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The Play-Driven Approach for Learning

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Abstract

In India, early childhood education is primarily based on a teacher-led direct instruction approach, lacking a focus on independent development among children. However, the NEP 2020 (National Education Policy 2020) mandates the integration of play-based learning to teach Foundational Literacy and Numeracy, presenting implementation challenges in the school environment. Our recent survey of primary teachers unveiled that the fear of chaos and a perceived inability to maintain discipline were the main reasons for avoiding play-centric or toy-based pedagogy. Teachers prioritize order over play-based learning, expressing concerns that play lacks educational value and hinders knowledge acquisition. The struggle to select suitable games, toys, and activities for the classroom results in limited learning outcomes. Consequently, teachers remain hesitant to promote play in classrooms. The study aimed to enhance children's mathematical and literacy skills through toy/game-based interventions. Workshops organized by the principal investigator included activities like arranging numbers and reading passages. These engaging interventions utilized games such as Housie/Bingo, musical numbers, Chatterbox, riddles, and story cards. In line with the National Educational Policy 2020, grade 3 is a critical transitional stage where students should possess foundational skills by age 8. However, many students lack these skills. This study addresses the issue by focusing on grades 2 and 3 students in Gandhinagar, Gujarat. It revealed an undeniable influence of toy/game interventions on children's foundational literacy and numeracy abilities. After the interventions, significant improvements were observed in both groups under examination, with more students demonstrating proficiency in the skills for the first time and others enhancing their existing proficiency levels.

Keywords: Playful learning, Toys based pedagogy, FLN skills with Toys / Games in India

Introduction

Enrolments and Indian Education System

The Indian education system is widely recognized for its didactic and teacher-led approach (Gupta, 2021), with limited opportunities for student discussions due to excessive teacher talk. Child-initiated learning is almost non-existent (Jhingran, 2013). Surprisingly, despite these challenges, the primary education sector has achieved a remarkable Gross Enrolment Ratio (GER) of over 100% in recent years, excluding the pandemic-induced school closures. According to the UDISE+ (Unified District System for Education Plus) 2023 report (Ministry of Education, Govt of India, 2023), the GER reached 103% in 2021-22. However, this seemingly impressive figure doesn't reflect actual daily school attendance, as there has been a persistent issue of chronic absenteeism among students (Banerji and Mathur, 2021). Since 2005, the attendance of students in primary schools has consistently hovered around 70% (Pratham Foundation, 2023; EdCil: Technical Support Group, 2008). Unfortunately, research on student attendance has been limited, and the data from the aforementioned reports only represent the days the surveys were conducted. Recently, the government has initiated the collection of daily attendance records through Vidya Samiksha Kendra, but this data is yet to be made available (Ministry of Education, Government of India, 2022).

Learning Outcomes

Based on the data presented above, it becomes evident that a significant number of students attend school regularly. However, the learning outcomes for these students are shockingly abysmal. Both the ASER Report (Pratham Foundation, 2023) and the National Achievement Survey (NAS) dashboard (Ministry of Education, Government of India, 2023) reveal alarming statistics for class 3 students. More than 50% of these students struggle to read numbers, while less than 50% can perform basic addition (and only 26% can do subtraction). Perhaps even more appalling is the fact that over 60% of class 3 students lack the ability to fold or cut paper to create a simple 2-D shape. These distressing figures underscore the urgent need for educational reforms and targeted interventions to improve learning outcomes among students.

The problem

Directly quoting from Banerjee et al. (2007): “The problem is that while we know a reasonable amount about how to get children into school, much less is known about how to improve school quality in a cost-effective way”.

Teacher Quality

The quality of education in the country is influenced by several factors, with substandard teaching emerging as a prominent contributor. While some argue that factors like school infrastructure and resource scarcity affect teaching practices and subsequently impact learning outcomes, Muralidharan's research (2013) indicates limited or no influence of such factors, including school infrastructure, teacher pay, and teacher-pupil ratios. Unfortunately, India faces a severe shortage of teachers, with a staggering 747565 primary government school teacher positions vacant as of December 2022 (Agrawal, 2023). Even among the current teachers, many lack the necessary skills and preparation. It's important to clarify that inadequate teacher training is not the issue, as Muralidharan (2013) reports that over 80% of primary school teachers receive training. However, the quality and effectiveness of this training are remarkably low, resulting in subpar learning outcomes for students. For instance, teachers are not trained to teach in a differentiated manner in a class where children vary considerably in ability level or where multiple-grades sit in the same class. (Kailash Satyarthi Children's Foundation 2020).

Technology Interventions and Private Tutorials

Technological interventions have often been proposed as a solution to tackle the challenges of improving teaching quality and enhancing learning outcomes. However, recent reports from UNESCO (2023) and Banerjee et al. (2007) shed light on the fact that technology can be prohibitively expensive, and its effectiveness remains a subject of mixed evidence. It's essential to recognize that technological interventions alone cannot bridge the knowledge gap in children's learning effectively. Interestingly, in India, parents attempt to address their children's learning deficiencies by enrolling them in private tutorials. However, a recent study by Berry and Mukherjee (2019) has revealed that these tutorials do not have any significant impact on student test scores or learning outcomes. This suggests that relying solely on technology or private tutorials may not be the silver bullet to improve education in the country.

Pedagogy of rote learning

The most significant factor influencing student learning is how teachers engage with their students (Loeb and Béteille, 2009). To promote effective teaching, it is crucial to understand the classroom practices, materials, and potential barriers to learning. Research conducted in three Indian states found that teachers spend only 44-58 % of their time on classroom activities, mostly focusing on traditional and repetitive methods like recitation, instruction, and desk study (Dundar et al., 2014), as noted by Jhingran (2012), contributes to poor reading achievement, neglecting a deeper understanding of the content.

NEP2020/NCF2022

In response to these issues, the Government of India introduced the New Education Policy (NEP) in 2020, which brought significant changes to early childhood education (Ministry of Education, Govt. of India 2022; Muralidharan and Singh 2021). The policy emphasized a child-centric, toy-based pedagogy without exams, textbooks, or rote learning for students from preschool to class 2, known as the Foundational stage (National Steering Committee 2022). Despite the ample research supporting the benefits of toy/play-based pedagogy in the international context (Walsh, McMillan, and McGuinness 2017), there was limited prior research in the Indian context. The present study aimed to fill this gap by exploring the effectiveness of toy/play-based pedagogy for teaching Foundational Literacy and Numeracy in both the Indian Government school educational setting and a remedial setup like a summer camp.

Teachers' perceptions of Toy/Play based pedagogy

In 2023, we conducted two teacher surveys to gain insights into teachers' perceptions and beliefs regarding toy-based pedagogy. Surprisingly, we found that some teachers considered didactic practices like dictation and recitation of multiplication tables as play or interactive activities for the child. However, the study also highlighted significant obstacles to adopting toy/play-based pedagogy, such as the time-consuming preparation of activities and concerns about maintaining classroom discipline. Teachers expressed confusion about the actual effects and impact of toy-based pedagogy, and many felt that using this approach hindered their ability to cover the syllabus within the required time frame (Brahmbhatt 2023).

Our study

In this study, we aim to address the gap in literature by showcasing the effectiveness of toy/play-based pedagogy in the Indian Government educational system and as a part of a remedial summer camp. We provide detailed descriptions of all the conducted activities, including the time required for preparation and execution. Additionally, the study offers valuable insights from field observations on children's reactions to these activities.

Study Design

According to the National Educational Policy 2020 (Ministry of Education, Government of India, 2020), grade 3 represents a shift from the foundational to preparatory stage of education. At the age of 8, students are expected to have acquired fundamental skills, such as arranging numbers between 1 and 99 in ascending and descending order, reading and writing numbers both in words and numerals, and demonstrating proficiency in their mother tongue. However, as mentioned earlier, many students enter grade 3 without these essential foundational literacy and numeracy skills. This puts them at a disadvantage, leading to falling behind in class 3 and subsequent formal education. This challenge is particularly pronounced for students who lack support at home and are first-generation learners.

The NCF 2022 (National Steering Committee, 2022) outlines all the learning goals that a child should achieve by the age of 8. For this study, and to make it manageable for one person, we selected a few of these key objectives. We implemented play activities (described below) to enhance the skills of the children under study. The primary objective was to demonstrate that these playful activities effectively facilitated learning of specific curricular goals in a fun and engaging manner. By showcasing the effectiveness of these activities, we aimed to highlight the potential of playful learning as a valuable educational approach.

The study comprised two distinct groups. The first group consisted of 25 grade 2 students from a government school, who received a daily 2-hour toy/game-based intervention over 9 days. The second group consisted of 20 students from grades 2 and 3, participating in a 9-day summer workshop outside of school, incorporating toys, games, and activities. The pre and post assessments were conducted on the first and last day. Participants' foundational literacy and numeracy skills were assessed. The post and pre-assessment results were then compared to evaluate the

effectiveness of the intervention.

Participant Selection for the Study

Selection Criteria for Summer Camp

In mid-May, we held a summer camp for children aged 6-9. The summer camp flyers were distributed through various parents groups to invite registrations. We received 117 registrations, of which 86 participants (aged 6-9) were selected - 54 for the experimental group and 34 for the control group. Other children registered did not belong to this age group. On the first day, 32 from the experimental and 15 from the control group attended, but only 20 participants from both groups continued until the last day due to summer holidays and family travels.

Grade 2 Students' Selection in Govt. School

In April 2023, the study was conducted in Gandhinagar government schools after most exams had concluded. During this period, students from various schools, except for Borij Government School, were largely absent as many opted for vacation time instead of attending classes, even though regular classes were scheduled according to the academic calendar. The lack of attendance was evident due to teachers not enforcing it. Despite this situation, Borij Government School had the highest number of students attending, making it the chosen school for the study. This school has two Grade 2 classes of 60 students each. On the first day, 90 students participated in the study from both the classes. However, only 25 students consistently attended until the last day, and their data were utilized in the analysis.

Selection of Control group participants

In April 2023, Basan school was contacted. Grade 2 students, who had completed their exams and were approaching the summer holidays, were invited. Eighteen students attended on the first day. However, after an 8-day gap, a post-assessment was conducted, and only 12 out of those 18 students participated. Consequently, the control study included only 12 students. On both days, students participated in newspaper-based craft activities. The study aimed to assess whether any natural improvements in FLN abilities occurred with this control group.

The Activities Selected for The Interventions

In this section, we present the engaging and interactive activities designed for our research study involving children. These activities are categorized based on whether they were conducted during school intervention or the summer camp (see Table 1). In both settings, the medium of instruction was Gujarati, the mother tongue of all students in the government school was Gujarati. However, it's important to note that some students in the summer camp did not have Gujarati as their medium of instruction in their respective schools.

SR NO	Game / Activities Details	Game Activities used for Intervention during	
		Regular School	Summer Camp
1	Riddles	✓	✓
2	Chatterbox	✓	✓
3	Hunting words from Newspaper	✓	
4	Matching with Numbers	✓	✓
5	Name Correction Challenge	✓	✓
6	Musical Number Hunt	✓	✓
7	Tambola / Bingo	✓	
8	Personalised Name Plate Design		✓
9	Wrist band		✓
10	Friend Tree		✓
11	Matching a Number with object in the picture		✓
12	Hitting the numbers		✓

Table 1. Activities used for interventions

School Intervention Activities

Riddles (in Gujarati language)

We selected 20 riddles in Gujarati language to familiarise children with complete sentences in their native language and objects from daily routines. For example:

૧) એવી કંઈ ચીજ છે જે ખાવા માટે ખરીદીએ પણ તેને ખાતા નથી ? (જવાબ - પ્લેટ)

English translation: There is something that we buy to eat but do not eat it (Answer - Plate).

૨) એવું શું છે જે એક જગ્યાએથી બીજી જગ્યાએ જાય છે એ પણ પોતાની જગ્યાએથી હલ્યા વગર ..? (જવાબ - રસ્તો)

English translation: What is that which goes from one place to another without moving from its place? (Answer - road)

We expected the students to engage in critical thinking to solve these simple riddles, improve their reading abilities and vocabulary (Buchhoff 1996). Preparing and writing the riddles took about two hours. We used multiple sources on the internet to collate the riddles. There also exist riddle books in Gujarati. To introduce the children to these riddles we did not need additional materials beyond existing facilities like a blackboard, chalk, and duster. In the class, we first wrote a riddle on the board and asked the students to read it. We read out the words they found difficult. Then we asked them to explain it to the other participants.

The duration of the activity was determined by the number of riddles discussed in the class. In our case, we spent 10 minutes playing 3 riddles multiple times during the intervention period.

Chatterbox

The chatterbox, also known as the fortune teller, is a simple paper toy that children can easily make using paper from their notebooks. We found step-by-step instructions on how to make it on YouTube, and it took us about an hour to prepare for the activity. We practiced making it a few times before feeling confident enough to teach it to the students.

The toy consists of eight paper flaps, and one flap is lifted to reveal the "fortune" for that day. In the classroom, each student was asked to make their own chatterbox while we provided instructions. They were then instructed to write

fortune-telling sentences on each flap, which served as a practice in forming sentences and reinforced future tense communication. After completing their chatter-boxes, the students had the opportunity to exchange and play with their classmates' creations. The entire activity took approximately 120 minutes of class time.

Hunting words from Newspaper

Children were given a newspaper page, scissors, and glue. They find 10 words on the page that start with the first letter of their name, cut them out, and paste them in their notebooks. They then ask the instructor for the word's meanings. This activity fosters vocabulary learning and active participation without requiring much from the instructor to prepare. This activity took approximately 120 minutes of class time.

Matching with Numbers

In the "Matching with Numbers" activity, students are assigned a number in either digit or word form. They must find their partner with the same number but in the opposite form (digit or word). For instance, a student with "5" in digits should find someone with "five" in words in Gujarati. This interactive game reinforces their understanding of number correspondence. Preparation needed 50 one-sided A4 size papers and took approximately 10 minutes. The activity took approximately 20 minutes of class time.

Name Correction Challenge

In the "Name Correction Challenge" game, students shared their names in their first language. We wrote each name on the board with deliberate mistakes. The student whose name is displayed must identify and correct the mistakes. No preparation time is needed for this activity. The activity took approximately 15 minutes of class time.

Musical Numbers

In the "Musical Number Hunt" game, students form a circle are given randomly assigned numbers, either in digit or word form, on A4 size paper. A running student picks a number when the music stops and finds its match within 30 seconds from the circle. Successful matches continue running; otherwise, another student replaces them. Preparation takes about 15 mins using 50 one side blank A4

size papers. This activity held the attention of the participants for a period of 40 minutes.

Tambola/Bingo

In this Tambola/Bingo game, students receive bingo sheets with numbers and blanks. We prepared 50 bingo sheets from 5 A4 papers. Gujarati number bingo can be found online or adapted from English bingo. Preparation takes about one hour. During the game, the instructor calls numbers in words, and students mark corresponding digits. They win by completing a horizontal or vertical line for a "Sub House" or marking all numbers for a "Full House." It's a fun way for students to practise numbers in digits and words. 60 mins preparation time is needed for this activity. The participants were engaged in this game for 120 mins.

Summer Camp Intervention Activities

Personalized Name Plate Design

In this activity, students create nameplates using A4 or any size paper torn from their notebooks. They use sketch pens to write and decorate their names in Gujarati. This engaging activity helps students practice writing and reading their names with no preparation required from the facilitator. The participants were involved in this activity for a span of 30 minutes.

Wrist Bands

Young participants make wristbands with their names in Gujarati using used newspapers and scissors. They further decorate the bands with sketch pens. The activity includes making Mobius bands, showcasing a fun magic trick to the participants. It allows students to effortlessly write their names while being enjoyable. No preparation time is needed from the facilitator. The participants were actively involved in this activity for a period of 25 minutes.

Friend Tree

The participants were given a printed A5 size sheet with a tree with 10 faces on 10 branches. The participants were briefed to write the names of 10 classmates in their mother tongue after approaching them. This activity fosters reading and wri-

ting in their native language. It takes 10 minutes for preparation with online free templates, and this activity was carried out by the participants for a total of 35 minutes.

Matching Numbers with Pictures

Students get an A5 printed sheet with numbers written on it from 1 to 99 in numerals and words in their mother tongue. Using scissors and glue, they find A6 sheets with pictures representing numbers and stick them next to corresponding numbers in their notebooks. We prepared it for a class of 60, requiring 40 pages and 2 hours of preparation work to find and cut pictures from A4 sheets. For a duration of 120 minutes, the participants were engrossed in this activity.

Hitting the number

During the game, the facilitator called out various numbers, and each participant took turns to hit the corresponding number with a paper ball. The board had 25 numbers written in words or numerals. This engaging activity helps participants recognize and practice numbers in both forms. The facilitator can conduct the game without any preparation time. This activity was carried out by the participants for a total of 35 minutes.

The assessment framework / rubric / set of rules

Evaluating Skills: Pre and Post Assessment: During the pre and post assessment, individual participants completed tasks in Gujarati. The PI called each participant separately, assigning various tasks with a time limit of 3-5 minutes. Most participants responded promptly, indicating if they could complete the task or not due to lacking the necessary skills. Tasks involved reading long and short sentences, writing sentences, arranging numbers from 1 to 99 in ascending and descending order, writing numbers in words and numerals, and recognizing the numbers.

Testing Participants' Abilities: Participants were tested using the following instructions:

- Write your name in Gujarati and transcribe a sentence or paragraph from the textbook or whiteboard into Gujarati.
- Read the sentence on the board. For example, "My name is Ramesh and I am residing in Ahmedabad, Gujarat, India." This was written in Gujarati.

- Arrange 5 numbers in ascending and another 5 in descending order.
- Write these numbers on the board in words and numerals.

Grading Based on Task Completion: Students were assessed on various tasks, including reading fluency, writing sentences in their mother tongue, recognizing numbers in words and numerals, and arranging numbers in ascending and descending order. Based on their performance, they were classified into four categories: satisfactory, unsatisfactory, poor, and very poor. (Table 2).

Grading	Reading	Writing	Number in words	Arranging numbers	Meaning
Satisfactory	Read a sentence fluently with correct pronunciation	write a sentence with space, punctuation, and readable letters	write 4 random numbers in words from 1 & 99	can arrange all the 5 numbers in ascending and descending order	can describe meaning of a short passage correctly
Poor	partially correct intonation and pauses (approx. 50%)	partially (50%) correct punctuation, space, and handwriting.	write 2 numbers in words from 1 & 99	arrange numbers partially (approx. 50%) in order.	describes partially correct meaning of a short passage
Very Poor	read one or two words.	writes only one or two words.	Write only one number in words.	arranges only one or two numbers.	Can only describe the meaning of one or two words.

Unsatisfactory	not able to read	not able to write	not able to write	not able to arrange numbers	Cannot describe the meaning
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Table 2. Grading Based on Task Completion

Results and Discussions

Pre-assessment data

School Participants: Among the 25 students studying in Gujarati medium, 8 exhibited poor reading skills, 13 struggled with arranging numbers in ascending and descending order, 16 had difficulty describing the meaning after reading a sentence, and 9 were completely unable to write numbers in words (Figure 1).

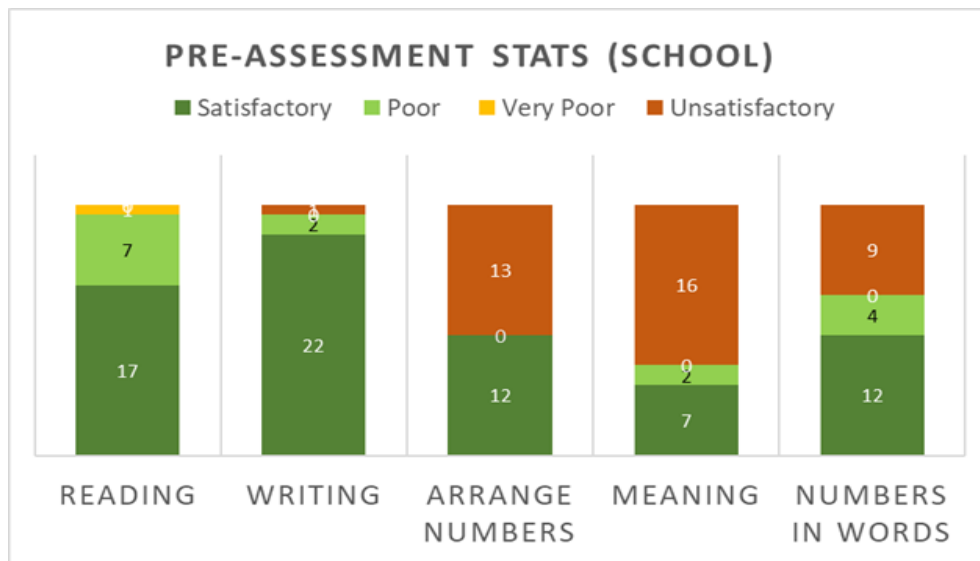


Figure 1. Pre-Assessment Statistics (School)

Summer camp Participants: In the English medium group of 20 students, 13 had very poor reading skills, 12 struggled with writing, 8 with number arrangement, 13 with comprehension, and 17 with writing numbers in words (Figure 2).

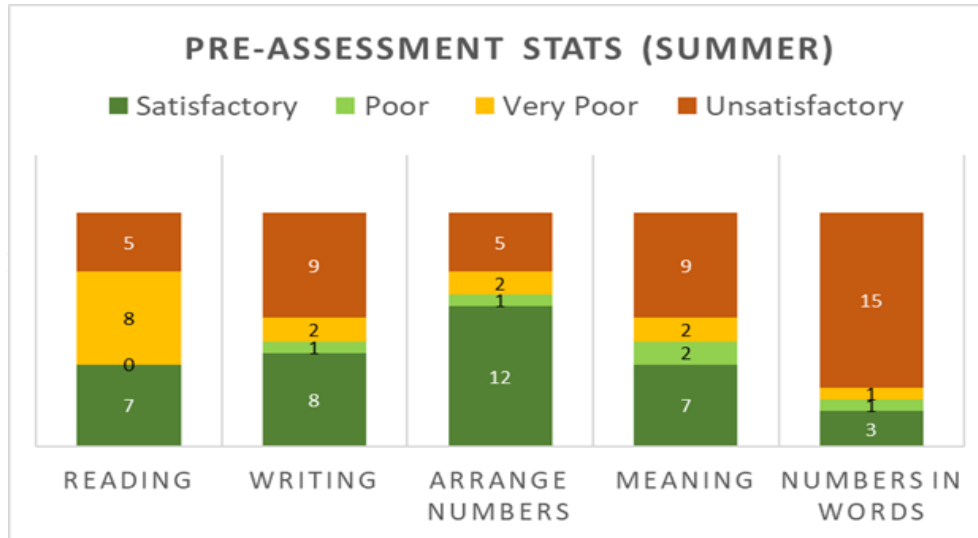


Figure 2. Pre-Assessment Statistics (Summer Camp)

Control group Participants: In the Gujarati medium school of 12 students, 9 had very poor reading skills, 6 struggled with writing, 10 with number arrangement, 10 with comprehension, and 10 with writing numbers in words (Figure 3).

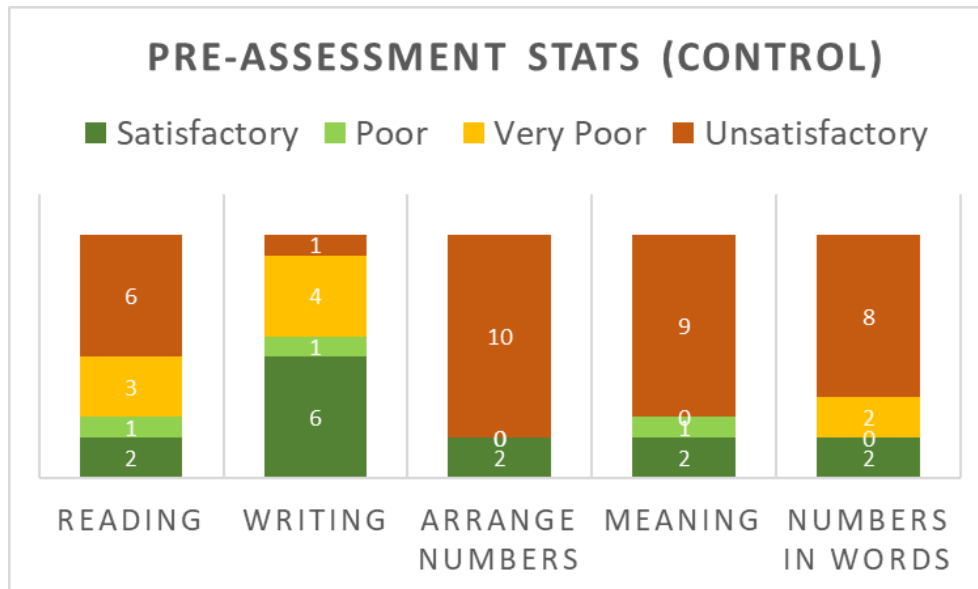


Figure 3. Pre-Assessment Statistics (Control Group)

Reaction of students in each activity

SR NO	Game / Activities Details	Preparation Time	Student Engagement time	Approx. Group Engagement %
1	Riddles	1 hour	5 min /riddle	70%
2	Chatterbox	1 hour	2 hours	90%
3	Hunting words from Newspaper	0 min	1 hour	50%
4	Matching with Numbers	10 mins	20 mins	65%
5	Name Correction Challenge	0 mins	15 mins	40%
6	Musical Numbers	15 mins	40 mins	50%
7	Tambola / Bingo (in Gujarati Numbers)	1 hour	2 hours	90%
8	Personalised Name Plate Design & Wrist band	0 mins	40 mins	80%
9	Matchstick models	45 mins	90 mins	90%
10	Friend Tree and Finger Puppet	20 mins	40 mins	60%
11	Matching Number with objects treasure hunt	1 hour	2 hours	90%
12	Hitting the numbers	0 mins	15 mins	40%
13	Story Cards	0 mins	60 mins	75%

Figure 4. Activities Engagement during the study

Riddles (in Gujarati language): Both school participants and summer camp participants enjoyed riddles, but their engagement approaches differed. School participants with higher Gujarati language skills read and discussed riddles together, making it easier for them to understand and guess answers. In contrast, summer camp participants, with lower language proficiency, required facilitator explanations. However, they showed less creativity in guessing answers and relating riddles to their daily lives.

Chatterbox: Though the chatterbox (fortune teller) aimed to develop language skills, both groups focused more on crafting and art. Most participants made fortune tellers, but less than 25% wrote their daily fortunes in their mother tongue.

Hunting words from Newspaper: The activity engaged students, cutting words from the newspaper starting with the first letter of their name and gluing them in their notebooks. Some students preferred cutting pictures over words, finding visuals more captivating than just words.

Matching with Numbers: Initially, participants were unsure how to interact and find classmates with the opposite number form (digit or word). However, they quickly figured it out and completed the task in 8-10 minutes.

Name Correction Challenge: Participants took turns spelling their names in their mother tongue, while the PI intentionally made mistakes for them to correct. This humorous twist engaged participants for 10 minutes, after which the PI considered replacing the activity/game.

Musical Number Hunt: Both groups thoroughly enjoyed this game, with participants enthusiastically running around the circle as long as they kept winning. Challenges, such as reducing time from 30 sec to 20 sec and then 10 sec, increased difficulty and provided opportunities for new players. However, 80% of students were sitting, making it less enjoyable for them.

Tambola/Bingo: Participants found Tambola/Bingo interesting, listening to numbers spoken by the facilitator and marking them on their bingo sheet. Recognizing the numbers was not an issue, but some struggled to remember them. Despite this, the game engaged everyone for 120 minutes.

Personalised Name Plate Design: Participants in the summer camp study group, with lower Gujarati proficiency, learned to write their names in Gujarati. Decorating their nameplates with sketch pens and colours interested them more than writing itself.

Wrist band: All participants enjoyed making wristbands with their names and found decorating them enjoyable. They particularly liked the Mobius band, trying to cut it in half. It was a magical experience for most.

Friend Tree: Most of the participants could write all the 10 names in the friend tree in Gujarati language. Initially, the participants hesitated to approach their fellow mates to ask their name. However, in one hour they were able to write names and could also colour their tree. Craft and art again were an engaging element for the participants since it was a means for them to be actively involved in the activity.

Matching a Number with an object in the picture: This game received the best response from participants, who actively searched for pictures representing numbers from 1 to 99. They enjoyed using and improving their numeracy skills by matching objects in pictures with specific numbers, cutting and gluing them in their notebooks.

Hitting the numbers: Young participants enjoyed hitting numbers on the whiteboard based on their turns. While they recognized spoken numbers, hitting the right spot with the ball posed a fun challenge. The game combined movement and number recognition, creating enjoyment. Yet, some participants who finished became bored over time, and occasional chaos ensued as students waited for their turn.

Description of post assessment data

School Participants: Among the school participants (Total 25 students), 6 improved in reading, 3 with writing, 7 in number arrangement, and 8 in sentence comprehension. (Figure 5)

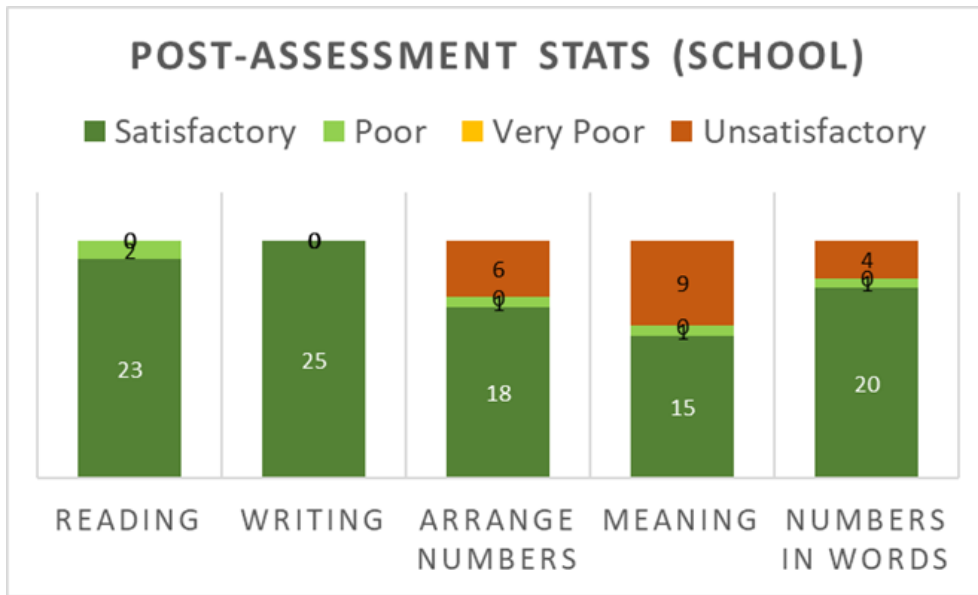


Figure 5. Post-Assessment Statistics (School)

Summer camp Participants: Among the Summer camp participants (Total 20 students), 7 improved in reading, 7 with writing, 5 in number arrangement, and 5 in sentence comprehension, 3 in number in words. (Figure 6)

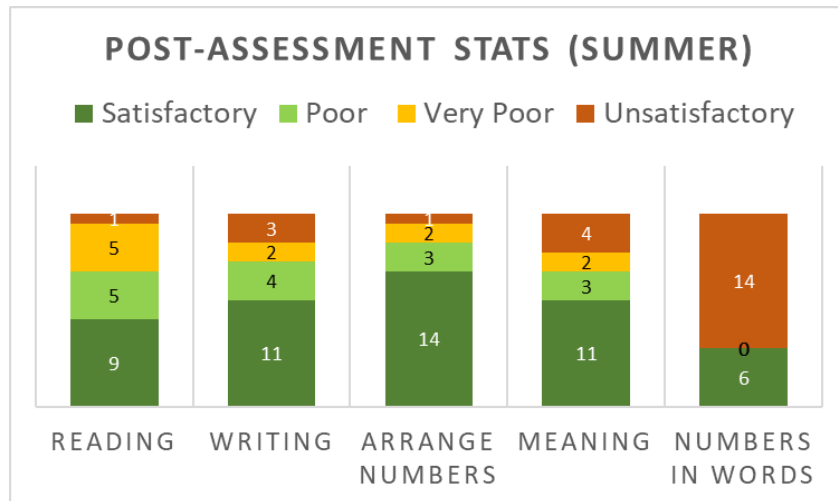


Figure 6. Post-Assessment Statistics (Summer Camp)

Post-assessment results show significant improvements in writing, reading, sentence comprehension, number arrangement, and writing numbers in words for both participant groups.

Control Group Participants: Among the 12 students, 10 exhibited poor reading skills, 10 struggled with arranging numbers in ascending and descending order, 11 had difficulty describing the meaning after reading a sentence, and 10 were unable to write numbers in words. (Figure 7)

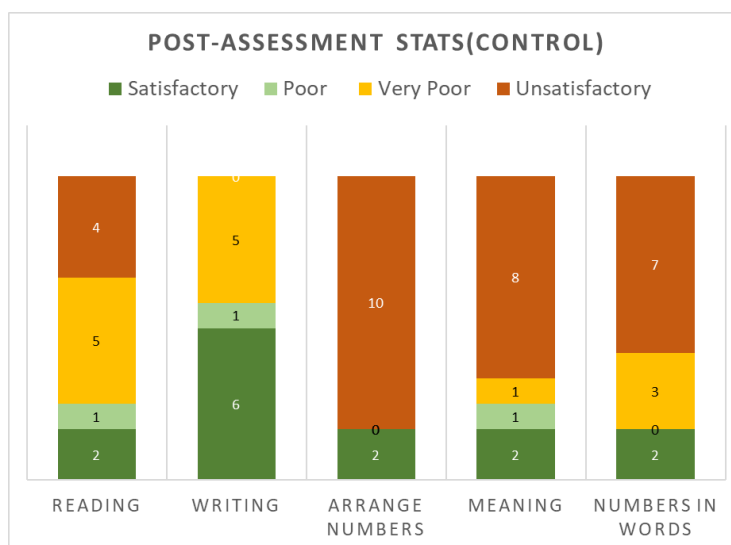


Figure 7. Post-Assessment Statistics (Control Group)

Analysis and Interpretation of Results

In this section we analyze the data using statistical techniques – paired t-test (Table 3) (to compare pre and post assessment performance) and 2-sample t-test (Table 4) (to compare the score changes in pre/post assessments of the intervention groups with the control groups). The following are our Null and alternative hypotheses.

Null hypothesis for paired t-test: Pedagogies incorporating toy-based learning do not facilitate children in acquiring foundational literacy and numeracy skills.

Alternative hypothesis for paired t-test: Pedagogies incorporating toy-based learning facilitate children in acquiring foundational literacy and numeracy skills.

The post-assessment test revealed noteworthy improvements in the mean scores of the students' performance in both the intervention groups. To ensure that these observations were not merely coincidental, we conducted t-tests on these scores. The resulting p-values are presented in the table 3. For this analysis, we selected an alpha value of 0.05 to reject the null hypothesis.

Remarkably, in almost all cases, we successfully rejected the null hypothesis, indicating that the observed changes were not due to random chance. Even in the two highlighted cases the p-value is very close to the alpha value of 0.05. The p-value is a crucial statistical measure that indicates the probability of observing the observed change (e.g., improvement in reading skills) due to chance alone. For example, in our case, the p-value of 0.0028 in the reading column suggests that there is only a 0.28% probability that the observed improvement in reading skills is merely a result of random chance (as shown in table 3).

Such a low p-value provides strong evidence that the observed improvement is likely a result of the intervention (e.g., incorporating play-based pedagogy) and not just a random fluctuation in the data.

T-test p-values		Reading		Writing		Number in words		Arrange numbers		Meaning of words	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Summer camp	Mean scores	6.12	7.75	6	7.87	4	4.75	7.5	8.75	5.8 7	7.625
	<i>p-value</i>		0.0028		0.0027		0.0552		0.0144		0.0060
School	Mean scores	9.1	9.8	9.4	10	9.14	9	4.8	7.5	3.4	6.3
	<i>p-value</i>		0.0027		0.0807		0.0029		0.0028		0.0019

Table 3. T-test p-values

Null hypothesis for 2 sample t-test with same variance: Pedagogies incorporating toy-based learning do not facilitate children in acquiring foundational literacy and numeracy skills more rapidly compared to regular teacher-based classroom learning or no intervention.

Alternative hypothesis for 2 sample t-test with same variance: Pedagogies incorporating toy-based learning facilitate children in acquiring foundational literacy and numeracy skills more rapidly compared to regular teacher-based classroom learning or no intervention.

The post-assessment test revealed noteworthy improvements in the mean scores of the students' performance in both the intervention groups, very little or almost no improvements in the scores of students in the control group. To ensure that these observations were not merely coincidental, we conducted 2 sample t-tests (Table 4) on the mean difference of the pre-post assessment scores comparing intervention groups with the control group. The resulting p-values are presented in the table. For this analysis, we selected an alpha value of 0.05 to reject the null hypothesis.

Remarkably, in almost all cases, we successfully rejected the null hypothesis, indicating that the observed changes were not due to random chance. Such a low p-value provides strong evidence that the observed improvement is likely a result of the intervention (e.g., incorporating play-based pedagogy) and not just a random fluctuation in the data.

In the three instances highlighted, the p-value consistently exceeds the established alpha threshold of 0.05, converging around 0.2. This suggests that, given the limited size of our control group data, arriving at a definitive conclusion remains elusive. However, it's worth noting that disparities may also stem from variations in the intervention activities selected for the summer camp as opposed to those used in the school setting. Despite this uncertainty, the results do appear promising, laying a solid foundation for future extensive research endeavors.

Two sample t-test p-values comparison with control groups		Reading		Writing		Number in words		Arrange numbers		Meaning of words	
		Summer camp/ School	Control	Summer camp / School	Control	Summer camp/ School	Control	Summer camp/ School	Control	Summer camp/ School	Control
Summer camp Vs	Mean Score Change: Post vs. Pre-Assessment	1.625	0.416	1.875	0.208	0.75	0.208	1.25	0	1.75	0.208

Control	<i>p-value</i>		0.049		0.022		0.188		0.039		0.037
School Vs Control	Mean Score Change: Post vs. Pre-Assessment	0.7	0.416	0.6	0.208	1.8	0.208	2.1	0	2.3	0.208
	<i>p-value</i>		0.232		0.265		0.033		0.023		0.027

Table 4. Two sample t-test p-values comparison with control groups

Discussion

Extending the Future Intervention Studies for Enhanced Insights: The intervention study spanned 9 days, with pre and post assessments on the 1st and 9th days, respectively. Future studies could extend the intervention period to observe the effects over a longer duration. Additionally, while the study assessed 4 FLN skills, there is potential to enhance the scope by including more skills in future research.

Sampling and Participant Demographics in the Study: The research engaged 20 summer camp attendees and 25 regular school students through random sampling. For broader validation, replication across varied Gujarat schools, both government and private, with increased participant numbers is recommended.

Attendance Fluctuations and Study Challenges: Fluctuating pre and post-assessment figures stemmed from school attendance issues. The study's timing, post-exams and pre-summer vacation, led to many students missing due to travel. Also, adapting games and instructions for varying age groups and skill levels is vital for improved learning outcomes.

Future Research Directions in Play-Based Learning:

Further research should delve into the effective integration of play-based learning within educational frameworks to better understand its alignment with curricular goals. Additionally, exploring playful assessment strategies for educators and their seamless incorporation into classroom practices is pivotal. Lastly, promoting play-based activities, not confined to schools but extending to homes and public spaces, is essential for nurturing children's holistic development. These areas warrant focused investigation to harness the full potential of play as a dynamic and comprehensive approach to child education and development.

Conclusion

In conclusion, our study strongly supports the positive influence of toy/play-based learning on fundamental literacy and numeracy skills for students from varied backgrounds. This research provides substantial evidence for the effectiveness of incorporating play-based approaches within education.

Highlighting the importance of teachers' perspectives, it becomes evident that addressing their concerns is pivotal to encouraging the adoption of toy/play-based teaching methods. To achieve this, we recommend comprehensive training programs and workshops. These initiatives should enhance teachers' awareness and comprehension of toy/play-based teaching techniques, while also guiding the integration of discipline strategies aligned with playful learning principles.

In essence, our findings underscore the significant potential of toy/play-based learning, reinforcing its role in nurturing core literacy and numeracy skills. By addressing teachers' reservations and equipping them with the necessary tools, we can empower educators to embrace this innovative pedagogical approach, ultimately enhancing learning outcomes for students with diverse backgrounds.

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