Teachers’ Impact on the Development of Student’s Domain Specific Self-schemas

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ABSTRACT

It has been shown that students’ subject-based self-schemas predicted students’ choice of goal orientations (Ng, 1997). A subsequent study showed that self-schemas were causally linked with how and why students learn mathematics (Ng, 1998b). This paper builds on the past research and investigates how students’ self-schemas can be changed. The interview findings with four year 10 students were reported. These students’ self-schemas in learning the subject changed when they encountered different teachers. They claimed that important teacher related variables like teacher-student relationship, instructional strategies, design of task and support for autonomy could lead them to take on a new understanding of their “selves” in relation to the subject. It is suggested, therefore, that self-schemas can be understood as a situation variable that can be malleable from an educational perspective.

INTRODUCTION

Motivation to learn can be understood conceptually as fixed and trait-like or alternatively as situational and dynamic (Brophy, 1987). These two different perspectives on motivation may induce not just a different understanding of why students learn, they also may influence how motivational problems should be dealt with effectively. When motivation is conceptualised as a personal trait, responsibility resides more on students than teachers to motivate effective learning. When students fail to learn, it is then their own crippling personal attributes that have caused the problem. That said, this belief that students’ motivation is fixed, may lead to a devaluation of the importance and effectiveness of teachers’ work and effective teaching in reviving students’ interest in school work, and at best, it may help frustrated teachers to feel more comfortable with their ‘failures’ in teaching ‘unmotivated students’.

In contrast when motivation is conceptualised as situational, it is in a dynamic and fluid form. All related variables within a learning situation will come into play to determine students’ motivational state. Motivation is not just a function of students’ internal attributes but a result of the interaction and the reciprocal influences among students and their teachers (Skinner & Belmont, 1993). This dynamic perspective of student motivation puts more control and responsibility on teachers. In this sense, teachers have the opportunity to organise learning procedures and content central to a learning situation in a manner that students will be able to learn with confidence and interest. More importantly, motivation conceptualised as situational denotes that it is malleable through various means and highlight the positive role that teachers can play in students’ engagement in learning activities.

This paper offers qualitative evidence that students’ motivation to learn is malleable by their teachers. It also sheds light on how students’ motivation to learn can be modified through rigorous and well-planned actions of thoughtful teachers.

THE SELF-SCHEMA CONCEPT AND RESEARCH

Motivation in this paper is investigated using the notion of self-schemas. Self-schema, a term coined by Hazel Markus (1977), refers to a cognitive generalisation of one’s self-knowledge in a specific domain from past experiences. Self-schemas serve as organisers that mediate and regulate behaviours. In addition, self-schemas also provide incentives, standards, plans, rules and scripts for behaviours (Alexander, 1997; Cross & Markus, 1994; Oyserman & Markus, 1993). It has been found that self-schemas had a bearing on information processing about the self (Markus, 1977), forming perceptions about others (Lewicki, 1984; Markus & Smith, 1981) and drawing inferences from ambiguous social information (Côtremble & Markus, 1987).

Garcia and Pintrich (1994) developed a theoretical model of self-schema in education. In their model, self-schema is a composite concept made up of four complementing dimensions, namely, affect, temporality,
importance and efficacy. The affect dimension denotes that people’s affective state is influenced by their current self-schema. The temporal dimension distinguishes between the past, present and future selves. The value dimension focuses on the centrality and importance of a self-schema in defining one’s identity or core conception. The efficacy dimension refers to the belief that one has the ability to attain, maintain or avoid a particular self-conception. They utilised this model to study a ‘good student’ versus a ‘bad student’ self-schema (Garcia & Pintrich, 1993). The findings showed that students who embraced a ‘good student’ self-schema were more likely to exert volitional control on their learning and usually had better school results. The reverse is true for the students having a ‘bad student’ self-schema.

Ng (1997, 1998a, 1998b) applied this conceptualisation and narrowed it to study how and why students learn mathematics. In a pilot study with an Australian sample, Ng (1997) explored the relationship among self-schemas, perceived teacher’s teaching goals, perceived relationship with teacher and goal orientations. It was found that self-schema outweighed the other two social variables in predicting students’ goal orientations. In particular, self-schema was the most important predictor for the mastery goal. Similar results were found in a subsequent study (Ng, 1998b). The findings of Australian studies were cross-culturally confirmed. In a subsequent study with a sample of students from Hong Kong (Ng, 1998b), it was found that self-schema was causally linked with how and why students learn mathematics. Positive self-schematicity in learning mathematics opened up two different learning paths. Positive schematic students either learnt with a mastery path, which was characterised by an emphasis on the goal of mastery and deep learning approach. They were also found to take up a performance path that composed of a performance goal and achieving approach. However, positive schematicity correlated much stronger with the mastery path than the alternative performance-achieving path. Students following either paths expected a good grade at the end of year. This is in contrast with students having negative self-schematic views. The latter group learnt with performance goal but a surface approach, which led them to a low expectation of their year end grades.

These empirical findings are consistent with the postulation that self-schema is causally tied to students’ goal orientations. However, path analyses based on correlations cannot provide conclusive evidence of causal relations. More conclusive evidence is provided by interviewing students about their experiences so that changes in various personal and situational factors can be simultaneously measured and contingencies identified. This paper grows out of the past research and investigates how students’ self-schemas have changed over time. An understanding of how self-schemas change will shed light on how teachers can modify teaching procedures and design meaningful tasks that help nurture positive self-schemas among students. This is especially significant for helping low achieving students rejuvenate their interest in learning a subject that they dread.

METHOD

The Interviewees

Twelve year ten students were selected for interviewing. These students were participants of a survey study and a classroom diary study completed earlier in 1998. They were selected on the basis of their scores on the self-schema construct in the survey. Teachers were consulted regarding the suitability of these students as interviewees. These students fell into three categories: positive self-schematic (N=6), negative self-schematic (N=3), and aschematic (N=3). They came from 3 different classes in two different high schools in the Metropolitan West Region of Brisbane.

The Interview Procedures

Students were interviewed three times either during the lunch break or during the mathematics lesson. Each interview took about 45 to 60 minutes. Consent forms were signed by their parents before these students were interviewed. The interviews were taped and transcribed subsequently.

The interview process followed the ethnographic interviewing strategy suggested by Spradley (1977). During the first interview students were asked to talk freely about their backgrounds and interest. Then they were asked to respond to some important descriptive questions related to their self-schemas. These questions included ‘what do you think of maths?’, ‘why do you learn maths?’, ‘what is a motivating maths lesson?’, ‘what is an unmotivating lesson?’, ‘what is a good or bad mathematics teacher?’, and ‘how do you learn mathematics?’.

Students were then encouraged to reflect on their past experiences. They were asked if they had the same perceptions about mathematics, the same set of reasons for and the same way of learning it in the past.

During the second interview, students were asked to confirm if they had given the correct information in the first interview. Several sets of cards which recorded students responses from the first interview were shown to the interviewees. They were asked to confirm if the information recorded represented their views. Contrasting questions (‘Is X different from Y?’) were asked so as to clarify the meanings of their responses, and more specifically, to identify the differences among similar responses. For example, contrasting questions in this study included: ‘Do you learn other subject in the same way?’ ‘Did you have the same set of learning reasons last year?’ In order to further understand students’ responses, the cards which recorded their responses were sorted into a few major themes like learning reasons, learning strategies, motivating lessons. Students were asked to sort the cards in the same theme into order and explained why they had sorted the cards in that way. Additional contrasting questions were asked.

During the third interview, students were asked to respond to a set of fabricated learning situations. They were then asked to explain why they had reacted in that way. They then ranked these situations and explained why they had ranked them in that specific order. Additional contrasting questions were asked to clarify the interviewees’ point of views.
THE RESULTS

For the purpose of this paper, interview data of those students who reported changes in their self-schemas in learning mathematics were selected. Only four of the twelve students reported significant shifts of their self-schemas. Of those four students, three came from a low achieving class and one came from a high achieving class in another school.

Description of the interviewees

Jack, Ben, Mick and Amy came from two different high schools in the Metropolitan West Region of Brisbane. Jack was from a high achieving class. The rest was from a low achieving class, in which they learnt mathematics through an special intervention programme.

Jack experienced a sharp break in learning mathematics in the first year of high school when he came across a good teacher. His experience of the subject in the primary school was not very encouraging though not totally negative.

Ben, Mick and Amy came from the same class. Amy held a negative self-schema in learning mathematics since primary school. As for Mick and Ben, they developed negative self-schematic views in learning the subject in their early high school years. However, after learning with an intervention program for a term in year 10, they reported great change in their understanding of the subject and their ways of learning changed (See table 1).

Table 1: Interviewees' self-schematic types over time

<table>
<thead>
<tr>
<th></th>
<th>Year 10 (1996; during interview)</th>
<th>Year 10 (1996; survey)</th>
<th>Year 8 &amp; 9 Primary School</th>
<th>Maths ability</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jack</td>
<td>positive schematic</td>
<td>positive schematic</td>
<td>positive schematic</td>
<td>negative</td>
<td>high ability</td>
</tr>
<tr>
<td>Ben</td>
<td>positive schematic</td>
<td>negative schematic</td>
<td>negative schematic</td>
<td>positive</td>
<td>low ability</td>
</tr>
<tr>
<td>Mick</td>
<td>positive schematic</td>
<td>negative schematic</td>
<td>negative schematic</td>
<td>positive</td>
<td>low ability</td>
</tr>
<tr>
<td>Amy</td>
<td>positive schematic</td>
<td>negative schematic</td>
<td>negative schematic</td>
<td>negative</td>
<td>low ability</td>
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</tbody>
</table>

Before the change: A negative self-schema

Before the schematic change, these students had a negative self-schema in learning mathematics. This negative self-schema was characterised by the following attributes, expressed as self-statements: 'mathematics was boring for me', 'mathematics was difficult for me', 'I didn't care about the grade I got in mathematics', 'mathematics was not important to me', and 'I didn't look forward to study more mathematics'.

Jack thought that mathematics was boring, which was related to the nature of the task he was given in primary school. He thought that mathematics homework was repetitive and boring, and he did not put effort into learning it. In addition, he did not care about his marks. Note how Jack attributed his negative self-schema to an external influence, the repetitive nature of the tasks in the following excerpts.

J (Jack): I thought maths was really boring. 'Cause it's always the basic calculation steps, subtraction, addition, multiplication and division. Yeah, it's very boring...And I didn't do my homework. I also didn't do any revision before the exam.

R (researcher): That means all through your primary school you're not really interested in maths.

J: Yes, not really interested in it.

R: And you didn't think that it's important.

J: Yes, not important...

R: Did you mind that you were getting a poor result in maths?

J: Maths?

Ben had a negative self-schema in learning mathematics, which had led him to perceive mathematics lesson as a torture. He was satisfied with a passing grade.

B (Ben): I hated it (maths)...he's (the maths teacher) like a guard. 'Here we go, back to the prison.'

R: Oh, No.

B: It's just like (being) locked up. You know. 'cause it's sort of like a torture chamber. And on weekend, like, everyone was like running to the door, trying to get out first.

R (researcher): Um, in year 9 I just hoped that I'd pass. Like I just hoped. I didn't care what I got as long as I passed. Yeah.

Mick explained that his negative self-schematic view in learning mathematics was related to his failures in understanding the mathematics lessons in year 8 and 9. This caused him to refrain from putting effort into learning the subject. Note how he rationalised his position in the following excerpts.

R: Did you work that hard when you were year 8 and year 9?

Mick: Year 8, year 9?

R: Yeah, did you work that hard?


R: So how did you learn (maths) in year 8 and year 9? Just tell me.

M: We didn't learn at all.

R: You didn't learn anything? So you don't...did you spend any time on maths like you do now?

M: No.

R: Um, like you just sit there and think, 'Oh, how much longer I have to do this?' 'Cuz when you don't understand something, you don't show any interest in it. You won't be interested in something you don't understand. Like if you didn't know how to use a computer, why would you be interested? You know. You'd hate doing it, 'cuz you don't understand how to do it. That sort of feeling. If you don't understand an area, you would find it boring 'cuz you don't know and you wouldn't know how to use it.
As for Amy, her negative self-schema was basically related to her lack of ability in doing mathematics. She did not have any successful experience in learning mathematics since primary school. 

A(Amy): I couldn't do maths in primary school.
R: was there any reason why you couldn't do it?
A: Um, I had to remember things.
R: You mean you had to remember the formula and rules.
A: yes. And I was not doing fine. They put me into a special class.

**After the change: A positive self-schema**

All the four interviewees experienced a change in their self-schemas. After the shift, they began to embrace a positive self-schema in learning mathematics, which is characterised by the following self-statements: 'I liked Maths', 'I could do maths', 'I was willing to put effort into it', 'I expected a high mark in it', 'I knew maths was important for me', and 'I could see myself doing maths related jobs in the future'.

Jack experienced a schematic change when he moved to high school. He no longer found the subject boring. Instead, he was interested in it and was willing to put effort and time into learning it. He also adopted deep learning strategies like reading additional books, preparation before lessons and doing extra exercises for studying mathematics.

"In the main, my interest in maths increased. Because when my interest increased, I would just try my best doing it."

"I no longer thought that maths was boring. I would take the initiative to read extra books in the library about maths... prepare for the coming lesson. Like reading over the chapter. And sometimes did some questions."

More importantly, he cared about his grade and intended to do well after failures. The following excerpt shows how he monitored his learning after failure.

"I started to worry about my mark. You would think like 'I failed this time, why was that? What has happened? Ah, it's because of this and that.' Then you would try to do well next time."

Increasingly, Jack realised the relevance of learning mathematics. To him, learning mathematics has become personally meaningful. It is then not surprising to find that he intended to build a career around mathematics.

"I once thought maths was just for calculating the change when you shop in a supermarket. And then I came to realise that maths is required in building a house, like how the light will go and where we should put a lamp. All requires maths. Everything needs maths."

"I planned to do jobs related to maths after that year... Yeah, related to maths. I at one stage wanted to be a maths teacher but later on I realised that it's not possible. I knew I wouldn't make a good teacher myself."

As for Ben, his direction of self-schema has been reversed after engaging in an intervention program. He was willing to put effort in learning mathematics and planned to get a higher grade. More importantly, he started to love the subject and understand the importance of it.

B: So I got about 2 or 3 modules to finish now. There are extra modules if you want to get a higher grade. So what I'm trying to do is to do all the homework. So all in holidays I'm gonna to take home a few modules, um and do a lot of work on the modules.

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B: I love it (maths).
R: you love it?
B: yeah. It's just the teacher made me (hate it) in grade 8 and grade 9... But now I just love it.

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B: Um, it's one of the most useful subjects. Every job needs maths. Like, to get a warrant... you have to do maths, you need to do all the measurement and do all the work in maths. Um, so it's probably one of the reasons why I'm putting all mine into school work now....

Similiar changes were found in Mick. Note how he explained that he had been persistently putting effort into the subject after engaging in the Intervention programme. In addition, he intended to keep this mode of learning for the next two school years. He also understood the practical importance of the subject.

"Everynight... I'm always doing maths. Like I won't have to do all the other subjects. But maths is just the thing I want to do. 'Cause I want to get through the modules. I just want to become used to it. So next year, every night, no matter if I get homework, I'll just get used to keep(ing) on. 'Cause it's the only way you can... you'll be able to... At least half an hour or an hour, just working through it."

"It's important. Mathematics involves about everything. Ratio... even a cook. Even a cook. You know you need to know how much to buy and things like that."

Amy also showed radical change in her way of learning mathematics. She aimed for a higher grade. Although she saw no reference of the subject to her future aspiration, she did not reject it straight away as she did in the past.

A: I like it (maths) better now. We don't do it...like a class. You can go as fast as you want to.

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A: If I don't need to do it (maths), I don't think I would. 'Cause for the future job, I don't think I need it very much.

R: Now, although you are 'forced' to do it, you start to like it better.

A: In the past... straight away I wouldn't worry doing it. Now, I think about it more, whether I need it or not.

R: Do you find it useful?
A: Some stuff, yes.

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A: I do try to get as good as I can. So start in next month I try to finish (the rest of the module) so I can get a C at the end of the year. And do the extra modules to get a B or an A. Yes, so I am trying to do as good as I can in that way."

**Reasons for the Change**

The interviewees provided various reasons for the changes of their self-schemas. These reasons were
broadly related to the effectiveness of teachers and their teaching in the formation and development of learning self-schemas. I classified the interviewees’ attributions for the change of their self-schemas into three teacher related variables, namely, the design of the task, instructional strategies and teacher-student relationship. In the following sections, I examine these three variables.

1. Design of the task

In the case of Jack, his first high school maths teacher designed challenging tasks that aroused his interest. It is important to note that challenging is defined in terms of students’ ability and understanding. To make a task challenging, it means that the task is within the reach of students’ ability; that is, it is not too difficult, and yet it requires students to expend effort to get it finished. The following excerpt vividly depicts what a challenging task should be.

Jack: They were not very difficult but they were not easy either. You just could manage to do them. But you wouldn’t think that they were easy. So, it’s just right. They made you put effort into them. And then you would get the answer. You would be very happy and then you’d want to move onto the next one. And it was designed like one after one. Only when you finished the first one that you’d know how to do the second one.

In addition, Jack’s teacher also designed tasks that suited students’ needs. She designed two sets of worksheets, one for the able group and one for the less able group. Worksheets for the able group involved basically word questions. While worksheets for the less able group were characterised by pictures and games which attracted Jack’s interest. It is important to note that Jack’s maths teacher offered the same instruction to both groups. The following excerpt shows how Jack thought about these two types of worksheets.

They were fun. I found the bright kids’ worksheets really boring. They were pages of words. Our worksheets got pictures, some questions and find a word (a game), I think they were really fun.

2. The intervention program

As for Mick, Ben and Amy, the intervention program helped them to reverse their negative self-schemas. The intervention program was actually a curriculum tailoring design. The teachers first trimmed off all the difficult concepts and tasks in the curriculum. The intervention program then divided the year 10 mathematics into 6 modules. The first four modules covered the basic concepts in mathematics and the last two covered the advanced topics in year 10 mathematics. Students were to finish the first four modules in order to get a pass in the subject. If students manage to advance to the fifth or the sixth module, they could get a B or an A accordingly. In addition, students did not have to sit for a centralised examination. Every student learnt at his or her own pace. Once students finished all the exercises in the module, they could ask for a test of that module. If they passed, they could advance to the next module. If they failed, they had to re-sit only the section(s) they have failed.

The module design motivated the students to learn. It was characterised by the following special features: encouraging mastery, self-paced learning and autonomy, achievable goals, non-evaluative. These attributes coincide with motivational principles advanced by educational researchers in achievement goal theory and self-determination theory. The following interview fragments of Ben, Mick, and Amy corroborate these motivational characteristics of this module based intervention programme.

Encouraging mastery

Ben: Yeah, I like it. Like, um, I find it easier to understand, I’ll be able to... like with the normal maths, um like I used to get straight ‘A’s in class. When it came to the test I got D. I found that doing that is hard. Now the module, it’s kind of like... gives you a few chances to pass. You don’t have to re-do the whole test. You only have to do the questions that you got wrong.

Autonomy

Mick: I find it easier now to get a higher mark. Because it’s like self-paced, it’s easier to understand, you got, um, different tests to do, finish the test get a um... satisfactory mark. And you’ll be able to pass that module and be able to get to next part. Work through it, pass the test and next one, that’s just like sections, like so it’s easier.

Self-paced

Mick: Before it’s like one week we do algebra, next week we do fraction, next week we do like it keeps changing. And then after a month you have to do algebra again, but you would have forgotten by then ‘cause you know everything keeps changing around. You become used to it. And then when it changes, well, it’s a bit difficult when they change it. ... The module, well, is self-paced

Less evaluative, less stressful

Mick: Instead of um, like you better study hard because the test is in two weeks. And then everyone gets worried. Because they’re not ready for it. They need more time to work. But with this, you can go through the module again and then do the test. Just to make sure.

Achievable target

Amy: I like it now ‘cause I can do it. I can do it in my own speed. And I can do it now. ‘cause you know when you finish all the four modules you’ll get a C. So if I pass, I can try to get the other two modules finished, which is good.

In addition, as the module mathematics is a student centred design, teachers do not need to teach a topic every lesson. Teachers become the tutors or facilitators of the class. They also offer individualised help for students who have problems, which students treasure very much.

Help available

Amy: Um, when he has to teach everyone, has to stop and talk to those who don’t understand. And that means, you have to wait. But now, you just go up and talk to him.
3. Instructional strategies

In addition to the design of task, Jack also attributed his change in self-schema to his teacher’s instructional strategies. Her instructional strategies focused on two principles: interest and mastery. In order to make a lesson interesting, she would incorporate materials from outside of the curriculum, skillfully ask questions that aroused students’ interest, design activities and games by which students could learn with fun, and provided feedback that encouraged mastery and effort. The following excerpts show these characteristics of her instructional strategies.

Novelty

she was not just teaching the textbook, she got things outside of the curriculum. And she would give us some interesting questions every now and then. So then we thought it was quite fun.

Teaching for understanding

For example, when she teaches us a theory, she would not just go through it with us. She would ask us to close our books after she had explained the theory. Then she would ask us questions. She would not just ask questions directly about the theory. Like A + B equals to or A square + B square equals to C square. She would not just ask in that way. She would go around to other things which are related to it. To see if we understand. See if we can build the link.

Activity based

And some times, the teacher....I thought it was really fun. She would give us a law, and divided the class into two sides; one was for, the other was against the law. Then we started debating why you agreed and disagreed. And through this, we learnt something new. She would do the conclusion at the end and she would also introduce another law. Then you learnt another law.

Student involvement

she made the class fun, like doing some measurement in the playground, how to arrange things in a better way. She would ask us like what were the downsides of doing something in a specific way. We would then argue over it, sort of like a debate

Constructive, mastery focused feedback

for example, like how much you have scored compared with the last exercise. Because we got the same amount of work in every exercise. So she would say how well you have done this time and compared to it with the last one, like you have done better or worse. And she would also comment if you had pay attention in the class. If you got some poor comments, you would just work harder next time. Just to show that you can do as well as other does.

Immediate feedback

J: She would return your work the next day.
R: She marked the work and returned it the next day?
J: Yes. 'cause we had two exercise books. When you hand in the first one, then you work on the second one, then you get the first one back and hand in the second one.

4. Teacher-students relationship

It is important that teachers keep good relationships with students. A good teacher-student relationship can be achieved by relaxing classroom rules and making jokes during the lesson. All interviewees quoted reasons related to this variable.

Jack: she wouldn’t behave like a strict teacher having a higher status. She would play with us, make jokes, that made us less nervous... Yeah, we had more fun with her. Other teachers were not bad, but they seldom played with us.

More importantly, to be approachable and be willing to offer genuine help are vital for nurturing a good teacher-student relationship.

Ben: Um....I don’t know I just got on well with him (the teacher)....If you don’t understand it, he’ll run it through which is...so that you can understand it. Then he’ll give you an example. And then he’ll just keep talking until you get it. So I just really appreciate him in that way.

Mick: If we are struggling we just go and ask him if he can help us, and he will.

DISCUSSION

The primary purpose of this paper was to understand how students’ motivation, conceptualised as self-schemas, could be changed. The interviews of these selected group of students showed that self-schemas were malleable. More specifically, it is through building a caring relationship with the teacher, the design of task, and special instructional strategies that teachers were able to change students’ self-schemas (e.g. Brophy, 1987; Newby, 1991; Pintrich & Schunk, 1996). These effective teaching practices actually provided students with a new set of experiences and memories that contrasted with their previous histories of learning mathematics. These experiences addressed two specific dimensions of the self-schema framework, namely, affect and efficacy. For example, Jack found his teacher fun and her teaching was characterised by interesting tasks. These would certainly provide Jack with a new set of experiences contradicting his past encounters with mathematics which he saw as a boring experience. As for Ben, Mick and Amy, the module design addressed their lack of success. The module provided abundant opportunities for students to be successful with effort. It is through personal mastery and effort that they achieved a sense of efficacy.

However, it seems that the other two dimensions, importance and future selves, were less available for modification by teachers even with all these effective teaching strategies. It may be possible that interest and efficacy are the stepping stones in forming positive self-schemas. Once students have accumulated sufficient learning experiences characterised by interest and efficacy, then the other two dimensions might eventually develop. This can be corroborated from the experiences of the interviewees. Jack with abundant fun and successful experiences in learning mathematics showed greater internalisation of the mathematic learning self. He would say ‘I intend to do
jobs related to maths'. Whereas, Mick, Ben and Amy although they recognised the importance of the subject or knowledge, their recognition remained less personal. This can be explained by their limited positive experiences in learning mathematics since they were put into the intervention programme for only one semester.

It is important for teachers, therefore, to locate which dimension(s), students tend more likely to rely on for processing information or experiences related to learning. It is probable that certain student may rely on one of the schematic dimensions to make a decision related to how and why he or she learn a subject while other rely on several of them. For example, Amy when describing her negative self-schema in learning mathematics has concentrated on the ability dimension, while Jack talked about all dimensions described in Garcia and Pintrich's framework. Future research is needed to assess the relative importance of the various dimensions in affecting students' learning engagement. 'Efficacy' and 'affect' may be associated more with an immediate task while 'importance' and 'future selves' may be re-cast as more global constructs influencing learning in a more general sense.

Another issue is related to the theoretical understanding of self-schematic change. What does it mean to have a change in one's self-schema? At face values, it seems the four students changed their self-schemas, but were these changes stable or transitory? A permanent change in self-schema can be understood as a departure from the past schematicity in term of its direction and content, which enables one to drop his or her old way of perceiving and understanding and taking up a new one. In other words, a permanent change in self-schema means a redefinition of one's 'self' in terms of the new experiences. For example, in Jack's case, we can be sure that he has developed a relatively stable new self. This can be verified as Jack maintained a strong positive self-schema despite having a bad mathematics teacher in the second year of his high school.

A temporal change in self-schema means that there is no fundamental reversion of the self. Students with temporal change will probably slip back to the old self once the favourable conditions or experiences are removed or replaced by unfavourable or negative experiences. This may be the case for Mick, Ben and Amy. It is still early days to ascertain if the intervention may have lasting effects on their selves. We can only be sure that under the new instruction procedures, these students were given a chance to reassess their understanding of the subject and it relation to their own selves. The jury is still out concerning the longer term change in their self-schemas. However, with persistent effort in providing these experiences, a temporal change in self-schema could eventually be turned into a more stable one.

Two other important issues have arisen with regard to the results of this study. First, the importance of the teacher and teaching in modifying students' motivation to learn. The interview data showed that the teachers and their teaching could make a tremendous impact on students' learning and motivation. Under the right learning environment, students will be able to learn with confidence and interest. However, considerable time and effort are required of teachers in order to set the right learning environment for students. More importantly, teachers have to believe that students are capable of learning despite their initial low level of interest. Without such a belief and commitment, teachers may need to rely on less effective strategies such as extrinsic reinforcers, punishment and reward (Newby, 1991). In contrast, intervention programmes that build upon these strategies suggested in this study (e.g. Stipek, Givvin, Salmon & MacGyver, 1998) showed significant effects on improving students' motivation in learning mathematics. More recently, Midgley and Edelin (1998) reported that more stringent efforts were still needed from teachers, school administrators and policy makers in order to turn school and classroom learning environments more to the needs of the middle grade students. And good news have been recorded from those schools in which reform efforts have been made to develop a mastery learning environment.

The second issue is related to how motivation should be conceptualised. Although we have got no explicit information about how the teachers of these interviewees thought of motivation, given their effort and commitment in designing the tasks, writing up the intervention program to address the needs of their students, it can be deduced that they took responsibility and commitment in motivating their students to learn. Such persistent and thoughtful actions may probably be related to their belief that motivation is dynamic and situational. If these teachers had considered motivation to learn as a fixed entity internal to students, they might probably have embarked on an alternative course of action to deal with their students' motivational and learning problems, which might include sending students to special remedial classes, tracking them into a low ability stream, lowering expectations for them. In this way, students would take the blame for their failures and low motivation. It is more desirable, therefore, for teachers to perceive motivation to learn as a situational phenomenon and to assume responsibility to help students learn with confidence and interest.

To conclude, students' motivation to learn, conceptualised as self-schemas, can be modified effectively by teachers who provide students with positive learning experiences through designing meaningful tasks that are challenging and interesting, employing effective instructional strategies and maintaining a good relationship with students. These positive experiences address directly the efficacy and affective dimensions of students' self-schemas in learning mathematics. However, it is important to note that such a change in self-schematicity can only be sustained through persistent and consistent efforts of teachers who believe that students' motivation to learn is not fixed but depends more on the reciprocal influence among teachers and students in a learning situation. Otherwise, the self-schematic change may be temporal and students may slip back to the old crippling 'selves' when the external favourable conditions are removed.
REFERENCES


