. Because there is no assurance that a conventional education will provide students with sufficient practice and experience to develop problem-solving skills, the inclusion of learning activities based on puzzles is quickly becoming a larger and more significant part of the curriculum. Puzzle-based learning is also gaining popularity because it is fun(Meyer et al., 2014). Therefore, we focus on the importance of teaching mathematics through games and puzzles. Furthermore, we demonstrate some sample of how various mathematics problems can be presented through games and puzzles that makes the problems attractive to the students.

#### IV. Method

This is a qualitative and illustrative-based article that aims to explore the teaching of mathematics through games and puzzles, particularly in the context of the pedagogical reforms suggested by the National Education Policy (NEP) 2020. The paper adopts a descriptive design, supported by conceptual analysis and demonstrative examples. This study is developed within a review-based and demonstration-oriented framework, concentrating on the application and implications of game-based learning in mathematics.

# V. Demonstration

The 16-rule game is a popular game for students atthe foundation level. This game is used to practice addition and subtraction. In this game, a pack of cards is provided, having numbers from 1 to 9; see figure 1. Two students are needed for this gameplay. The rule is that each player can choose the card alternatively three times. Ultimately, the sum of all three cards, which the player will have if they are 16, will determine the winner of the game. The catch is that there are only nine cards with numbers from 1 to 9, so only one card can be chosen.



Figure 1: Two players gameplay of 16 rule game

#### • Magic square game

16 rule game

A square array of numbers, often positive integers, is referred to as a magic square in recreational mathematics if the sums of the numbers in each row, each column, and both major diagonals are the same. The magic constant is the constant sum, and the order of the magic square is the number of integers down one side. Magic squares have a long history, dating back to at least 190 BCE in China. The three-square magic square initially occurs in India's Gargasamhita, where Garga suggests using it to appease the nine planets (navagraha). Here, we have demonstrated a magic square of order 15, see figure 2.



*Figure 2: 15 rule magic square* 

#### • Six-Sided Math

The six-sided math game uses four big hexagons with some relatively smaller hexagons. Students are asked to fill up the smaller hexagons with the numbers from 1 to 9 so that the total sum is 30. This type of game is used to familiarisestudents with polygons, see figure 3.



Figure 3: Six-sided math game

#### • Counting triangles

The triangle counting game is a very popular game to increase reasoning ability among students. Students need to observe very carefully for this game. In this game, a shape such as triangle, square, rectangle is partitioned into various kinds of triangles. Then, students are asked to count the number of triangles. The level of difficulty increases with the increase in partitions, see figure 4.





#### • DIGIVIDE game

The Digivide is a mathematical game for division, see figure 5. This game is provided on the Transum website. It is a vast collection of mathematical games and puzzles. Teachers (Primary or Secondary) and upper Secondary/high school students are the intended audience for Transum. The majority of the materials on this website are free, and it is anticipated that math students all around the globe would find it useful and enjoyable. John Tranter is the creator, designer, and maintainer of Transum, which has been expanding gradually since 1997.



Figure 5: Digivide game

For more mathematical games and puzzles, see the reference (Clemens et al., 2003).

# VI. Benefits and Challenges

#### I. Benefits

• Games are enjoyable and may provide a setting for students to strengthen their mathematical understanding. Students improve their computational fluency by exploring links between numbers and more effective tactics while playing and analyzing games.

• Students may learn from one another and function at various levels of thought while playing games. One student may be learning a concept for the first time among a group of students playing a game, another may be deepening his or her comprehension of the subject, and a third may be consolidating previously taught notions.

• Using arithmetic games with primary school students also has the advantage of lowering students' anxiety about making errors. Because they worry about embarrassing themselves in front of their classmates, many students are reluctant to engage in whole-class activities. Math games provide a small group or partner environment where making an error doesn't seem like a major risk, and because it's simply a game. Students' confidence typically spreads to the full group setting over time when they gain it in a small group or couple environment.

• Much more enjoyable than a worksheet are math games. Students will be much more engaged in answering the arithmetic problems when they are presented in a game style, even if teachers utilize the same questions and present them on game cards rather than worksheets. Kids are far more engaged in learning while they are having fun. Students learn more and retain information longer when they are actively participating in their education.

• Games aid in igniting our students' interest in arithmetic and cultivating a passion for it. Students like and enjoy playing games. When our students are enjoying themselves and actively participating in the learning process, the best learning takes place. Students in elementary school need to understand that arithmetic is more than just doing problems in a workbook. Giving kids the chance to enjoy math via games can help them develop a passion for the subject that will last a lifetime.

#### **II.Challenges:**

• To help students retain information, teachers may sometimes employ games whose only purpose is to practise number facts. Because they rely so heavily on students' learning and recall, these games tend to lose

students' interest quickly. While some students can quickly retain information, others may require a few seconds to do the math necessary to understand the material. Students may mistakenly believe that being "smart" in mathematics entails prioritizing memory speed over appreciating the value of thinking when they are exposed to scenarios in which recall speed determines success(Olson, 2020). As a result, students may develop an aversion to mathematics if they are unable to solve problems quickly using computational shortcuts such as numerical patterns or related facts.

• Early studies showed that games were more successful in raising student performance than more conventional educational methods. Games, however, are not hardcore true. There is evidence that, compared to other engaging, student-centred methods, games are less successful in supporting learning retention when used alone(Bragg, 2012).

• The use of games in education has drawbacks. One is that some kids may be deterred from participating because they are afraid of failing to meet their objectives and feel intimidated by the idea of competing with their classmates. Another conclusion is that paying for success in games played in class might lead to lower-quality work(Kickmeier-Rust et al., 2014). As a result, while playing games, teachers should avoid from awarding rewards or additional points. The reverse consequence would be that students would become more concerned with the outcome than the learning process.

#### III. Conclusion

In conclusion, teachers should be open to using innovative pedagogies in the classroom, particularly those that have been shown to increase student enthusiasm and, in some circumstances, academic accomplishment. Research shows that educational games have positive social, cognitive, and emotional effects(Spires, 2015). In contrast to the conventional classroom, game-based learning provides students with a learning environment they prefer and enables them to acquire the skills necessary for the workplace. According to the research review, game-based learning has no blatantly detrimental impacts other than those caused by student preferences and instructor adjustments. Therefore, where practical, teachers should be open to using games to assist students in reinforcing and consolidating concepts, both in the classroom and potentially as homework. Teachers may be encouraged to continue using games in the classroom, provided they are used as one element of a variety of engaging learning activities that actively support mathematical learning. Although the argument for their usage in classrooms remains debatable and requires additional research, their inclusion can be beneficial.

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