Research Papers

Enhancing Teaching-Learning of Mathematics among Grade II Children Using Storytelling Strategy

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Abstract

This study is an action research aimed at enhancing mathematics learning of a low-participating class of Grade II learners to being more participating and getting engaged in doing mathematics. Storytelling proved to be an appropriate strategy for this involvement. Story-based on a popular animated series was adapted and concepts related to skip-counting were embedded into story situations. Anecdotes from the field included students' verbal and written responses and pre-service teachers notes in their reflective journals. It was derived that the enhanced participation of Grade II children could be a result of the strong agency that the story fostered in the young learners, making them realise that their mathematical expertise was valuable and had serious implications for someone (the story characters).

Keywords: *Storytelling, Action Research, Skip-counting, Participation, Communication, Primary School Mathematics*

सार

यह एक क्रियात्मक अनुसंधान है जिसका उद्देश्य कक्षा 2 के गणित विषय की कक्षा में कम प्रतिभागिता करने वाले बच्चों की प्रतिभागिता को बढ़ाना हैं। इस भागीदारी के लिए कहानी सुनाना एक उपयुक्त रणनीति साबित हुई है। इस अध्ययन में एक लोकप्रिय सजीव श्रृंखला के आधार पर कहानी का चयन किया गया तथा स्किप काउंटिंग से संबंधित अवधारणाओं को कहानी की स्थितियों में लागू किया गया। अध्ययन में वास्तविक स्थिति से उपख्यानों को एकत्रित किया गया जिसमें छात्रों के मौखिक और लिखित प्रतिक्रियाएं एवं पूर्व-सेवा शिक्षकों

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द्वारा उनके चिंतनशील पत्रिकाओं में उल्लखित नोट्स को शामिल किया गया। इस विधि के प्रयोग द्वारा बच्चों में भागीदारी में वृद्धि पाई गयी । यह विधि संभवतः बच्चों में यह समझदारी विकसित करने में सहायक हुई कि उनकी गणितीय विशेषज्ञता तथा बच्चें दूसरों (कहानी के पात्रों) को प्रभावित कर सकते हैं ।

Introduction

The policy document of The National Council of Teachers of Mathematics, *Curriculum and Evaluation Standards* for School Mathematics advocated, "the use of children's books as a vehicle for communicating mathematical ideas" (NCTM, 1989, p.5). Following this recommendation, a lot of work has been done in this area. Studies recommended the use of literature, storybooks, epic stories and museum as means for discussing mathematical ideas (Forbringer, 2004; Gerretson and Cruz, 2011; McDuffie and Young, 2003; Schiro, 2004). They saw immense potential in using children's literature for teaching mathematics and asserted that an effective teacher may use these resources to locate mathematical ideas within the stories. Researchers (for example, Casey, Kersh, and Young, 2004; Egan, 1986; O'Neill, Pearce, and Pick, 2004; Zazkis and Liljedahl, 2009) have promoted storytelling and narratives as potential ways for creating a context for learning mathematics. They claimed that these resources help in improving students' thinking, communication and problem-solving abilities.

Vygotsky's socio-cultural theory stresses at the fundamental role of social interaction in the development of cognition. Stories, viewed from a socio-cultural perspective, when told within a culture, teach its members the culture's interpretation of who's who and the implications of their roles, "…what is right and wrong, good and bad, aims and obstacles, collaboration and conflict, power and prohibition, causes and consequences… cultures teach us the stories within which we live" (Smith, 1990). Hence, stories provide opportunities for individual learning as well as social interaction.

Stories being a multi-modal system are important from the individual and socio-cultural perspective. While constructivism asserts that knowledge is actively built up by the cognising the subject where the function of cognition is adaptive, it implies that people build knowledge by integrating new experiences with prior knowledge. Storytelling provides many avenues for generating new experiences to create multiple learning opportunities.

The use of storytelling in the mathematics classroom is a relatively new aspect, with lines of scholarship coming from

only a handful of countries, such as North America, Europe and Australia, a lot remains unknown about the use of stories in teaching mathematics. Flevares and Schiff (2014) while reviewing the literature pointed out many missing links in the understanding of this pedagogic strategy. They suggested more work should be done through multiple methods of investigation, like, large-scale experiment-control studies and fine-grained studies of individual students. Also, significant gaps exist in understanding student's cognitive engagement, classroom practices and individual differences. They have highlighted the absence of many required research studies that can help build an understanding of the positive impact of using children's literature in teaching mathematics on students and their teachers. The present study was a step in that direction.

The study an action research conducted in the primary classroom that had many persistent issues. Despite all best efforts students didn't showed interest in participatory in interacting and communicating mathematics. The teaching-learning of mathematics, storytelling was used as a pedagogic strategy in the classroom.

The Site

The purpose of the action research study was to explore the role of storytelling in enhancing teaching-learning of mathematics in primary classes. The research question it addressed was, Can storytelling, as a teaching strategy, help in addressing the problems of low participation, low communication and fear for mathematics with primary children?

The class understudy was Grade II of a government school of Delhi. The class comprised of 22 students (8 boys and 14 girls). The students were in the age group of 7 to 8 years.

The action work was done with a pre-service primary grade teacher, who was the fourth and final year student of an elementary teacher's training course (Bachelor in Elementary Education, University of Delhi).

Field observations, students' written and verbal responses, classroom-conversations between the intern-teacher and the students, and Reflective Journals (RJ) written by the intern-teacher were used as indicators of knowing students' participation. The reflective journals of the intern served as an extremely useful source as in it there was description about the things that happened

during teaching, about students' learning, and most importantly, self-analysis of the teacher's pedagogies. The anecdotal writing in the reflective journals helped to understand the change in students' participation and learning.

Backdrop of a Low-Participating Mathematics Classroom: A Dissatisfaction

Before formally teaching the class, the intern observed a couple of mathematics classes being taken by the regular teacher. It was observed that during the regular mathematics class, children followed the procedures chalked on the blackboard by the teacher. Paper-pencil tasks were dominant and the children hardly communicated with either the teacher or with their peers. Many of the students were observed to have developed a fear for the subject. It was gathered that the children could state numbers from 1 to 100 in a sequence, like a routine exercise, but lacked the understanding of the number patterns and number-sense. From the limited communication that took place in the class, it was deduced that owing to the one-sided communication by the teacher, there was a feeling of low participation on behalf of the children. Considering the children were just about 7–8 years old, one would expect the class to be a vibrant space loaded with fun and participation. Contrarily, an atmosphere of silence prevailed in the mathematics class, which indicated that the children either feared the teacher or the subject.

The pre-service teacher started to take initiatives by following participatory approach to make mathematics interesting. By teaching skip-counting using a manipulative, i.e., g*anit-mala* (a rope with hundred beads having groups of ten beads in alternate colours) the class was involved. It was hung in the front of the room and students were called to work on it. A starting number and a number to be used as a counter to skip were given to the children. It was assumed that working with a manipulative will increase the participation of the class as they would invent their strategies and construct ways of doing skip-counting. However, soon it was realised that none of the intended goals could be accomplished by using the manipulative. Most of the students were only doing one-by-one counting with little enthusiasm. They were seen losing interest as well. Many of them asked, "Why are we doing this?" which indicated a lack of interest, participation and not liking the subject as well.

In the next attempt to make mathematics interesting, the manipulative was replaced with a game. This time, a number board was given with numbers 1 to 100 printed in squares and 4-colored counters and a usual dice to play with. The students were placed the in group of 4. The game involved throwing the dice and making three skips of the number on the dice from their present positions. The one who first reached the mark of 100 would be the winner. When the game was given to the students they took interest in it but after playing it for two rounds, they started losing their interest. This game too could not hold students' attention for long. Soon they were seen throwing the dice at each other and not doing mathematics.

It was found that the use of manipulative and games was not doing any good to the class. It looked rhetorical as the children had replaced paper-pencil with manipulative. The children were still not engaging with mathematics. Based on the outcomes another pedagogic strategy was tried and storytelling was chosen as a pedagogic tool to make mathematics interesting and her classes more participatory.

The story sessions were planned and embedded mathematics into the story situations. The details of the story sessions and engagement with learners were:

Planning and Implementing the Intervention: The Storytelling Sessions

The format used for storytelling was that of an epic story (Schiro, 2004). An epic story lasts for many days, like a long story, and was narrated in small chunks over many sessions. In every session, at least one mathematical task was embedded in the story situation. A popular animated series was chosen as plot and concepts related tonumber patterns were embedded in the story.

A total of eight sessions were taken to cover the entire story for teaching number patterns. During each session, students were narrated a part of the story and had to solve one task leading to the elementary understanding of number patterns. In the first session the children were told to observe repeating patterns in the world around them. In Session 2, children had to do exercises on continuing and completing repeating patterns in worksheets, Session 3 and 4 were dedicated to discussing skip-counting. Session 5 and 6 were based on growing patterns.

In Session 7 and 8, children had to create coded messages using the idea of number patterns.

Every session included story narration, concept introduction, discussions and worksheets containing problems on the chosen concept. Mostly, the tasks were based on the exercises given in the NCERT Grade II textbook, *Math Magic* (2006).

Mathematical Task Embedded in Story Situation and its Description

In this paper, the data obtained during the Session 3 in which skip-counting was planned was reported.

The mathematical task on skip-counting was embedded into the story situation where the students had to help the protagonist cross a lake (Details of the story narrated to the students was given in the Appendix. Here, the mathematical task was being described). As per the situation of the story, the protagonist had to cross a lake in order to find his lost friends. The lake could be crossed by stepping on the stones floating on it. These stones were numbered from 1 to 50. A starting number was announced along with the skipping-counter. For example, if 13 was announced as the starting number and 4 as the counter, the children had to start from the 13th position and find strategies to move to 17, 21, 24 stones and so on. The role of students was to help the protagonist cross the lake so they had to listen to the numbers, (both starting number and the skipping-counter) very carefully. They were told that any mistake in their working would lead to consequences for the protagonist, like slipping in the water. To make the story interesting and to help remove the fear of one right answer, the children were given the freedom to do trial and error without fearing the drowning of the protagonist. Three lives were assigned for the protagonist which meant they could make a maximum of three mistakes.

A rope was placed in the class and equally spaced placards of numbers 1 to 50 were posted on it (if the children wished to use this manipulative as a reference of number line). This manipulative could help children count forward and backward while performing skip-counting. Further, to give the students a feel of the story, one student was selected from the class to act as the protagonist and rest of the class was asked to guide him in the jumps. The moves had to be made collaboratively.

Since, the children were doing skip-counting for the first time, so it was started with small numbers as skipping-counters, gradually increasing the complexity of the task, giving bigger numbers to jump subsequently. The children were given skip counters to move forward as well as for making backward moves. After doing enough engagement with the story, worksheets were handed out to the children. The worksheet had a picture of a rope with numbers 1 to 50 written on it. Blanks were provided beneath the picture for children to write the skip-count sequence of numbers. The starting position, skipping-counter and direction of the moves were announced. The skipping-counters were changed from time to time and the children had to calculate accordingly. Also, were given questions on counting forward and backward, the class moved back and forth between numbers 1 to 50 many a times. In the worksheets, children had to fill in the sequence of numbers that they would obtain after doing the skip-counting. For example, 5, 7, 9, 11, 13, 15 had to be written after the skip count of 2 from the starting position of 5. They also had to speak out the numbers after finding the final result.

The anecdotes shared provided glimpses of how the subject of mathematics was made interesting and ensuring active participation of the learners during the class.

Evaluation and Reflections

In the study, storytelling has been used a conduit of mathematics learning by embedding mathematics content into the story situations. Students attempted mathematics tasks while they listened to a story. Engagement with story and mathematics took place simultaneously as student's mathematics expertise was crucial for helping the story characters in solving their problems. The evidences of students' engagement with mathematics and story characters were interspersed with each other.

It was observed that the children listened intently to the skipping-counter that was provided to them. The students invented their own methods to find their answers. For example, many students used the image of the rope as an aid to mark their skip count (this could be because the image resembled the manipulative displayed in the front of the class). Students' scribbling on the picture of the rope provided in the worksheets gave evidences of their unique thinking styles. Reva, a student, skipped the counts

and marked circles to present the landing stepping stones. So, she started from 14 and moved forward 3 steps in her mind and circled the landing tones14, 17, 20, 23 on the rope-image provided in the worksheet. Shubam, another student was seen doing the counting-on process. He started from 14, marked 15, 16, 17 with circles, making sure he had made three circles and then wrote 17 in the space below. To get the next number, he again made three circles from 18 onwards to reach 20. Saina and Anuj did same as Shubam but underlined the count of skipping-counters instead of making circles. Amit, on the other hand, wrote 1–2–3 as counters to make a note of the skipping counts. He started from 14, wrote 1–2–3 on numbers 15, 16, 17 and announced the last number, i.e., 17. The number on which the counter digit 3 landed became the answer. So, the counter digit 3 landed on 17, giving it as the answer. Moving ahead, he again wrote 1–2–3 beneath 18,19, 20. Some students, on the other hand, didn't used the rope image at all. They were seen to be counting numbers on their fingers. For instance, Gita showed three fingers and counted-on from the starting number.

While the task was going on, all children were busy in doing individual calculations. It was observed that the whole class worked for one single goal of helping the story characters. Each child was enthusiastic of doing the task, and if they could not, they were open to ask for help from their peers. This level of participation from the class was quite different from the ones observed earlier. A non-participatory class had started to exchange ideas in order to save their story characters.

After a few minutes of working with the first mathematical task which was about making forward skips of 3 starting from 14, the level of difficulty was increased. Different starting numbers, were given such as 27, which were not easily identifiable of the rope. Many more sophisticated strategies emerged. For instance, a student, Ganesh was seen doing adding-on strategy orally, without doing any interim marking in his worksheet. Ganesh was observed saying, “from 27, 3 steps will be 30… because 27+3 is 30. Then it will be 33…and 3 more…so 36”. He was adding the counter of 3 mentally. This explanation revealed that Ganeshhad made a connection between the skipping-counter and adding the counter as an operation. Simultaneously, many more students were seen making connections between skip-counting and addition.

Rishabh, for example, was seen making connections between the operation of addition and the skipping-counter 6. He explained, "I add like 36 on top and 6 below it". He used the vertical algorithm of addition to find the answer.

Another episode of independent discovery that was noticed when the class was asked to begin from 15, moving forward using the skipping-count of 4. At this instance, Garima wanted to share her method, "If I do two jumps of two stones, it will be a jump of 4, isn't it?" It was noticed that Garima was decomposing the skipping-counter, and hence this opportunity to introduce how numbers can be decomposed. Garima was asked to demonstrate her method by taking another starting number, keeping the same skipping-counter 4. Garima explained her method confidently and immediately gave the correct answer. In order to extend children's thinking about number sense, the class was asked to consider Garima's method and use it for their forthcoming skips such as for 7 and 8. Many children got the idea of decomposing the skips and now the Grade II children could be seen decomposing the skip of 7 as skips of 4 and then 3 or vice-versa. Some decomposed them in three parts, doing skips of 2, 3 and 2.

Another revelation emerged when a student Saurav decomposed the number by compensation mechanism. A compensation mechanism was rounding off the number to its earliest base 10 and then compensating for the extras. Saurav was seen using decomposing-compensation strategy with the skip count of 8. He said, "I first found 10 steps forward and then I went two back.... like 33 and then 32, 31. So 31 is the answer". The corresponding number sentence were written on the blackboard, "+10–2 = +8" and the meaning of the symbols were explained that were introduced. then another task was given to strengthen the idea. This time the starting stone number was 31 and the counter was 9.

By sharing different methods, the class was introduced to many ways of working with skip-counting. The inter-changeability of the methods were demonstrated which emerged from the students themselves. The aim of students' work was to ensure so that all the students participated in the discussions. Students were seen to imbibe and follow the different methods shared by their classmates. Henceforth, they selected their own methods to find the sequence of numbers for skip-counting. Moreover, their oral and written expressions reflected their thought processes while spelling out the answers. Students' work showed high accuracy and fluency in calculations.

Students' engagement with their tasks was evident in another anecdote. It was reported that while the session was going on, the students were so engrossed in calculating and helping the story characters that they didn't noticed the presence of the teacher in-charge. On the usual day, students would have stopped their work and wished the teacher-in-charge whenever she entered the class, but on that day, the children were so engrossed in the work that they didn't realised her presence. In fact, the level of engagement was so high that they were focused to finish the task before going home. Teachers and children from the adjoining classes visited the class on an account of curiosity. Such was the involvement with the task that the students continued to 'help Dee without getting disturbed by anyone's presence' (RJ, p. 27, Session 3). No child expressed a desire to leave the task in between and go home even when urged by their parents. It was only when the teacher announced that the protagonist had finally crossed the last stone and had safely entered the castle, the students felt a sigh of relief and stopped their work. They applauded themselves and were happy about accomplishing their task, which was to lead the protagonist to a safe place. The enthusiasm related to the story and doing mathematics didn't ceased at that point. The children yearned for an extension of the story as they were inquisitive about the protagonist's further journey. It was ensured that was not the end and story would be continued the next day.

Concluding Comments

The communication and participation of the stated session was a glimpse of all sessions in which storytelling was used as pedagogy to involve students in doing mathematics. Storytelling helped the intern-teacher in solving the problem of low participation in the mathematics classroom. It was reported that the story, besides providing a meaningful context to the children, helped to break the teacher-student barrier.

Students were highly interested in solving the problems faced by story characters. They persisted on the tasks well beyond the classroom timings, thus showing increased participation. The class discussions also demonstrated the use of multiple methods and procedural fluency. The children explained their methods to everyone, learnt new ways from others, and also made connections between mental computations and addition. Their oral expressions and written responses gave enough evidence for their increased level of communication while exchanging their working procedures.

No content area could be mastered by learners unless they were engaged with it. In the discipline of mathematics, this phenomenon were highly pronounced (Dhankar, 1993; Boaler, 2008). Engagement with the content was dependent on the interest that one had in the content being transacted. Fredrickson (2001) has defined interest as 'a momentary thought-action tendency that involved an impulse to explore'. Thus, considering 'interest' as a cognitive activity. Further, taking interest in a task involves feelings of being animated and enlivened which implied that evoking interest activated a system that generated positive emotions in an individual. Feelings of interest involved affect, attention, motivation and cognition. The study aptly demonstrated a situation that was instrumental in arising interest in the students at their engagement level. The increase in engagement was sensed at the affective as well as cognitive levels.

In addition, students felt that their mathematics expertise was valuable and had serious implications for someone (the story characters stuck in a situation). This fostered a strong agency in the learners which was evident in their engagement with the task of helping the story characters. "They were highly focussed on the task at hand and were not taking any chances with their calculations" (RJ, p.27, Session 3). Each student felt like a 'hero' as they assumed they had the power to drive the outcome of the story. The story context, hence, allowed students to indulge in mathematical initiations that were personally relevant to them. As Schiro (2004) termed it, storytelling pedagogic strategy helps to 'bridge the gap between the subjective and objective realities'. Students' emotional and personal connection with the story characters (subjective reality) led to their self-initiation in doing skip-counting (objective reality). The children were doing mathematical tasks which mattered to them, showcasing an amalgamation of their emotional and cognitive selves. The pedagogic strategy of storytelling helped in making the uninteresting class interesting; and on a general note offered many unexplored possibilities in the teaching of mathematics.

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Appendix I

A Glimpse of the Story

Dee and Nee were fast friends. Dee was a friendly robot who lived with Nee. Dee had an endless supply of fantastic gadget that helped Nee in his adventures. Our story began on a Sunday morning which was a holiday for all. Dee, Nee, Shina, Jane and Suni were going to the park for playing. When they reached the park they saw that it was already full of children and there were no swings available for them. They felt sad and sat quietly in a corner thinking how their Sunday was going to be a waste.

Nee whispered something to Dee as if he was trying to say something more than his words, "What shall we do now Dee?". Shina was also upset and she complained, "It seems like we will be stuck like this the whole day...Dee please do something." Others also started pleading to him. Dee looked at his friends and he said, "Let me see..."

Dee closed his eyes for some time and then took out a big ball from his gadget bag. He said, "Here is a magical sphere and this will help us." Everyone was puzzled and they asked, "Dee, how will a sphere help us in playing?" Dee placed the sphere on the floor and gave it the following command,

"Oh dear ball, please go and see,

Show us a place happy and glee,

Where swings make us gay

and we can play all day"

The magical ball followed the instructions and after searching, it showed them a beautiful place with big parks and lots of swings. Everyone was happy to see this place and they started shouting, "Wow! Let's go to this park". Dee took out a gadget 'small beam' from his bag and flashed it on all his friends. They all shrunk in size and they entered the ball to go into the new magical place. The moment they entered this magical land a strong wind blew. The wind was so strong that before they could realise what was happening they were flying in the air. They all got separated and did not know where they had landed in this new land. They were all shocked and scared and did not know what to do next.

Dee and his friends were unaware that they had entered a magic land that was under a spell of an evil magician. Dee, while

wandering about, met an old magician who told him about the spell and agreed to help him to reach the evil magician. But before he could reach the evil magician, Dee had to cross many obstacles.

(The story till here was narrated on the first day. During the first two sessions Dee was confronted with challenges that were actually worksheets on repeating patterns. Students solved the worksheets and helped Dee in finding two of his friends. He had also moved closer to the castle of the evil magician. In the third session, the story narrated was as follows.)

Dee and Nee were very happy to find Shina. They were getting closer to the evil magician. The evil magician was losing his temper, his powers and his youth. He was shocked to see that Dee had succeeded in entering the castle, a task no one had ever accomplished till that day. He was sure that someone was definitely helping Dee in this misadventure. He now decided that it was time to confront Dee and defeat him.

The magician worked out another plan. He built a deep lake of water around the centre of the castle so that Dee and his friends could not reach him. Dee and his friends were surprised to see the sudden emergence of this lake and immediately guessed that this was another evil move by their enemy. Dee also noticed a broken bridge across the lake and some pieces of stones floating around in the water. The peculiar thing about the bridge and the pieces was that there were numbers written on them. Suddenly there was a celestial announcement. The voice was so loud and scary that Dee and his friends were shivering with fear. It was the evil magician. He said,

"Dee, you think you are smart?

Let me see how smart!

I will give you one chance,

I want to see you dance.

The floating stones are no ordinary stones.

If you step on the wrong one,

You shall never leave this town.

If you select the right one,

You may be the one!

I will tell you how to start,

Hope you have a strong heart."

Dee shouted back, "I want my friends and I want to go home. Why don't you try me? You are inviting trouble for yourself". Only the evil magician knew which stones were steady and could be used to cross the lake to enter the castle. He said, "Listen to the skip counter carefully and skip that many numbers from the current number. To cross this lake, you have to step on the correct numbered stone".

(At this point, the mathematical task of skip-counting was introduced.)