

AN ANALYSIS OF PRIMARY TEACHERS' REFLECTIONS ABOUT THEIR MATHEMATICS CLASS

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ABSTRACT

Teacher education programmes play a prominent role when the quality of education is the main concern of the country. Among the long list of programmes focusing on preparing elementary teachers, Bachelors of Elementary Education programme is one of the programmes that gives immense spotlight on preparing reflective teachers who can think about their classroom practices regularly. Mathematics is treated as a subject that is very abstract in nature and demands extra efforts from the teachers' side. The paper aims to study and analyse teachers' reflections about their mathematics class. It is a qualitative study mainly aimed to study the role of reflections in the future classroom implications. Fourteen prospective teachers were selected to take part in the study who shared their reflective journals along with the observations of their classes. The result of the study showed that teachers' reflected upon the nature of activity, the teaching learning material and their students' responses when mathematics was planned and taught.

Keywords: Beliefs, Classroom Practices, Reflection

INTRODUCTION

Mathematics is considered to be the subject that deals with logic and includes topics like numbers, shapes, measurement and many more. There has always been a debate about its nature. On one hand there are views held by scientists and engineers who perceive mathematics as a static discipline like a store of various formulas, theories and results useful to solve any problem and passing the same store to the next generation. On the other hand, mathematicians recognise it as a dynamic and growing field of study that contributes to human civilization (Steen, 1988). The root of this distinction lies in the 4th century when Plato and Aristotle characterized its nature based on their philosophical ideas about knowledge. According to Plato, mathematics can be understood as an abstract mental activity and objects of mathematics are existent on their own in the sensory world beyond the ideas of the mind. Contrastingly, Aristotle believed in experiential reality therefore mathematical relationships can be formed through the collection and classification of information received through the senses and without the senses. Progressively, a lot of views and theories were presented by many thinkers following the dichotomy between Plato and Aristotle; however none of them provided a strong foundation for the nature of mathematics. Consequently, the modern view of mathematics perceives it as a human activity which is not governed by any school of thought but keeps the ideas in the focus that are derived or constructed during the process.

A great deal of mathematics learnt by students comes from their school education that is eventually formed by the classroom practices adopted by their mathematics teacher. According to Cooney (1985) as quoted in Dossey (1992), "the conception of mathematics held by the teacher has a strong impact on the way in which mathematics is approached in the classroom." For example, if a teacher views mathematics as an "instrumental knowledge", she tends to focus on the step by step procedure for a given task and helps her learners in reaching a fixed solution determined by those steps. Instrumental knowledge is the set of fixed plans in order to carry out a mathematical task (Skemp, 1978). While the teacher following a "relational knowledge" view of mathematics might focus on creating

opportunities for students to create multiple paths to perform a mathematical task. Relational knowledge can be defined as a collection of conceptual structures that a person uses independently to construct various plans or ideas to solve a problem (Skemp, 1978). Thus, the classroom practices are a reflection of teachers' conceptions of the subject, learner and teaching.

The quality of being a reflective practitioner always supports a teacher in making a sound decision, critically examining her experiences and generating new ideas. John Dewey also put emphasis on the process of reflection for learners by saying, "We do not learn from experience. We learn from reflecting on experience." This process is generally guided by writing the reflections regularly and making improvements based on that. A teacher who reflects upon her experiences like teaching in the class, thinking about the reasons of why a particular activity succeeded or failed, which kinds of material led to a useful discussion is the one making efforts to advance her interaction with students in a meaningful manner.

The present paper attempts to study the teachers' reflections about their mathematics class. One cannot overlook the fact that the nature of mathematics is significantly different from other subjects for the reasons that it is abstract, it has its own language and most of its topics follow a hierarchy. Further, the conceptions held by teachers about mathematics play a significant role in the classroom practices. Consequently, it becomes even more important to know how teachers look at their mathematics class as it might decide the future course of action to improve their overall teaching practice.

LITERATURE REVIEW

John Dewey was the one who started taking interest in reflection for the professional growth of the teachers. Dewey (1993) defined reflection as the "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends". He saw reflection as a form of thinking that a person deliberately has about an experience that ultimately helps him or her in learning from experiences. In a similar way, Boud et al (1985) explained reflection as a word assigned to intellectual activities where an individual is engaged in the exploration of experiences that direct them to new understandings. A number of thinkers might define it differently however all of them agreed to its importance for a teacher and in the teaching learning process.

Larrive and Cooper (2005) made a difference between reflective and non reflective teachers. According to them, a non reflective teacher is not able to consider all possible reasons affecting a situation hence blame learners for not performing in the class. Here, the teacher is rigid in adopting new techniques and solutions for the problems and affirm teaching techniques without exploring the remedies. Distinctively, a reflective teacher gradually generates the ability to consider all possible reasons to evaluate any particular situation related or not related to their class. This ability of regularly jotting down their mind helps in searching solutions for all kinds of problems and provides support in students' understanding.

Schon (1983) differentiated between 'reflection in action' and 'reflection on action' that worked as an important criterion to make sense of the teachers' actions and decisions in most of the research. The reflection in action is the thought process that takes place during the activity. Schon also stated it as "we may reflect in the midst of action without interrupting it". This helps the teacher in reshaping their thinking about what they are doing while doing it. This 'stop and think' type of reflection allows us to choose the path on the spot (Manen, 1991). It allows a teacher for the 'moment to moment'

monitoring of actions and considers it as an individual process. On the other hand, the reflection on action is the process that takes place after the event and the teacher reflects back on every detail of the event, the strengths and weaknesses, evaluation of the used teaching strategies and material and decides the future course of action that might improve the result. Schon (1987) explained it as “we may reflect on action to discover how our knowing-in-action may have contributed to an expected outcome”.

Ernest (1988) noted that teachers’ reflection about their mathematics class is one of key elements that influence the mathematics teaching. He further stated that teacher’s conceptions about the nature of mathematics and its meaning are the foundation of what happens in their mathematics class. Reflection, specifically in mathematics, supports teachers to develop coherent rationale for their views and actions which make them aware about the feasible solutions just like a vehicle for knowledge growth. Chamberlin (2009) also stated that, “teacher’s reflections were more aligned with teaching for understanding when they thought about their mathematical learning experiences in the role of a learner before considering implications for their teaching”. This also supports the findings that the role of conception about the nature of mathematics is important for mathematical classroom practices. Peterson and Williams (2008) shared that understanding of mathematics in the teaching and for the teaching are very much affected by experience of teaching as a student teacher and the conversations and/or reflection about the same.

OBJECTIVES OF THE STUDY

The research intends to focus on the following objectives:

- To analyse prospective teachers’ reflections about their mathematics classes
- To study the role of reflections in future classroom practices of mathematics

METHODOLOGY

It was a qualitative study. The aim of the study was to understand how teachers reflect on their teaching practices and students’ understanding of mathematics. Since the focus was given on studying the experiences of each teacher’s classroom practice, a qualitative approach was found appropriate for the present study. Moreover, the nature of mathematics is so different from other subjects and the study deals with mathematics in a school setting that becomes the vital reason for choosing a qualitative approach.

Participants

The data has been collected from the prospective teachers who are presently in the final year of Bachelors of Elementary Education, Mata Sundri College for Women, University of Delhi. The Bachelor of Elementary Education (B.El.Ed.) is a four year integrated professional degree programme of Elementary Teacher Education offered after the senior secondary stage of school. The final year students teach at primary level for four months as part of their internship practicum. They teach Mathematics, Hindi and Environmental studies in an integrated manner. Reflective journal writing has been considered as an essential component of the programme therefore students start writing reflective journals right from the first year. There were a total of 49 students in the final year, out of which 14 were chosen for the study on a voluntary basis after they expressed their willingness to participate in the study.

Instruments

Final year students' reflective journals about their mathematics class are used as the main instrument for the study. They were asked to write reflective journals about the mathematics class that they think was successful and what were the reasons for its success. Apart from this, their mathematics classes were observed as part of their internship programme and discussions were also conducted in smaller groups about the mathematics classroom practices. These discussions did not centre on a particular class but overall classroom practices related to the subject.

RESULT AND DISCUSSION

All the data received through reflective journals show that teachers have shared the details of mathematics class that they like along with the challenges faced during the discussion part. They have shared details of the overall lesson including the introduction part, reasons for taking up a task, interaction with children and many more. The table number 1 given below shared the class and topic details of all the teachers that they shared in the reflections. All the teachers have been assigned a number which is used in the analysis part to share their experiences:

Table 1: Details of classes and topics taught by prospective teachers

S. No.	Teacher	Class	Topic
1	Teacher 1	IV	Patterns
2	Teacher 2	IV	Fraction
3	Teacher 3	IV	Measurement
4	Teacher 4	V	Measurement(Length)
5	Teacher 5	V	Fraction
6	Teacher 6	III	Measurement(Length)
7	Teacher 7	III	Shapes
8	Teacher 8	IV	Mapping
9	Teacher 9	II	Pattern
10	Teacher 10	V	Area and Perimeter
11	Teacher 11	III	Shapes
12	Teacher 12	IV	Shapes and Spatial Understanding
13	Teacher 13	IV	Pattern
14	Teacher 14	III	Pattern

This section discusses the various components of those reflections and their classroom practices of mathematics based on observation and discussion with them.

- **Activity sets the rhythm of the lesson**

As per the details received in the reflective journals, the success of mathematics class largely depended on the selection of the activity that was decided by the teachers keeping in mind the topic.

Teacher 1 had asked her students to bring a piece of cloth for the pattern activity. She shared:

'For the introductory activity, I asked the learners to bring any piece of cloth from their homes or any other object which might have a particular design or pattern drawn/printed on it. It was an observation based activity, where the learners had to observe the object they have brought on the basis of difference between designs and pattern'

Teacher 2 shared,

'I noticed that some of the students had difficulty in understanding the fraction concept. When asked to represent the shaded part, some children wrote $5/4$ instead of $5/9$. Similarly, some of them wrote $5/2$ instead of $2/5$ that showed they had no clarity of denominator and numerator. So, to help them I showed them about 20 flashcards of the figures with shaded parts and their fractional representation written along with the figures drawn and I asked them to observe each card carefully.'

In both the cases, teachers were able to reflect upon the reasons for their selection of the activity. Teacher 1 was clear that she needed to focus on the difference between design and pattern therefore she began the lesson with an observation activity. Further, she gave a choice to students to bring the cloth or object of their choice that would help them relate the subject with their daily life activities. The teacher seems to have a constructivist perspective as she tried to create an opportunity for learners to build mathematical knowledge. The position paper on 'Teaching of Mathematics' based on the National Curriculum Framework, 2005 also states that 'Making mathematics a part of children's life experience is the best mathematics education possible'.

The decision of teacher 2 shows that she reflected back on the children's previous construction of knowledge about fractions that also included some misconceptions regarding representation of fractions and decided the future course of action i.e. an activity that can strengthen the visualization of various fractional parts in children's mind. Since students wrote $5/4$ instead of $5/9$, it shows they had no understanding of part-whole relationship and they only represented the ratio of shaded and not shaded parts. The selection of flash cards activity by the teacher to show various fractional parts with the symbolic form communicates that the teacher knows the importance of establishing base for any concept in order to follow the hierarchical nature of mathematics. Here, the teacher is able to think about the ramifications of these gaps in learning of a concept through reflective writing.

Some of the teachers even used questions to create conflict in children's minds so that they can think about those questions while doing the planned activity.

Teacher 3

'Let's find out how many centimetres are there in one meter. Students started getting the answers with the help of paper strips of different measurements and gave various responses like 112cm, 84 cm and 94cm'

Teacher 4 wrote a question while teaching measurement in the class

'How can we measure the distance between school and home?'

I also observed one of the teachers using questions while teaching the concept of volume. She asked

'How many small cups can fill this big bucket?'

It is just a chance that all the examples focused on the concept of measurement (length and volume). However, all the questions promote the use of estimation skill among children which is one of the essential skills a mathematician can build over time. These teachers are able to reflect upon the topic specific demands of the lesson and use appropriate questions to develop the required skill. This is a clear example of what Shulman (1986) has defined as Pedagogical Content Knowledge that centres on the ways and techniques to teach a specific topic so that it becomes easy and useful for children.

It can be concluded that the teachers' selection of activities for different topics was determined on the basis of children's previous knowledge, to provide remedy to errors or misconceptions formed by them, to enhance a particular skill specific to the concept and to strengthen the relationship between school and out of school knowledge. All these aspects mirrored in their reflective journals and classroom practices.

- **Teaching Learning Material works as a bridge between abstract concepts and real life applications**

It was found that all teachers gave importance to the teaching learning material and these materials took a central spot in their mathematics lesson. A variety of material like games, real objects, fraction kits, pattern kits and even classroom space was used as a learning material. The teachers reflected upon the importance of the TLM in their writing as

Teacher 5 while teaching fractions to class 5 gave some pieces of different fractional parts to form complete circles by finding the correct piece. She shared,

'Most of the groups were able to make two circles from the given parts. The interesting thing to be noticed is that the students from the group were exchanging the parts of the circle with each other to form their own circles. It happened when a student informed me that she had seen a part in another group which she could use in her group to complete her circle and then asked if she could ask the group for the same. This is how the idea of exchanging parts of circles to each other as groups began. It was amazing to see their cooperation and collaboration with each other.....During the activity, I observed that the students tried every given piece in all the ways possible to form a circle, and eventually it helped them to easily find and locate the parts of the circles to form and complete them.'

Teacher 6 while teaching measurement of length to class 3. She shared,

'I gave students some material like different lengths of pencils, different lengths of paper strips, cloth cutting, notebooks and books, some wrappers of things like chips, toffees, chocolates, milk etc and asked them to put the things in two categories: long and short. Once they categorized material in two categories we had a discussion about it'

Teacher 7 while teaching shapes to class 3 students used a game which had different levels of tasks based on difficulty level that provided a chance to develop understanding of shapes among students. She shared,

'I moved on to the game, where almost all the students identified the shape of the object (picture card) correctly although a few of them got confused between square and triangle for which I asked them to look at the picture carefully and then decide its shape. Also, most of the students faced difficulty in identifying the edges and corners of a circle and to make them understand that a circle has no corners and one curved edge, I took the help of colour pencils and made a square using them. Next, I asked students to identify the sides as well as the corners connecting the sides/edges. Then I asked students if we can make a circle using these pencils to which all of them replied No'

All the above examples show that teaching learning material is an inseparable part of the mathematics classroom. Teacher 1 was able to reflect about the holistic learning that the TLM provided to her learners when they could learn to cooperate with each other and the concept of sharing with each other got strengthened. This was the additional learning of cooperation provided by the fraction kit other than understanding the concept. The teacher 2 had used real life objects to introduce the concept

of short and long. The teacher used the material as a medium to develop the concept of measurement instead of telling them the actual length of the pencils in abstract form. She focused on developing the ability of comparison among students so that they can divide the material based on the differences found. Both the teachers were able to make decisions about the material required to help children understand the topic of fraction and measurement that shows they were aware about the relevant pedagogical techniques as I have also observed them using different materials for different topics in the class. Behr et al (1992) also used an analogy to discuss the importance of teachers' ability to identify a useful technique as "In the same way that children are encouraged to discuss similarities and differences between various isomorphs of mathematical concepts, teachers should be encouraged to discuss similarities and differences between pedagogically related actions in various mathematical contexts". Here, the teachers are doing this with the help of reflective journals where they get a chance to think about their actions and instructions in the class.

The use of the game by Teacher 3 along with the decision taken during the activity to develop and strengthen students' understanding about shapes and their properties can be put clearly in the category of 'reflection in action' defined by Schon (1983). During the lesson, whenever she found her students struggling with the concept, she immediately used the material and game to explain the concept. Here, she was able to analyse her children's thoughts and errors and used teaching learning material as a tool to discuss the concept in the concrete form. The relevant questions asked by her also supported the understanding of the concept as mere material would not be sufficient for the learning.

Another teacher (8) used her classroom as a resource to discuss mapping and direction. While teaching her class 4 this concept, she shared,

'It was fun for the students because often children are given more pencil and paper work to explore problems in a mathematics classroom. I started my class with basic directions wherein children were divided in the pair of two. Each pair had a partner and one of them needed to guide them and make them reach the destination of the class. I was happy because I was able to use my classroom as a resource. Later I used a maze wherein one of the children was blindfolded and other need to give the direction to cross the destination'

It is important to note that Teacher 4 is very well aware about the resources to be used for a particular concept and she has a wide understanding of the teaching learning material. Since the concept of mapping and direction is used when we go from one place to another, the teacher used the same example to make the connection between school and daily life activities. Additionally, she also had an idea that one activity is not enough to build any concept therefore she used another maze activity for the same.

Overall, it may be said that teachers understand the importance of material in developing the mathematical understanding among students and are proactive enough to take decisions and conduct meaningful discussion during the activity that shows the use of reflection in action.

- **Children's responses give direction to the teacher**

All the teachers gave immense value to students' responses in their reflective journals as these responses helped them execute the lesson plan properly and guided them in future preparation also.

Teacher 8 shared,

'One of the interesting questions that was raised by a student ma'am how is it possible that my left is her right and right is her left....I learnt that we often impose the language and terminologies on the children during teaching learning process like I repeatedly told my students to use left and right which I think was not much required at that stage as they focused more on the landmark'

Teacher 1 shared,

'One of the students classified design material as pattern but it was a design. So another student questioned him, "ye pattern kaise hoga....agar aap isko dekho to yahan ek design wali line miss ho rahi hai baki to repeat ho rhi hai lekin ye line nahi ho rhi hai"'(How can it be a pattern.... If you look at it carefully you will find that one line is missing whereas other lines are repeating but this line is not repeating)....this child got the idea of pattern and asking others also to identify the same in every design'

Teacher 2 wrote,

'When I asked them to write the fraction of shaded part, one of the students raised query and asked "hum hamesha coloured wala part hi kyu likh rahe hain...jisme colour/shade nahi hai wo bhi to fraction mein likh sakte hain"'(why are we always writing the fraction of coloured part...Those non shaded parts can also be represented in the fractional form)....Because of this response, I gave them problems in which they have to find the fraction of the non shaded part so that learners will not form this misconception that only shaded part can be represented in the form of fraction'

Teacher 3 shared,

'During the measurement activity, I asked learners to measure the kilometre also with paper scale. So one learner replied that kilometre is a huge number so it will be difficult to measure with paper scale. When I asked that how she knows this, she said her father's workplace is 6km away from her house and her father goes there by bicycle which takes a lot of time'

In all the examples shared above, children's responses act like a medium that tells the teacher whether she is doing it right or not and how she can move ahead with that understanding of the concepts. Looking carefully at the examples, we noticed sentences like 'I learnt that we often impose.....', 'I think was not much required.....', and 'this child got the idea of.....', 'because of this response, I gave this problem.....' We can say that teachers' decisions are mainly dependent on students' responses. In the example 1 where the child had difficulty in dealing with direction and specifically with 'right' and 'left', it tells the teacher that she does not need to focus too much on the terminology at this stage. The second example communicates the teacher about how keenly children observe and question if some new concept or example does not fit into their schemas. Peterson (1991) also discussed in one of his principles on Cognitive Guided Instruction that teachers need to analyse children's thinking by asking them appropriate questions and listening to their responses carefully.

The third example is clear evidence of a teacher displaying her conceptions in the classroom while teaching the concept of fraction when she was not aware about providing only typical examples to represent fractions i.e. fraction of the shaded part. The way she had studied the representation of a fraction where only a shaded portion is always asked in the fraction's problem, a child pointed out and questioned it. The teacher got the right direction and tried to include other possible cases of non shaded parts also.

Some of the teachers also mentioned about the errors made by students either verbally or while performing an activity that also gave them a chance to build their discussion in the right direction. Teachers also found it challenging to respond to children's doubts as it was difficult for them to think about an answer or they were not fully prepared for the conceptual discussion. It is also seen in their reflective journals that they did not discuss a lot about the future course of classroom practices as their reflective journals ended abruptly in most of the cases.

CONCLUSION

The prospective teachers pursuing the Bachelor of Elementary Education Course and soon will be teaching in a school as a regular teacher are able to reflect upon their mathematics classroom pedagogies and think about the reasons that contribute in developing students' understanding and smooth transaction of activities. The role of teachers' conceptions about the nature of mathematics is very important as it decides the way of dealing with the subject in the classroom. However, one cannot overlook the role of professional education that guided them to consider child psychology hence the nature of the subject is built with a holistic approach. These teachers reflected upon the nature of activities and teaching learning material that led them to a constructivist approach of knowledge. Narrating a story on weight, interaction with real life material for shapes and measurement, observing patterns on clothes, playing games on fractions and shapes concept were some of the activities that they conducted in their primary classes followed by discussion on important parts. Teachers also faced a number of challenges in executing their mathematics lessons like less support from the school for innovative activities, insufficient subject knowledge about some topics like decimals, measurement etc, inadequate teaching time because of the excessive examinations in the form of unit tests and term exams. Teachers reflected upon these reasons and tried to find solutions by discussing the concept with their classmates and teachers at the college for subject clarity, they used waste material for activities and taught students in the first or the second half of the school time during examinations. The practice of daily writing reflective journals supported self evaluation and greater thinking among prospective teachers and it even helped more for subjects like mathematics.

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