Teachers' perceptions of teaching mathematics at the senior secondary level in Fiji

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Mathematics teaching has undergone many reforms in recent decades. Much of the reforms have originated as a result of advancements in the fields of cognitive psychology, mathematics, and mathematics education (Raizen, 1997; Begg, 2003; NCTM, 2000). The changes have been particularly significant in the areas of mathematical curricula and instructional strategies, including the use of technology in teaching and learning mathematics. The above mentioned changes have led mathematics educators to re-look at the overall goals of mathematics teaching with particular emphasis to active student involvement in an enquiry-based learning as opposed to the expository style of teaching used traditionally. These innovations have led to newer and more challenging roles of the mathematics teacher.

Thompson (1992) argued that it is important to study teacher beliefs and perceptions because teachers' frequently treated their beliefs and perceptions as their knowledge and that teachers' beliefs and perceptions had an impact on their experiences and practices in the classrooms. In recent times, there has been considerable interest shown in the affective domain of mathematics education with research findings pointing out that affective variables have profound impact on classroom practices of mathematics teachers (Grootenboer, 2006; Prescott & Cavanagh, 2006; Boz, 2008). In other words, teachers' conceptions of mathematics and mathematics teaching are greatly influenced by teachers' personal experiences from the classrooms (Thompson, 1984; Ballati & Rigano, 2011).

The purpose of this study was to explore and understand the personal experiences of the senior secondary mathematics teachers regarding teaching mathematics, with particular emphasis on the challenges which teachers perceive as influencing their instructional behavior. The following research questions guided this study:

1. What do Fijian mathematics teachers like most about teaching forms five and six?
2. What major teaching-related challenges do mathematics teachers face in teaching form five and six mathematics?

This study will add to our current understanding of teacher behavior given the lack of related research in the context of a small, developing island nation in the Pacific. Such an understanding is important because mathematics teachers' experiences will tell us what works and what may not work in the reality of classroom teaching.

Secondary Mathematics Education in Fiji

Fiji has a well established education system, beginning from pre-school up to tertiary level. There are 175 secondary schools in Fiji which generally cater for Year 9 (form 3) to Year 13 (form 7). Year 7 and Year 8 are either last two years of primary school or the first two years of secondary school. With this variation, some secondary schools offer five years of education while others offer seven years of education.

The mathematics curriculum

The mathematics curriculum in the pre- 1970's was dominated by arithmetic. The main contents included numbers, calculations with numbers, fractions and decimals, time and linear measure, money, ratio, proportions, averages and percentages. Changes were recommended by the 1969 Royal Commision Report in 1969 and this saw a special unit called Curriculum Development Unit (CDU) established within the Ministry of Education in 1968. In 1970, the United Nations Development Programme (UNDP) initiated curriculum review began. This review was confined to forms 1 to 4 (year 7 to year 10). By 1984, this review was completed. However, there have been no significant changes to the curriculum since then.

Upper secondary Mathematics

For form 5, 6 and later form 7, the mathematics curriculum was New Zealand based, beginning 1968, replacing the old UK curriculum, the Senior Cambridge. New Zealand School Certificate (NZSC) examination was taken at the end of Form 5, with New Zealand University Entrance (NZUE) examination at the end of Form 6. Later, the NZSC and NZUE were revised to make available a South Pacific option for the South Pacific schools. In 1987, move was made to abolish the examination at form 5 level and replace the NZUE with a locally prepared examination called Fiji School Leaving Certificate (FSLC) .The year 1989 saw the first group of students sit the FSLC. Apart from the examination, Fiji retained most of the New Zealand mathematics content for its upper secondary school.

In 1988, Ministry of Education produced a mathematics prescription for Forms 5 and 6. The major topics that form part of the Fiji School Leaving Certificate Examination mathematics syllabus for Year 11(form 5) and Year 12 (form 6) level include: Basic Mathematics, Algebra, Functions & Graphs, Coordinate Geometry, Trigonometry, Calculus, Geometry, and Probability and Statistics. While the content to some extent may be similar to what is offered in other countries, the organization of the content sees some basics covered at form five while some, usually the difficult parts, left to be covered at the form six level. This means that all the topics which are covered at form five are also taught at form six, except for Calculus, which is covered fully at form six level. The organization of the content means that every student will go through the same content at form five and six, which will then be assessed through a common national examination at the end of the form six year. The way in which mathematics education for upper

secondary is organized and assessed is different, for example, from how the mathematics content may be organized in the Australian context.

National Examinations

At secondary level, there are national examinations at Form 6 (Fiji School Leaving Certificate) and Form7 (Fiji Seventh Form Examination). All the examinations are administered locally by the Examination Unit of the Ministry of Education. There is a strong emphasis on examinations in our education system. Examinations at all levels serve selection purposes and those who succeed continue to the next levels.

With the aim to reduce emphasis on written examinations, the Ministry of Education has recently introduced school-based assessments (Sharma 2000) or internal assessments (IA) at Form 3 and Form 4.

Mathematics Teachers in the Service

Mathematics teachers in Fiji are generally better qualified than many of their counterparts in the Pacific region. This is because the professional training and development of secondary teachers' in Fiji is done through both pre-service courses for those joining the service and in-service courses for those already in the teaching force.

In the year 2008, there were 765 secondary mathematics teachers'. There were 242 Fijian mathematics teachers', 500 Indian mathematics teachers' and 23 of other races. There were 478 male and 287 female mathematics teachers'. In general, the mathematics teacher population is dominated by males of Indian ethnicity. With regards to the educational qualifications of mathematics teachers, around fifty percent of mathematics teachers are university graduates and thirty percent of the teachers are diploma holders (Ministry of Education, 2008). These figures are likely to change in the near future as more females take up mathematics teaching courses at the University and more diploma holder's start taking up in-service courses at the universities.

Classroom practice in mathematics

Leung (2005) discussed characteristics of mathematics classrooms in Hong Kong and Japan based on the evidence from the 1999 TIMSS video study. The study recorded a superior performance of students from East Asian countries. The data showed East Asian classroom to be mostly dominated by teacher talk. This was true for other non-Asian countries as well, where teacher talk was considerably more than that of the students. Hong Kong teachers were recorded as the most talkative while Japanese teachers were least talkative.

Another important feature of classroom instruction was that East Asian countries learned more subject matter than other countries and more than 75% of lesson time was spent dealing with

new content. It was also revealed that lesson time was dominated by students working on mathematical problems. These problems took a long time to solve, involved more proof, and were often presented using mathematical language in contexts unrelated to the real life. In sum, the quality of instruction in East Asian countries was judged to be high. In Hong Kong, 30% of the lessons were judged to be of high quality, while only 5% of lessons in Australian & Netherlands were judged as high quality. In U.S., none of the lessons were judged to be of high quality. Leung (2005) concluded that despite the rhetoric of constructivism, meaningful learning can still take place even in a teacher-directed setting.

Kawanaka, Stigler, & Heibert (1999) studied mathematics classrooms in Germany, Japan and United States based on a TIMSS video. In the US, concepts and procedures were mostly simply stated and not developed. Students mostly practiced routine procedures and classroom discourse was dominated by the teacher where students mostly responded to questions in yes/no answers. In Japan, concepts and procedures were developed through examples, demonstrations and discussions and less time was spent by students on routine procedures. On the contrary, more time was spent on inventing new solutions or thinking about mathematical problems. The teachers asked more 'describe/explain' type questions. In German classrooms, concepts and procedures were developed but students practiced routine procedures. The classroom discourse was dominated by the teacher using more 'describe/explain' type questions. Stevenson (1999) also studied mathematics classrooms in Germany, Japan and the United States and noted similar observations.

Difficulties in Teaching Mathematics

Carr (1990) identified 16 challenges that mathematics teachers experienced in teaching mathematics in New Zealand. Some of the major challenges included: Insufficient time to devote to the preparation and teaching of mathematics; changes and initiatives from central authorities, for example, textbook or curriculum changes; children's negative attitude towards mathematics; need for more and better resources; and assessment and evaluation in mathematics.

In a study of science teaching in Fiji schools, Prasad (1996) identified many problems which included lack of resources including suitably qualified human resources; lack of motivation on the part of the teachers; examination driven teaching in schools and a lack of continuous assessment. Raj (1985) also carried out an investigation of mathematical abilities and attitudes in Fiji many years earlier. He argued that very few students made an effort to think their way through a problem and many showed reluctance to do much unless they were given precise step-by-step instructions to solve the problem. He believed that this was due to the apparent "spoon-feeding" techniques which many teachers were almost forced to use under pressure to complete the syllabus in the limited time available. Students were thus taught rigid methods by rote to solve well set questions. Little time, if any was afforded to the logical construction of the components required to solve a problem. This pattern, Raj noted was particularly common in the upper secondary schools where some observations indicated that the syllabus was overloaded with many new and complex concepts.

In another local study, Muralidhar (1989) said that many students found mathematics difficult. According to her, one of the reasons for this difficulty was due to the emphasis placed on traditional style of class-teaching where the teacher transmitted mathematical ideas to a class of more than forty students. All students were treated in exactly the same way irrespective of their learning styles. In such situations, she argued, many students would receive presentations inappropriate to their learning styles.

Muralidhar (1989) reported that many secondary school teachers thought that it was not worth spending too much time on using teaching aids or trying out any other new methods to make pupils understand. Many teachers believed that it was good if students were helped to master the skills required, as this would help produce better examination results because the school and the parents were only interested in the number of passes produced. Thus the popular method of teaching in an expository style was common due to the overcommittment to examination results.

Methodology

This study was carried out in two phases. The first phase used a researcher developed survey questionnaire to gather preliminary data. One hundred and eighty questionnaires were sent via mail to ninety schools throughout Fiji, representing two questionnaires per school. An attempt was made to cover the geographical spread of schools across the country. Out of this, eighty six questionnaires were received from forty three schools, representing a forty eight percent (48%) response rate. This was considered satisfactory result taking into consideration the scatter of schools over a wide geographical area and the remoteness of many of the schools.

The questionnaire asked teachers to indicate their confidence in teaching based on a three point scale: very confident (VC), fairly confident (FC), and not confident (NC). The questionnaire also included open ended items enquiring about interesting aspects of teaching mathematics and the challenges of teaching mathematics. Only those teaching forms 5 and 6 mathematics were asked to fill in one of the questionnaires while the Head of Department of each school was to fill the other questionnaire. It is a common practice in Fiji schools for Heads of Department to teach forms 5 and 6 mathematics. This study only included forms 5 and 6 teachers because these teachers are still working in an environment which is heavily influenced by the national examinations. Teachers in the lower forms no longer work under such situation because of the abolishment of the national examinations at form 4.

The second phase of this study was a follow up interview with a sample of 20 respondents from the greater Suva area. These teachers were chosen firstly because of convenience purpose as it would save travel time and other resources. Secondly, all these teachers had indicated in their survey questionnaire their willingness to be part of the second phase of the study. The third reason for choosing teachers from the urban centres was that these teachers work in similar working environment in terms of teaching classes with large number of students. The researcher used lead questions which focused on the good aspects of teaching mathematics and the

challenges of teaching mathematics to guide the interviews. Each interview lasted for approximately 20 minutes and was audio taped. The interviews were later transcribed and a largely qualitative data analysis was carried out.

Analysis and discussion

This section provides an analysis of questionnaire data and major findings from interviews. In this analysis, three major areas of interest will be perused in detail: Teaching experience and confidence levels; interesting aspects of teaching mathematics, and the major challenge of teaching mathematics.

Teaching Experience and Confidence Levels

Teachers' confidence in teaching mathematics was considered important because it measured the readiness and preparedness of teachers to teach mathematics at the two levels.

The majority of teachers (81 percent) indicated a very high level of confidence in teaching mathematics at Forms 5 and 6 and no one said they 'lacked confidence'. Only a small group of sixteen teachers (19 percent) said they were only 'fairly confident'. The sixteen teachers' in the latter category had less than ten years teaching experience at these levels. As to be expected, years of teaching experience was closely related to the teachers' levels of confidence. Close to half of the teachers (47%) in the sample had between five to ten years of teaching experience. An important observation is that the majority (85%) of teachers in this group had less than ten years teaching experience. Only 13 teachers, representing one-sixth of the sample had more than 10 years of teaching experience. As to be expected, all of this group were very confident about teaching mathematics at forms 5 and 6 levels. The second highest group of teachers (38%) had taught for less than five years while eleven teachers (33%) were only fairly confident about teaching mathematics at forms five and six levels. A low number of teachers' (15%) had taught for more than ten years and all of these teachers were very confident about teaching mathematics at the two levels.

Table below recorded the teachers' level of confidence between an interval of Very confident (VC) to Not confident (NC).

Table 5.3: Number of years of teaching and confidence level

Years of Teaching	**Number**	**Confidence levels**		
		VC	**FC**	**NC**
< 5years	33	22	11	0
5 – 10 years	40	35	5	0

> 10 years	13	13	0	0
TOTALS	**86**	**70**	**16**	**0**

Interesting aspects of teaching

When asked about the most interesting aspects of teaching forms five and six mathematics, most teachers pointed to "subject content" and the way topics flowed well from form five to form six level. The two most popular interesting aspects were: interesting content and maturity of students.

Interesting content

Many teachers said they liked teaching Form 5 and Form 6 mathematics because they liked the content. They pointed to the structure and organization of the curriculum. The way the mathematics syllabus flowed well from form five to form six made it easy to plan lessons and teach accordingly. The sequencing and overlap helped a lot.

> *There is a smooth transition from Form 5 maths to Form 6 maths. The only topic not covered in Form 5 is Calculus.* (Survey Questionnaire 1)

It is evident that the way the Fiji School Leaving Certificate syllabus is organized for the two levels helped teachers in their planning and teaching. The Fiji School Leaving Certificate syllabus comprises seven topics, six are first introduced at form three and then revisited and expanded every year after that. By the time students arrive at Form 5, they should have a good foundation for progressing further.

Maturity of students

Many teachers reportedly enjoyed teaching forms five and six mathematics because of the maturity of students in the higher forms. Form five and six students are senior students of the school averaging around 16-18 year old and there are normally higher expectations on them to perform well. They are older and more mature. Some sixth formers would be school prefects.

> *What I like about teaching Forms 5 and 6 mathematics is that students display more mature thinking* (Survey Questionnaire 79)
>
> *It is easier to get through to Forms 5 and 6 students then Forms 3 and 4 students.* (Survey Questionnaire 72)

Some teachers teaching form five and six would also teach lower forms. Most teachers preferred to teach the higher forms five and six mathematics rather than forms three and four. In the allocation of teachers to classes, the old practice was to put new teachers in the lower forms and senior experienced teachers at higher levels. There is now a trend to reverse that. The perception now is that new students entering secondary school at form three need greater expertise than the

older students in higher forms, so they would get the most experienced teachers. This can be a frightening experience for new teachers who will face senior forms in their first posting. Overall, many teachers' liked teaching mathematics at form five and six levels mainly because they liked the content of the curriculum. Others liked teaching mathematics at the two levels mainly because of students who showed more maturity.

The major challenge

Large class size and an examination-oriented curriculum have been identified as challenges. These though are common challenges across all disciplines. This section will attempt to identify challenges more specific to mathematics teaching alone. The most commonly identified challenge was students' dislike of mathematics and this is discussed in detail next.

Students dislike of mathematics

According to teachers, most students do not like mathematics and are afraid of the discipline. These feelings are attributed to varied reasons which include:

- students lack of basics
- students lack interest in mathematics
- preconceived idea that mathematics is too hard

Students lack basics

Nearly all the teachers had come across students who were weak in mathematics. Students had now reached higher levels still lacking understanding of mathematical basics such as number and shapes. They knew the rules and formulas but lacked understanding of why these worked. They knew mathematics as a subject. These students were difficult to handle and needed special attention and time.

The main factor in students' lacking basics was the examination-oriented nature of the school learning which required teachers to teach the prescribed syllabus in a given timeframe and prepare students to sit for the national examination at form six level. Teachers told of students who had progressed to the next level up even though their mathematics level was low. There were no provisions for meeting shortcomings on one level in the next levels up. There is a government policy that requires that all students receive the minimum education up to form six level.

> *The students in one form six are academically weak. They were the "C graders" from Form 4. I find that the stuff I taught yesterday, the students forget if asked today* (Interview D).

> *In this school, we accept students from everywhere. Even those who fail Class 8 or Form 4 are promoted and given the chance to move up the ladder. We don't get very good students and we don't expect a lot from them* (Interview C).

While teachers generally agreed that students who are mathematically weak could learn at a slower pace, the examination-oriented system did not allow teachers to teach at a slow pace. One teacher had this to say:

> *They will only learn if you are teaching at a slower rate but this cannot happen because we have to prepare them for exams. We have to cover the syllabus for the exams. If you are spending a lot of time in one topic you we won't be able to cover the syllabus* (Interview E).

Whatever plans teachers draw up are centred on the examinations. The sequencing of topics and time allowed for each topic very much reflect the focus of examinations.

Students low interest in mathematics

Apart from classifying a student as academically weak, teachers also spoke of the students' fear of and dislike of mathematics. To be academically weak and yet still have an interest to learn mathematics is rare. Many students find mathematics difficult because they are not able to relate to the things they are learning. They do not like it and do not want to learn it even though they know it is an important subject.

> *Students dislike maths. In our classrooms, I find some students who are just sitting there, having lost confidence already* (Interview F).

> *Nowadays, we see that students are not that keen to learn maths. They concentrate more on other subjects* (Interview O).

Muralidhar (1989) noted that too many students disliked the subject. One reason for this was that the students never quite understood the real meaning of mathematical concepts. Muralidhar argued that the cause of such a vague understanding of the subject was due to the whole system of class-lesson where the teacher transmitted mathematical ideas and all students in the class were treated in the same way. It was assumed that all students would follow the lesson at the same rate, had the same style of learning, and would be able to master the same skills using the same method at the same time. In another Fiji study, Raj (1985) noted that a high proportion of students both at form four and form six were worried about their progress in mathematics. A high proportion of students at both form four and form six levels enjoyed mathematics more in the lower forms 1, 2 and 3 but lost this at higher forms where mathematics was harder work. Raj blamed the way students were more often 'told' rather than taught. However the author acknowledged teachers' struggles with an over-full syllabus where little time was left to actually teach.

Preconceived ideas about mathematics

The teachers in the current study reported that many students found mathematics difficult. Students came to the mathematics classrooms with preconceived ideas that mathematics is a

difficult subject. Many students were forced to take mathematics because it was a compulsory subject. These views were presented by the two teachers:

> *I am bit unhappy when students see maths as a difficult subject. There is a stigma attached that maths is a difficult subject* (Interview G).

> *Students have that thing in mind that maths is difficult. It is very difficult to look for strategies as to change their mind. At form six level you cannot change things overnight because this fear has been planted in their minds for a number of years now* (Interview P).

Summary and recommendation

This study revealed that majority of the teachers are confident about teaching mathematics at form five and six level and many liked teaching mathematics at forms five and six level because the content was well organised and the students showed more maturity toward learning mathematics compared to lower forms.

The most common challenge identified by the respondents was that students did not like mathematics. According to the teachers, factors which led to students not liking the subject included: lack of basics of mathematics on the students part; lack of interest in mathematics; students having a pre-conceived idea that mathematics was too difficult.

Because each students knowledge of mathematics is uniquely personal (NCTM, 2000) the kind of teaching required is different from what many mathematics teachers themselves have experienced as students in mathematics classes. Since teachers require time to learn and develop new skills of teaching and in the process change their conceptions of mathematics and its teaching, it is recommended that appropriate and on-going professional development of mathematics teachers be conducted in order to change the mindset of teachers. According to NCTM (2000), teachers are the key figures in changing the ways in which mathematics is taught and learned in schools.

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