

There is More to Learning Mathematics than Mathematics: Attributional Beliefs and Motivation of Maori and Pacific Island Students

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Students' attributional beliefs about the causes of their success and failure can have a substantial impact on their motivation in mathematics. In this paper I present data from a group of Maori and Pacific Island students who were chosen to participate in a summer scholarship offered by the Department of Mathematics. Students' enjoyment of being part of a bigger group and their appreciation of the well-structured support was evident. The analysis shows that for these students the encouragement from external sources was a major motivational factor. The weak link on their motivation is the intrinsic motivation.

At every level of the education system Maori and Pacific Island students achieve considerably less than students from other ethnic groups (Clark, 1994). The falling number of minority students from lower socio-economic backgrounds participating in tertiary education have been highlighted in the literature and has created much concern (Coxon, Anae, Mara, Wendt-Samu, & Finau, 2002; Pasikale, 1996). This is old news to us now, but what is less well known is how students' and parents beliefs about causes and the nature of school achievement may, at a subtle and general level, contribute to the problem. Uttal (1996) reminds us that the differences in achievement levels must be considered from a perspective that emphasizes the values that underlie education. He claimed that student's motivation to work hard and perform well is determined in part by culturally based beliefs about influences on performance and the value of effort. In a case study conducted last year (Latu, 2003), I explored the ways Pacific Islands learners' motivation is shaped by their culture. It revealed that culture is vital for students' achievement motivation and their expectations for future success. The value that they attached to their success determines how much effort they put into their study. They were given strong support from home but their expectations and values were different from that of the school and educators.

Because Maori and Pacific Islands students are under-represented at our mathematics courses, the University of Auckland's Science Faculty, as part of their equal opportunity provision for these students, have offered the "Aldis Scholarship" for school leavers from low decile schools. Students are required to take "Introduction to Calculus" (Maths 102) over six weeks of the summer period. On top of the normal two hours lecture a day plus collaborative tutorials, they are also given extra tutorials by the Maori and Pacific Island support tutors. Extra one-on-one tuition in the Maori and Pacific Islands "Tuakana Room" are also given by support tutors who have done the course before. The Aldis Scholarship scheme has run successfully for the last three years. In our experience these students have tended to credit their success to more freedom, good support, intense focus, and being part of a bigger group. Success in this context refers to continued high pass in final examinations.

This research aims to investigate these Maori and Pacific Island students' attributions for success and failure, and how these factors influence their behaviour and motivation to learn mathematics. An understanding of these students' attributional beliefs helps us to identify strategies that can be used to improve our services and help these students succeed

and gain confidence. It also helps us to understand students' lack of effort and how to address it.

We will focus on how students' motivation to learn mathematics can result from their attributional beliefs using Weiner's (1985) attribution theory. A theoretical background is provided with a review of literature on students' attributional beliefs and motivation. Research data from questionnaires and interviews are summarised and presented.

Theoretical Background

Students' Attributional Belief

Attribution theory is concerned with how individuals interpret events and how this relates to their thinking and behaviour (Weiner, 1985). It assumes that people attribute causes to behaviour. Weiner's theory of attributions has provided us with the theoretical framework for this study. According to his conceptualisation, causal factors accounting for one's success or failure can be classified along three dimensions:

- ☐ Locus of control (external versus internal);
- ☐ Stability (stable versus unstable);
- ☐ Controllability (controllable versus uncontrollable).

These causal dimensions have psychological force influencing expectancy for success and actual behaviour. Weiner (1985) has shown that the stability dimension is most closely related to expectancy for success. Esteem related affects are related to the locus dimension, and social related affects are related to the controllability dimensions. Weiner also discussed how attributions are systematically related to different kinds of subsequent behaviour and related it to the source of our feeling good, bad, or indifferent after we succeed or fail. He noted how attributions have affective consequences. Because our attributions influence both our subsequent behaviour and our feelings, we need to study them more closely.

Those who generally attribute their success or failure to their own behaviour are said to have an internal locus of control. Those who generally attribute their success or failure to luck or task difficulty are said to have an external locus of control. With respect to student performance, students who attribute their achievement to internal, unstable and controllable factors may think that their own contribution may be effective in improving their future expectation and performance. On the other hand, if students attribute their performance to external, unstable and uncontrollable cause, then their expectations for a successful education intervention may be minimal.

Attributions are the causes perceived by the individual, and may not be the actual causes. Pintrich and Schunk (2002) raised their concern about the accuracy of individual's attributions, but concluded that, from a motivational perspective, the accuracy of an attribution is not important in order for an attribution to have behavioural consequences.

Students' Motivation

In cognitive theory, motivation serves to create intentions and goal seeking acts (Ames, 1989). Motivation is a pivotal concept in most theories of learning (Weiner, 1990). It is what makes students engage with different tasks and put more effort into understanding tasks and the ideas in them. Having a strong will to pursue a particular course calls for a strong reason as to why a student would spend time and effort on it (Covington, 1998). Achievement motivation in particular is highly relevant to learning. Motivation to achieve

is a function of the individual's desire for success, expectancy of success, and the incentives provided (Dornyei, 2001). Keller (1983), presents a strategy that encompasses four components of motivation: arousing interest, creating relevance, developing an expectancy of success, and producing satisfaction through intrinsic/extrinsic rewards.

The assumption that is made here is that motivation is a cognitive activity and that students make specific choices about how and when they apply effort to learn. These choices are based on students' beliefs that mediate action (Covington, 1998). Belief in this context is something that a student knows or feels that affect effort to learn and that individuals only put forth effort when they perceive that the effort will result in fulfillment of their personal goals (Weiner, 1990). Deci and Ryan (1987), classified motivation into two classes, intrinsic and extrinsic. An extrinsic orientation is demonstrated when a student increases motivation and effort in order to obtain a desired item. In such a case, the task comes to be viewed as a means to gain the object that is wanted. Such tasks include activities undertaken to demonstrate one's abilities and competence relative to those of others. From an intrinsic orientation, participation in the task is the desired end. Participants invest effort because of the challenge that the task presents or because participation supplies feeling of competence, mastery, control, or self-determination.

Students' attribution patterns, and their achievement motivation, can be modified (Weiner, 1985; Uttal, 1996). The kinds of goals that need to be fostered as educators are intrinsic in nature, that is, they involve the desire to become more effective as a person or to perform actions for their own sake. According to Weiner (1990), high achievers will approach rather than avoid tasks related to succeeding. They believe success is due to high ability and effort and are confident they possess them. On the other hand, low achievers avoid success related chores because they tend to doubt their ability.

On a comparative study of American students with Asian students Uttal (1996) found an interesting difference between the perceptions of students from these countries towards their abilities in mathematics. He described how Americans may prefer to be satisfied with mediocre work than to think of their children as lacking in ability. Alderman (1999), stated that self perceptions of ability in mathematics seem particularly important for understanding student motivation in mathematics. He continued to claim that when an individual believes that ability is fixed and that he or she does not have a lot of ability, motivation and performance are negatively affected.

The Study

Twenty-four students were awarded Aldis Scholarships in 2004. Twenty of these students were from low socio-economic schools in the Manukau region. Students were chosen for the Aldis Scholarship based on their performance on their school internal exam results and their mathematics teachers' recommendation. This group was chosen for the scholarship because they were the most successful Pacific Island students in mathematics.

Because the study seeks to understand students' attributional belief from the students' point of view, open-ended responses were sought. A naturalistic paradigm with qualitative instruments was used. A questionnaire was designed with twenty-one questions to assess students' attributional belief and motivation. All but three students completed the questionnaire. Thus twenty-one students completed the questionnaire.

An interview protocol was developed to gather descriptive data in the subject's own words. Four students agreed to be interviewed. Two were high and two were low achievers in the course. The interview was semi-structured and took thirty minutes. Open-ended questions were used allowing flexibility to follow up and probe further using additional

non-script questions if necessary. With the permission of each student, the interviews were audio-taped. The four students are given pseudonyms as Student A, B, C, and D.

Results and discussion

Common themes that emerged from students' responses to the questionnaire and the interview that primarily related to students' attributional belief and motivations were as follows (none of the themes applied to every student):

- ☐ Group-work and tutorials;
- ☐ The "Tuakana" support program;
- ☐ More freedom, more time to focus and conceptual understanding;
- ☐ Students' effort, ability and time management.

Group-Work and Tutorials

The first three questions in the survey questionnaire were aimed at students' enjoyment of the course. All but one of the students reported enjoying the course, and the features most frequently noted as enjoyable were group work and tutorials.

Table 1

Sample of Students' Answers to Question 2

Question : What are the features of the course that you enjoy the most?	
Working together in a group	Working in groups and being independent
Working together with other students	The tutorials where we can help each other
The collaborative tutorials	I enjoy the tutorials in the group of 3 people

This confirms Oates (1999) finding that students feel that collaborative tutorials are beneficial to their mathematical understanding. Morton and Oates (1998) commented that students are often able to explain ideas to one another using an informal language which is readily understood by their peers. This study confirms these results for this ethnic group.

However, it may be also argued that working in co-operative groups is more beneficial for the Maori and Pacific Island students from a motivational perspective. In a cooperative-learning structure students usually work in small groups for group rewards and it seems to be a key factor in the success of cooperative structures (Slavin, 1990). The effect of failure is moderated and can be externalised by students as a group responsibility and low ability students can be part of a successful cooperative group.

From our experience these students often come from schools that have very few students in their senior mathematics classes. When students were asked what aspect of the course they enjoyed the most, they all attributed their enjoyment to being able to work with other students and being part of a bigger group. Two students' responses were:

Interviewer : What aspect of the course have you enjoyed for the last five weeks?.

Student B : I just like the silence and working with the other guys...and stuff...that was good...and getting help from you guys.

Interviewer : You said you worked together with other students?

Student B : Ohhh...yeah....not only the guys in the course but some of the old students that have been here before. ...like first year students from last year coming back here to do summer school.

Student Support and the “Tuakana” Program

When students were asked about the support they preferred, nineteen students referred to the extra tutorials and one-on-one help that was provided from the “Tuakana” room and the staff in general. Samples of students’ responds are summarised on Table 2 below.

Table 2

Samples of students’ answer for Question 5

Question : What support do you enjoy the most in the mathematics department?.	
Extra tutorials on different topics	Tutorials, extra help
The support of staff willing to help.	The support from lecturers and tutors, especially support from previous students
One-on-one help from older students	The huge amount of support from the staff as well as older students with any problems we have
Peers and tutors also from past students	Tutors offering assistance with assignment, and other exercises
Having weekly meetings and being there whenever you need help	

Hardre and Reeve (2003), in their comparative study of rural and urban students, found that one important role teachers play in helping students develop internal motivational resources is the provision of a classroom that supports and nurtures students’ needs for self-determination and competence. Competence represents the need for seeking out optional challenges and for perceiving oneself as being efficient; self determination represents the need to experience choice in the initiation and regulation of one’s behaviour such that student’s choices rather than environmental events determine his or her actions (Deci & Ryan, 1987). Thus educational environments need to find ways to support students’ needs for competence and self-determination. Students’ responses to some interview questions are provided below to support the validity of these arguments.

Interviewer : How important is it ... to have the [Tuakana] support?

Student B : Really important I reckon...student might go and see the internet and stuff, but its just like black and white board where as you get the help here...you get this and that...you see different aspect of things.

Interviewer : If we stop [the Tuakana] program what impact would it have on future students?.

Student B : Huge impact really... So I reckon it is important that we have this group and the support that we have now.

Interviewer : From what you have done in Maths 102. How confident are you with your maths?.

Student B : Pretty much went into the confident booster really. Last year I would sit in the maths class and not ask most of the time. ...but now I can just ask anyone.

Students were asked whether they will do more mathematics courses after taking Maths 102. Seventeen answered “Yes”. The interview responses confirmed one of the purposes of the Tuakana program, that is to build perceptions of self determination that support their engagement and persistence in academic task. Hardre and Reeve (2003) argued that the more supportive teachers are, the more positive will be students’ perception of self-determination and competence. They continued to say that the levels of motivation and perceived competence predict their behavioural intentions to continue their courses of study. Student A illustrates how important these supports are for these students.

Interviewer: If you would choose to do a degree in Math’s. Do you think you can do it?.

Student A: Probably ...If we still had help from here and stuff...then I think I could do it.

Freedom, More Time to Focus and Conceptual Understanding

The data confirm previous students' comments with respect to the differences between the school and university environment. They have more freedom at university to explore and to think about their mathematics.

Interviewer: What do you think the most difference between the maths at school and the university?

Student A: At school you got someone on your case all the time. Not like here you have to do it for yourself because no one cares if you fail. So it just up to you...and you have a lot more freedom here and there is a lot more help here than it was at school.

Student B: Completely different ...I mean its more ...there is more freedom to it here then there was at school. School is pretty much restricted about the subject where as this...like you...express freely. You get different point of view... where as you don't have one direct point of view from the teacher. It's directed from everyone around you and the lecturer himself.

Students were exposed to predominantly routine tasks in their mathematics education at school. It became apparent from the interviews that this had an impact on the students' attitudes and motivation in their university course. From a motivational perspective, the students' belief that the teacher should explain everything, and that mathematics learning involves procedures and memorization, can cause conflict and lack of student effort. The Maths 102 course encourages students to take an active role in their learning.

Interviewer: Now can you make a comment about the difference between the university environment and the school environment?

Student C: Oh...ha... at school they teach the short cut way of teaching the subject rather than coming to the university the lecturer elaborates hard out on... the subject... like he takes the long way to get there but at school you just get there... they give you an example on how to get there.

Interviewer: What method do you enjoy?

Student C: I enjoy the getting there... straight away... the school method. But its good... so ... you get the background of how you get the stuff because it helps you understand more... and yeah... but I think I just prefer to just learn it the short way.

Interviewer: Do you think you understand it that way ... when you just learn like the school way?

Student C: nah... I don't ... I don't know ... like at school I just look at the example... see how they did it and I just apply what they did to the problems that I have rather than if you understand it you can just have it all in your head and it's settle... like... thinking of those example you can just apply the knowledge that you have ...yeah... I think that would be easier.

Students' Effort, Ability, and Time Management Problems.

Weiner (1990) focused his attribution theory on achievement. He found that students with higher ratings of self-esteem and with higher school achievement tend to attribute success to internal, stable, uncontrollable factors such as ability, while they attribute failure to either internal, unstable, controllable factors like effort, or external, uncontrollable factors such as task difficulty. A great majority of students attributed their success to their effort and their failure to their lack of effort. Nineteen students answered "Yes" when asked if they felt that they could do better.

Students' overall responses to the survey questionnaire show a very strong sense of an external locus for their encouragement and motivation. The weak link in these students' motivation is the intrinsic motivation. Students who are high and consistent in "externality" lack the beliefs that make them take responsibility for their academic performance (Uttal, 1996). Therefore, their level of motivation to achieve in academic tasks may seem low. The response of the lowest achiever among the students who were interviewed confirms this:

Interviewer : From what you have learnt so far in the course, how confident are you in your maths?.

Student D : Ahh...not that confident... ahh...you have to put in a lot more work

Student C revealed how she was the only one who passed Bursary from the school she went to. She offered these comments:

Interviewer: Were [the students in your class last year] all motivated and worked hard?

Student C: No ! No! ...Everyone fail bursary except for me.

Interviewer: That's interesting...Did you have much support over there like you have got in here?.

Student C: Similar but you have more here.

Interviewer: What do you think made the other students fail?

Student A: They didn't care...

Interviewer: Was there help available?

Student A: Yeah ... But they didn't go to it.

Interviewer: Were the teachers good?. ...

Student A: Yeah ...the teachers were good...like if I have a problem I would go and ask but if they had they wouldn't go and ask. They just didn't want to take up their time with math's when they didn't have to...they failon all their subject not just math's.

Students who believe they have low ability are often less willing to try than those who know that they can learn (Weiner, 1990).

Conclusion

As well as confirming previous students' attributional beliefs and how more freedom and good support has contributed to the success of the majority of this group, the study reveals other interesting aspects of students' weaknesses that need to be addressed. Students' attributions of behaviour to external factors may be related to their subsequent expectations for control. As suggested by Mavropoupou and Padeliaadu (2002), causal attributions not only describe beliefs that explain human action, but they can promote certain levels of control and motivation in individuals as well.

There is a lack of determination and desire to be competent that was hard to find the cause of in this study. However, their lack of effort has a strong link with their level of satisfaction. The interviews revealed that these students, even those of lower ability, were satisfied with their performance. This is surprising given the low performance of most of the group on their term test. Future research should include a measure of perceived competence or ability that is vital for building students' confidence and determination.

Increasing student's interest in mathematics may result in higher quality experiences while doing mathematics and higher achievement. Thus, educators should focus more strongly on facilitating interest. Students highlighted the need for a supportive environment at their school that is similar to the "Tuakana" program. Most students commented that there was a lot more help at the university than there was at their schools. The six week period is a short time for the support offered to have a great impact on students' motivation, particularly for those who are not carrying on with other mathematics courses and hence do not have a chance to continue to be part of our mentoring system.

Students' responses confirm the reasons for the establishment of the "Tuakana" mentoring group. Students need a program that is aligned with their cultural background and a supportive environment that fosters their interest in mathematics. Further research needs to be done on a mechanism for developing intrinsic motivation of Maori and Pacific Island students. This research suggests that a good place to start is by analysing the nature of support networks and aligning these with the students' cultural background.

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