

REFLECTIVE PRACTICES AMONG MATHEMATICS TEACHERS

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Abstract: Reflective practice is one of the most important aspects of effective teaching. Once a teacher has engaged in the active process of teaching, he or she must consistently and regularly reflect on what is happening and what has happened in his or her classroom. Both reflection-in-action and reflection-on-action (Schon, 1983) provide tremendous opportunities for teachers to enhance the effectiveness of their teaching methods, especially for new practitioners. This paper reports the findings of a qualitative study carried out to determine whether Malaysian secondary school mathematics teachers reflect on their teaching activity. The study particularly strives to determine to what extent the teachers reflect before carrying out their teaching plan, whether they reflect during and after implementing their teaching activities in the classroom, whether there would be any factors that influence their actions, and what challenges (if any) they face in carrying out their lesson plans. Data were collected through classroom observations, individual interviews and also analysis of teaching records.

Keywords: reflective practice, mathematics teachers, reflection, mathematics teaching

Abstrak: Amalan refleksi adalah satu aspek penting dalam pengajaran berkesan. Apabila guru terlibat secara aktif dalam proses pengajaran, beliau seharusnya sentiasa membuat refleksi terhadap perkara yang sedang dan telah berlaku di dalam kelasnya. Kedua-dua jenis refleksi, refleksi semasa beraksi dan refleksi selepas beraksi (Schon, 1983) memberi banyak peluang kepada guru untuk meningkatkan keberkesanan kualiti pengajaran, terutama kepada guru-guru baru. Kertas ini melaporkan dapatan satu kajian kualitatif yang dilaksanakan untuk mengenal pasti sama ada guru-guru matematik sekolah menengah di Malaysia melakukan refleksi terhadap aktiviti pengajaran mereka. Secara khusus kajian ini cuba mengenal pasti sejauh mana guru membuat refleksi semasa merancang pengajaran, semasa dan selepas melaksanakan aktiviti pengajaran, sama ada terdapat faktor-faktor tertentu yang mempengaruhi tindakan mereka dan dalam cabaran yang dihadapi semasa pelaksanaan pengajaran. Data diperolehi melalui pemerhatian kelas, temu bual secara individu dan juga analisis yang dibuat ke atas dokumen pengajaran guru.

Kata kunci: amalan reflektif, guru matematik, refleksi, pengajaran matematik

INTRODUCTION

Reflection is a form of feedback used to help teachers improve and enhance the way they learn about teaching. As Webb argues:

If we are to become more effective teachers, we need to become more reflective teachers. To be reflective we need to articulate our theories of learning, critically examine them and replace those parts which we suspect or, better still, can show do not work. (1996, p. 30)

Consciously engaging in reflective practice enables the teacher to learn from, and therefore potentially enhance, their teaching practice. Reflective practice is a way to continually challenge current behaviour and to ensure that one's teaching technique is constantly being developed and enhanced. The teaching profession requires commitment and continuous enhancement of knowledge and skills among its practitioners. Thus, keeping a reflective diary about their experience as a teacher helps practitioners to reflect on and learn from that experience. In Malaysia, teachers are frequently advised to be more creative and open to innovations in order to make their teaching methods more effective, interesting and fun for students (Ministry of Education [MOE], 2007). Lowery (2003) suggested that reflecting should be a crucial fourth component that should be added to the basic 3R's (reading, writing and arithmetics). To stress the importance of reflection, student teachers are instructed to write down their reflections after every teaching session, and to participate in peer discussions to improve their teaching practice.

BACKGROUND OF STUDY

One of the approaches to maintaining the quality of an educational system is to keep teaching standards abreast of global educational development. The Malaysian Ministry of Education (MOE) has introduced action research in an effort to inculcate research culture among teachers in schools. In practice, when teachers engage in action research, they are actually paving the way towards improving their own learning process by reflecting on their teaching practices. By doing so, the teachers not only enhance their own teaching practices, but they also help their students to learn, and ultimately, they improve the quality of their teaching and the learning process as a whole.

Romberg and Carpenter (in Senger, 1999) claim that the success of any educational reformation should be the accountability of teachers, the major role players and implementers in the education system. According to Senger (1999), teachers should act as good listeners, observers and guidance providers, not just the authority in giving answers. They need a paradigm shift in pedagogical aspect from the expository approach to other approaches that require the student to construct and develop their own knowledge (Nik Azis, 2003). Students' active participation in the learning process would make learning more meaningful and at the same time intellectually challenging. In mathematics learning, teachers are the best individuals to determine which teaching strategies best suit their students and are most effective.

Teachers can always make some needed adaptations to the objectives of their mathematics teaching in order to match the ability of their students. If the main objective of mathematics teaching is to develop mathematical thinking, then teaching methods should not be based on drilling concepts and rote memorisation, as is practiced in many schools today. To overcome this challenge, teachers should adopt reflection-in-action and reflection-on-action as a way of looking at, connecting with, and thinking about their teaching (Schulman, 1987).

In 1987, Schulman recommended reflective practice as a way for beginners in a discipline to recognise consonance between their own individual practices and those of successful practitioners. As defined by Schulman, reflective practice involves thoughtfully considering one's own experiences in applying knowledge to practice while being coached by professionals in the discipline (Schon, 1996). Reflective practice can be a beneficial form of professional development at both the pre-service and in-service levels of teaching. By gaining a better understanding of their own individual teaching styles through reflective practice, teachers can improve their teaching effectiveness in the classroom.

Reflection-in-action is sometimes referred to as "thinking on your feet". It involves looking to your own experiences, connecting with your feelings, and attending to your theories in use. It entails building new understandings to inform your actions in the situation that is unfolding. There is a link to this process of thinking on your feet with reflection-on-action, which is normally done later, after the experience. Teachers may write up recordings, talk things through with a colleague, and so on. The act of reflecting-on-action enables them to spend time exploring why they acted as they did, what happened in a group activity and so on. In so doing, they develop sets of questions and ideas about their activities (Schon, 1983).

Effective mathematics teaching involves the process of incorporating various types of knowledge, such as knowledge of school mathematics, knowledge about students' development and their ways of learning, as well as knowledge of school culture and its impact on learning (Nik Azis, 2003). Teachers are required to plan their courses of action and reflect on their activities and their experiences as a continuous self-evaluation process in the effort to enhance the teaching profession. Do mathematics teachers analyse their actions? Do reflect-in-action and reflect-on-action take place in mathematics classrooms? This paper aims to analyse two mathematics teachers' courses of action and to determine whether reflective activities have taken place during the planning, implementation and assessment stages. What are the challenges faced, and how do they affect teachers' decision-making processes in the classroom?

OBJECTIVE OF THE STUDY

This research was exploratory in nature, aimed at gaining an in-depth understanding of the reflective practices of mathematics teachers. In particular, we wanted to find out to what extent teachers reflect on their daily planning and in the implementation of mathematics lessons. This study also attempts to determine whether teachers' decision-making processes are the result of their reflection.

METHODOLOGY

This study uses two mathematics teachers from different schools in Pahang, Malaysia, for its sample. The study's qualitative approach was adapted from Gay, Mills and Airasian (2006), who argued that the main focus for any qualitative study is to understand the social environment and activities from the subject's perspective. The observation technique, semi-structured interviews and analysis of documents were used to collect data, as was the triangulation technique was also used. Three teaching observations were carried out for each teacher, followed by individual interviews for each observation. The teachers were interviewed before each lesson that was observed. Altogether, 12 interviews were carried out for the two teachers. Their lesson plans were analysed by the researcher before they were implemented in classroom teaching. During the interview sessions, the teachers were required to explain any mismatch between the lessons prepared and those implemented.

Teaching observation is meant to verify exactly what happens in the classroom, and what type of reflection-in-action actually took place, independent of what the teacher recounts during interview sessions. As an outsider, the researcher can actually identify the practice routine that brings about contextual understanding (Merriam, 1988). Interview sessions allow the researcher to probe further when the subjects explain their actions. In fact, the interview enables the researcher to obtain information on experience, attitude, feelings, anxiety and values that cannot be obtained from classroom observation. Critical analysis of daily lesson plans allow the researcher to understand the objectives of the teacher's daily teaching plan. According to Creswell (2005), the process of triangulation is important in qualitative study as it helps to improve the accuracy of the study.

Analysis was carried out by going through all the data from teaching observations, verbatim from interview protocols and the researcher's field notes, and categorising into two main themes, reflection-on-action and reflection-in-action. For confidentiality reasons, pseudonyms are used in this article.

Case 1

Teacher Z, aged 52 years, has been teaching in the school since 1978. She holds a Diploma in Mathematics from Universiti Teknologi Malaysia. She is also the examiner for mathematics papers both at the lower- and upper-secondary public examinations. In her long teaching career, she has been a school warden and has served as the head of the mathematics department for the last three years. She was offered the position of senior assistant, but rejected the offer and prefers classroom teaching to administrative duties. Her colleagues often seek her out for advice, be it related to personal or teaching matters. Five other teachers in the school were her former students.

Reflection-on-action

Teacher Z used to introduce her lessons by explaining concepts, giving examples, and then carrying out relevant exercises for students to try before discussing the students' work together. She admitted her teaching approach has not changed much, although she was well aware of the changes and reformation brought about in the mathematics curriculum. She believes her approach of direct teaching is very effective compared to the usage of computers or courseware supplied by the education ministry. In fact, according to Teacher Z, students favour direct explanation using the board compared to the use of LCDs. She herself rarely uses computers or LCDs in teaching mathematics because it slows down the process,

as she has to repeat the explanation in spite of the fact that the CDs are self-explanatory. Here is an excerpt from an interview:

When using laptops I have to explain twice. Double work time is the problem... why not just explain straightaway... after all, the answers are the same.

Furthermore, students have to move from their classroom to the computer laboratory for every mathematics lesson, and it is a waste of time. However, she planned to use readily available CDs for revision later on. At the end of the conversation, she admitted that she sometimes faced problems in handling the computers as she is not very familiar with the contemporary teaching tools. The following is an excerpt:

I am not good at computers, do not know... so slow, after all, still the ultimate aim is the examination.

For learning to be effective, Teacher Z insisted that students pay particular attention and listen carefully to her explanation.

Teacher Z is quite concerned over her students' mathematics performance and tries to accommodate her students of different abilities. She has made some changes in her lesson preparation, especially on the approach adopted to suit the class she was going to teach. For the slower class, she spends more time explaining the concepts, and, to compensate for the time spent on explanation, she increases the number of tasks given for the weekends. Besides students' abilities, time is another important factor to consider in her lesson planning.

Regarding the language used in instruction, Teacher Z teaches in the national language for almost 80% of the time to ensure that her students understand. She claimed that she has tried to teach mathematics in English, but felt like she were talking to herself, as there was no response at all from the students. However, she would make sure her students understood all English mathematical terms.

Reflection-in-action

In teaching, Teacher Z emphasised the knowledge and mathematics skills that involve the proper working procedures, accuracy of diagrams, and mathematics operations. She corrected her students' mistakes and misconceptions immediately

by asking them how they came to their conclusions. Figure 1 is an example of a student's mistake:

$$\begin{aligned}\frac{1}{2} \times b \times 5 &= 36 \text{ (Step 1)} \\ \frac{1}{2} \times b &= \frac{36}{5} \text{ (Step 2)}\end{aligned}$$

Figure 1. Example of a student's mistake

Reflecting on her action, Teacher Z claimed that she was not satisfied with the answers given and that it was important to rectify the mistake to avoid it being repeated by other students. The following is an excerpt from the interview:

If we don't rectify them immediately, they will always write the same way...you would divide when there should be multiplication... without knowing why and how it comes about...

For Teacher Z, the student's reasoning behind her solution indicates that the student has some conceptual understanding, and thus it would be easier to help her understand and be able to teach others as well.

In another example of a student's solution (Figure 2), Teacher Z discussed the mistakes for the class and finally asked the same student to rectify them on the board in front of the class. According to Teacher Z, her action was effective in helping the class to understand better, particularly for the student who made the mistake in the first place.

$$\begin{aligned}\text{Area} &= \frac{1}{2} \times (8+10) \times 5 \\ &= 40 \times 5 \\ &= 100\end{aligned}$$

Figure 2. Example of a student's solution

In one teaching episode, Teacher Z made some changes to her original plan. Instead of a textbook question to find the area of a combination of a rectangle and a parallelogram, she asked the students to find the area of a triangle. Then she changed the diagram again into a trapezium and asked for the area. When asked about the changes made that were not in the original lesson plan, her response was:

I purposely changed the question (original question from textbook) to ensure that students understand conceptually and are able to use the formula in different situations.

Towards the end of the lesson she discussed all questions. Reflecting on the discussion, Teacher Z reiterated:

I found some poor students still could not answer the questions correctly, and this was to dissuade them from just copying right answers from friends.

It seemed that Teacher Z analysed students' answers, observed their behaviours and responded to them accordingly. She was also quite flexible in the implementation of her lesson plan.

For assessment purposes, Teacher Z gave a lot of exercises, as she believes students should be given the opportunity to solve problems in class. By doing so, the teacher would be able to assess not only students' performance but their own teaching almost immediately. As a result of this reflection-in-action, she decided her next course of action, which is to have her students learn the multiplication table by heart.

Case 2

Forty-year-old Teacher *F* started her teaching career in 1995 after obtaining a post-graduate teaching diploma in mathematics and science from a local university. She was the head of the mathematics and science department in her last school, and the present school is her second posting.

Reflection-on-action

Teacher *F* planned her lessons based on her belief that good teaching should begin with explanation from the teacher and be followed by related exercises on the topic. Instead of using a textbook, she prepared some exercises on a worksheet for her students. When asked for her reasons for doing so, her response was:

They don't like textbooks... they prefer worksheets, they are lazy, too lazy to write, to copy.

She planned on supervising her students' group work in class. According to her, in teaching mathematics, she has to be close to students in order to make them feel better in their interaction, and to help her to understand her students. Realising the different abilities among students, she branded this class as her poor class. Teacher *F* reduced the amount of exercises given and asked her students to finish them in class, not to be taken home as homework. To a question regarding this issue, Teacher *F* confidently replied that she was pretty sure that her students would not finish them at home. She was very concerned about the ability of her students, and thus planned differently from her other classes so as to ensure they experience some positive reinforcement in their learning.

For some reason, Teacher *F* used an LCD screen or computers in her mathematics teaching in early part of the year only. The mathematics and science teachers had to share the viewing room, as there were not enough rooms for everybody. Thus, they need to plan and book the room in advance to ensure its availability. Concerning completion of the curriculum, she claimed that using computers or compact disks would slow down the learning process, as she had to repeat the explanation of concepts in the national language. However, she planned to use the compact disk provided later on during revision, if time permits.

Reflection-in-action

During the process of teaching and learning, Teacher *F* encouraged her students to work in small groups while she supervised their work from one group to another. At times, she discussed with the whole class. When asked for the reasons for switching from one approach to another, Teacher *F* said that she decided to switch to class discussion after getting some feedback from her small group observations, an indication that some reflection-in-action has taken place.

There was another occasion when, teaching the topic of *Angle of Elevation and Depression*, Teacher *F* just continued her teaching without adhering to her original plan, although she knew some students had not acquired the objectives she had set. She was quite frustrated to find that many of them did not finish their homework. She did not expect much from this group, just that they would manage to acquire some knowledge about the basic concepts in *Angle of Elevation and Depression*. In any case, she did not intend to go further in this topic because, according to her, this topic is not very common on examinations. Responding to this situation, she said:

If I were to stop, I would get nowhere... at least they come across it once... I will probably stress that topic again during revision time.

In a problem-solving session, Teacher *F* herself preferred that her students work on the worksheet, as it took too long for them to copy from the textbook.

She had planned for a double-period lesson (90 minutes) on plotting and comparing trigonometric graphs, but it turned out that they managed to complete just the first part, that is, plotting the graph only. The situation seemed to reinforce her belief about the students' abilities. When she realised that the students enjoyed working together on plotting the graph, she allowed them to go on, knowing very well that they would miss the next part of the lesson. She said to the students:

Though you have taken more time to do the graphs, you enjoyed them. I hope you can remember them better.

Teacher *F* seemed to consider the learning environment as an important factor in her teaching. She looked happy when asked about this during the interview session,

I was quite frustrated over what had happened, but then I had to comfort myself. Since they want to learn, why not let them, at least they get something.

To ensure her students really understood their mathematics, Teacher *F* used to get an average student to answer a few questions, one after another, before moving to a different student. She concluded that if an average student can answer those questions, there would be no difficulty for the good ones to grasp the ideas. Only at times would the voluntary students get the chance to answer. According to Teacher *F*, if they were not called on at all, they may get frustrated, and it would demoralise them. In one instance, she tried not to confuse students by replacing the symbol *alpha* (α) with *a* for the measure of an angle. When asked, students answered *ohm* (Ω). On hearing the answer, she changed to *a* again. However, in her explanation to students later, she used α again. She was seen to be very confused herself. In the interview, she admitted:

I thought they may not know... there not having been much use of this symbol... but then, in the text, it is used... I might confuse them...so I was undecided.

Factors that Influence Teachers' Decisions

Both Teacher *F* and Teacher *Z* relied very much on feedback from interactions with students before deciding on their course of action, be it on the planning or on the teaching itself. In the early planning stage, they did give some thought on certain steps taken in determining what techniques to implement before embarking on the chosen approaches to implement their lessons. They had some justifications for the chosen steps, and those reasons were based on their experiences in handling and managing these students. Students' abilities and their levels of understanding of mathematics in English were the main concern of both Teacher *F* and Teacher *Z*. As explained by Teacher *Z*:

They are so happy and show interest when they just pass the test. That why in the monthly test I make it easy to attract them. That is my principle, if somebody gets 38, just give her 40, so that they don't feel frustrated.

Teacher *F* referred to the ability of her students:

These rural folks cannot understand even simple English...we want to make them understand mathematics, language plays an important role.

The second factor mentioned by both teachers was time. It became a constraint to Teacher *F* in getting things worked out since not much work could be completed in class and students rarely did their homework. Students enjoyed working cooperatively in small groups and thus needed more time for the lessons. This excerpt explains the situation:

Hmm...in conclusion, if I want to teach them, do a lot of activities...they'll enjoy...but then, they cannot finish their work in class.

Teacher *F*, hostilely had to adhere to the school's requirements in completing the mathematics syllabus within a certain period of time. Thus, she gave more work

and exercises to be completed by students during weekends. She complained about her administrative load in one of the interviews:

This and that... lots of them... they expect too much which is non-academic, analysis and so forth. Sometimes the school administrators need analysis to be done this way and that way... a headache. For example headcount changes all the time. After a meeting it changes again... not much time left to go and think about teaching and learning.

In other instances, these teachers did not rely on feedback in deciding their next course of action. They just need to use their own discretion, such as when to use computers and the LCD and why they did not use them at the early stage of the year.

CONCLUSION AND IMPLICATIONS

Reflective practice is important in the development of all professionals, because it enables them to learn from experience. Although experiential learning is crucial in life (Warwick, 2007) we cannot quantify how much experience is enough, and it does not guarantee that more learning has taken place. Reflective teaching helps teachers in many different ways. Teachers would be able to recognise their individual progress, value on-going student achievements, significantly increase students' motivation for learning, enhance and develop forms of collaborative learning, increase learner independence, and subsequently enhance confidence. For the experienced teachers in this study, it seems that reflective practice has become a habit that they were sometimes not even aware of. The primary benefit of reflective practice for teachers is a deeper understanding of their students, their own teaching style and, ultimately, greater effectiveness as a teacher. In fact, students were the main factor contributing towards the need for these teachers to reflect on their practices. The overall implication for this study is that reflective practices among the mathematics teachers significantly developed their professional practices as teachers.

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