What They Say, What They Do
Understanding Student’s Perceptions

AUTHOR

Pamela Perger
The University of Auckland
Auckland
New Zealand

p.perger@auckland.ac.nz

BIO NOTES

Pamela Perger
Lectures in Mathematics Education in the Faculty of Education, The University of Auckland.
Research interests: Student perceptions of learning, and the use of children’s literature in the teaching and learning of mathematics.

KEY WORDS

Student perceptions, mathematics,
Research has shown students can identify practices considered appropriate for achieving when learning mathematics (Kershner & Pointon, 2000; McCullum, Hargreaves & Gripps, 2000). Yet, if you listen to students talking about the practices they consider important to succeed, and then observe the same students working in their mathematics class, you could be confused regarding what practices they really believe essential. As Argyris and Schon (1974) noted, an individual’s espoused theory (what is said) does not necessarily match their theory-in-use (what is done). Further investigation into students’ beliefs and actions are required to explain the difference between what they say and what they do. This article presents the espoused theory, theory-in-use and the follow-up discussion of three underachieving students where the identified differences were explored.

The number of New Zealand students underachieving in mathematics has long been a concern. Looking for reasons for either achievement or non-achievement is complex as many influences impact on any one individual (Donahue & Wong, 1997; Lee, 2002). Alongside studies that focus on teacher knowledge, teacher actions and policy-level changes, there needs to be a deeper understanding of student perspectives. As students are the major stakeholders in the learning process, to understand their learning experience, it is essential that their perceptions are considered (Anthony & Walshaw, 2009; Bishop, 2003, Forman & Ansell, 2001; McCullum et al., 2000).

The implementation of the New Zealand Numeracy Development Project (NDP) (Ministry of Education, 2010) provided professional development for teachers. This professional development focused on changing the teaching and learning of mathematics from a teacher dominated approach to one that focused on students developing strategies and understanding in the area of number. Students were seen as active participants in the learning process. Listening to others, sharing and justifying strategies, and working together were practices promoted during teacher professional development sessions. Yet Anthony and Walshaw (2009) noted the need to go further than just asking students to respond to mathematical questions, they identified the importance of teachers providing students with opportunities to think for themselves, ask questions and take intellectual risks if a relationship that encouraged independence was to be realised. Hunter (2007) recognised that by involving students in the learning process, and developing communities of inquiry, students were more able to take responsibility for sense making when learning mathematics. Through the positioning of students as proficient learners within an effective classroom community they are able to accept responsibility for their own learning (Angier & Pover, 1999).
In previous studies (McCullum et al., 2000; Kershner & Pointon, 2002; Kloosterman, Raymond & Emenaker, 1996) students’ perceptions of appropriate practices that enable them to succeed in learning mathematics were identified through the use of interviews. In a British study involving primary school students (McCullum et al., 2000), listening to the teacher was recognised as a key practice. Although these students noted listening to the teacher was important when the teacher was introducing a new topic, explaining something difficult or giving instructions about a set task, they recognised that to be successful in learning mathematics you needed to do more than just listen to the teacher. Asking the teacher questions was also an important ‘practice’ in learning noted by the students in McCullum et al’s (2000) study. Through asking questions these students believed they were able to find out something new, confirm their own thinking or clarify an idea, as well as receive feedback on their progress.

Working with others was another practice recognised by both adult experts and students as important when learning mathematics (Vosniadou, 2001; Angier & Povey, 1999). Vosniadou (2001) states that teachers need to develop learning environments and practices that encourage students to work in groups. The teacher works as a co-ordinator providing guidance and support both in mathematics content learning and in developing skills that enable students to work together. This ability to work together has been recognised as a skill students need to be taught (Peter-Koop, 2002; Vosniadou, 2001). Angier and Povey’s (1999) surveys and interviews showed that higher achieving 13 to 16 year olds recognised the advantages of working in groups. They saw working in groups allowed them to ‘help each other’ and by doing this they got more work done. They believed that by working in small groups they could ‘make up for each other’s faults’ and get ‘the best part of everybody’. The students recognised that when they developed better understanding of the mathematics because you had to ‘explain it more clearly’ and you were able to ‘compare answers’ and ‘talking to other people helped them understand’ (p154). These students only saw the benefit of working with others when the work was challenging or they were working on a ‘big’ problem.

McCullum et al’s British study (2000) showed that students as young as Year Two could recognise factors which impacted upon their learning. Other studies (e.g., Kershner & Pointon, 2002; Kloosterman, Raymond & Emenaker, 1996) identified that the practices students described mirrored those of their teachers. Students believed they were using practices their teacher promoted. However, when working with adults Argyis and Schon (1974) and Robinson and Lai (2006) cautioned that factors identified in interview situations are not always evident in practice. To better understand the learning experience from a student’s perspective what they say (espoused theory) has to be compared with what they do (theory-in-use). Then to complete the picture students need an opportunity to explain or defend any apparent differences between their interview statements and observed practices (Argyis and Schon, 1974; Robinson and Lai, 2006). Although this process has been used to make changes in business and teachers’ practice, there appear to be no studies undertaken of this process to gain a deeper understanding of primary aged (5 – 12 year olds) students’ perceptions of their learning.
The purpose of this article is to develop an understanding of what three underachieving Year 7 boys (eleven year olds) perceived as practices helpful to succeed in learning mathematics. Through listening to what they said (espoused theory), watching them at work (theory in use), and meeting with them to discuss the differences observed, a clearer picture of what they understood as important for their success in learning mathematics was developed.

**THIS STUDY**

**The Setting**

This study was situated in a large co-educational, multi-cultural intermediate school (Years 7 and 8, i.e. 11 – 12 year olds) located in a low socio-economic area of Auckland, New Zealand. This school differed from many other intermediate schools in that it employed a specialist mathematics teacher. The school had identified mathematics as a focus for development and had employed the mathematics specialist teacher to work with both students and teachers. This teacher worked with selected groups of high and low achieving students from the various syndicates within the school. The students who attended the classes taught by the specialist mathematics teacher were selected at the beginning of the year, based on the results of the standardised Progress and Achievement Test (PAT) \(^1\). During the year they attended the class every day during terms two and four remaining in their homeroom for the other two terms\(^2\).

Discussion with the mathematics specialist teacher and Deputy Principal provided the researcher with a description of the practice in the student’s homerooms. On going discussions with the mathematics specialist teacher during the process of planning and implementing this study identified her espoused theory. The specialist mathematics teacher’s espoused theory was clearly evident in her classroom practice during the observations conducted as part of this study. She believed in students taking ownership of their own learning and recognised that other students (as well as the teacher) had valuable contributions to make to the learning. She believed in challenging students and encouraged them to work in groups and seek help from both peers and the teacher when necessary. At the beginning of each class students chose where to sit and with whom. This learning environment was very different from that experienced in their homerooms where a more formal transmission model was the norm.

**The Participants**

The three boys whose responses are discussed in this article (identified as Kava, Mata and Sila – pseudonyms) were part of a larger sample of nine underachieving students who took part in the wider study. They are the focus of this paper as all worked on the same mathematical task during the observation section of data collection. The scores for both self assessed aspects (ability and

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\(^1\) PAT tests are a standardized test developed specifically for use in New Zealand schools. They are intended to assist teachers in determining the levels of development attained by students in their class.

\(^2\) The NZ school year goes from February to December and is divided into 4 (roughly even) terms.
attitude towards mathematics) and school standardised test results of the three boys are representative of the underachieving group. Students were asked to place themselves (in comparison with others students their age) on a continuum where 1 indicated they ‘hated mathematics’ and 10 they ‘loved mathematics’. A similar process was used when asking them to self-assess their ability in mathematics (1 equated to being ‘hopeless at mathematics’ and 10 ‘fantastic at mathematics’). Although they did not consider mathematics their favourite subject, all had a positive attitude towards the learning of mathematics, rating themselves between 7 and 10 on the 1 – 10 scale. (refer Table 1). Two of the three boys considered themselves above average in mathematical ability; this self-assessment contradicted their PAT results. The PAT ratings for these students ranged from 9 to 16 (ratings indicate where a student is placed compared to other New Zealand students of the same age or class level. A percentile rating of 16 indicates that 16% of students the same age or class level had a lower mathematics achievement score.

<table>
<thead>
<tr>
<th></th>
<th>Kava</th>
<th>Mata</th>
<th>Sila</th>
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<tbody>
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<td>Self-Assessment</td>
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<tr>
<td>Mathematics Attitude</td>
<td>9</td>
<td>10</td>
<td>7</td>
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<tr>
<td>Self-Assessment</td>
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<tr>
<td>Mathematics Ability</td>
<td>7</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>PAT Percentile</td>
<td>14</td>
<td>16</td>
<td>9</td>
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Table 1: Participants information

The Procedure
Individual semi-structured interviews were conducted with a group of underachieving students midway through their second term working in the mathematics specialist’s class. This was term four of the school year, students had already completed terms one and three in their homeroom and term two in the mathematics specialist room. Interviews were conducted in a withdrawal room next to the mathematics teaching room. Interviews lasted for approximately 20 minutes. To identify students espoused theory students were given the scenario: The new principal at your school has decided you need another mathematics specialist teacher like Ms S. He has asked you for your opinion about the sort of teacher / class you think will be best for children learning mathematics. What would be your advice? Other prompt questions to support this discussion included questions relating to; who could help them learn mathematics, who was responsible for them succeeding in mathematics, and what would a visitor see or hear if they came into the mathematics class. During these interviews information relating to students perceived ideal practices for success in learning mathematics was collected. Students were then shown a list of the practices they had identified and asked to rate them in order of importance.

Students were then observed working in the mathematics specialist class during a normal class lesson. The task worked on was an activity from the Figure It Out:
The activity – Container Contents – required students to identify how many rows of vehicles in each container given the information of how many in a row and total number of vehicles in the container. There were five questions with the last question providing only one variable therefore having more than one possible solution. The criteria for the observation session was based on the information gained at the individual interviews. Evidence of each time the noted practice/s was recorded along with the context in which it was used was collected. After the observational sessions were completed a group interview was conducted. The group interview provided students with an opportunity to explain or defend any apparent differences between their interview statements and observed practices. Group interviews were chosen for this part of the study as students were to be confronted with practices they had identified as effective but not demonstrated in practice. The group interview was considered to be less intimidating as it was a small group and all students knew each other.

RESULTS

Individual Interviews
All three students recognised themselves as the major person responsible for succeeding in learning mathematics through the use of statements below:
“Cause if you’re not good at it, it’s cause you don’t listen properly.”
“Cause YOU have to learn it.”
“Cause the teachers teach you and the parents make you do your homework so it has to be you.”

Espoused Theory
Students were asked what practices they perceived as important to succeed in learning mathematics. The practices identified were:
- Having time to think about the problem.
- Working with others to solve the problem.
- Listening to how other children solved the problem.
- Asking the teacher for clues.
- Asking other children about the problem.
- Getting the answer yourself or in your group.
- Listening to the teacher solve something.
- Using equipment to solve problems.
- Explaining how you solved the problem to others.
- Watching the teacher solve the problem.
When asked to list the five most important practices in order of importance all student chose listening to the teacher solve something as the most important. Kava and Mata identified listening to how other children solved a problem in the top five practices although at different levels. Working with others was another practice identified by more than one student (refer Table 2).

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3 Figure It Out is a series of books produced by the Ministry of Education for children to use in their mathematics classes. These books are distributed free to all New Zealand primary and intermediate schools.
Table 2: Students’ five most important practices for success in learning mathematics

<table>
<thead>
<tr>
<th>Student Rating</th>
<th>Kava</th>
<th>Mata</th>
<th>Sila</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>Listening to the teacher solve something</td>
<td>Listening to the teacher solve something</td>
<td>Listening to the teacher solve something</td>
</tr>
<tr>
<td>2nd</td>
<td>Having time to think about the problem</td>
<td>Asking the teacher for help (clues)</td>
<td>Getting the answer yourself or in a group</td>
</tr>
<tr>
<td>3rd</td>
<td>Listening how other children solve the problem</td>
<td>Asking other children about the problem</td>
<td>Working with others to solve the problem</td>
</tr>
<tr>
<td>4th</td>
<td>Explaining how you solved the problem</td>
<td>Listening to how other children solved the problem</td>
<td>Watching the teacher solve the problem</td>
</tr>
<tr>
<td>5th</td>
<td>Working with others to solve the problem</td>
<td>Working with others to solve the problem</td>
<td>Asking the teacher for help (clues)</td>
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Classroom Observations - Theory-In-Use
All three students entered the room confidently. The groups they chose to work in contained 4 or 5 members where the student being observed was the only one involved in the study. Kava and Mata’s groups contained boys only. Sila settled himself to work with a group of three girls. All three students watched and listened to the teacher as she started the session and worked through question one by asking students to contribute to the process of solving the problem.

Kava demonstrated the first three of the practices noted in his individual interview; listening to the teacher solve something, having time to think about the problem, and listening how other children solved the problem. At the beginning of the lesson he sat quietly listening to the instructions and following the demonstration of the first question making no attempt to answer any of the questions asked of the class. Once he had headed up his workbook he looked at the workbook of the student sitting next to him and started copying what had been written. At this point the teacher noticed that Kava could not see a Figure It Out book and rectified the situation (books had been distributed one book between two children to encourage students to work together). After completing the next question in the book Kava sat back in his chair looking at the book then up at other members in the group and back at his book. He ignored the question “have you finished?” asked by one of the group. Others in the group then started discussing wrestling. Kava stopped work and joined in. He came back on task when the class was brought back together to go over the set work. Kava followed what was being said, checking what he had written against what was said until he reached the end of the questions he had completed. He then put his pencil down and leant on his elbows until the class was asked to pack up.
Mata demonstrated two of his nominated five practices; listening to the teacher solve something, and listening to how other children solved the problem. At the beginning of the lesson Mata followed what the teacher was saying and doing, readily putting up his hand to answer any question asked. The Figure It Out book had been placed between himself and the boy sitting next to him. Mata settled at his desk working by himself throughout the session. He interacted with one other member of the group when he was asked if he had finished his work. Mata replied “Yeah” even though he had only identified one solution for the question with numerous solutions. The two boys then went on to discussing the merits of a calculator sitting on the table in front of them. At the end of the session, when the work was marked as a class, Mata followed the answers various students were presenting. He listened to what was said then checked this against what was written in his book. He confidently put his hand up to answer questions. At the end of the session he closed his book stating to no one in particular “I got them all right.” He did not wait for or seem to expect a response to this statement.

Sila demonstrated three of his nominated practices; listening to the teacher solve something, getting the answer yourself or in your group, and watching the teacher solve the problem. When the lesson began Sila listened as the teacher described the task for the day and watched as she worked through the first example with the class. He was keen to answer any questions the teacher asked during this process. He then settled to work quietly by himself taking control of one of the Figure It Out books, leaving the three other girls in the group to work using the remaining one. Once about five minutes into the working time he looked across at the work of the girl closest to him. No words were exchanged and he returned to working independently. Approximately half way through the lesson he looked back at the girl closest to him and asked if she had answered question three. When she answered that she had he announced that he had finished. She glanced at his work and informed him that he had to show his working. Sila then returned to his book to complete the task; he had demonstrated the aspect of getting the answer yourself, as one of his nominated practices. When the class was sharing solutions at the end of the lesson Sila was asked to explain how he had answered one of the questions. He proudly answered although his description was difficult to follow, even with prompts from the teacher. His confidence still remained high when the teacher asked if anyone else could share his or her solution. Sila continued to check his work against what was being said in class and even pointing out to the girl next to him that one of her answers was wrong.

Follow Up Interviews
All three students had listed working with others to solve the problem as one of the five most important practices yet this practice was not evident in any of the observation sessions reported on here. When confronted with the difference between what they said and what was observed, students justified the choice of this chosen practice through statements such as “You need to talk cause it’s important to get understanding – understanding is important.” Yet at the same time showed they saw a limited use of the practice by saying “sometimes you need to work with other people, for hard problems.” Working with others was something you only did if you got stuck. When it was pointed out that they had
not completed the task nor used any of the practices they had noted would help them, reasons were found for their non-use. Reasons included not being able to ask other students for help because you may be interrupting their thinking “other people might be thinking and you can’t interrupt them” or “you are really thinking and talking would interrupt this.”

Having time to think about the problem was a practice identified and demonstrated by one of the three students. Further discussion about the importance of thinking gave a greater understanding into what these students considered this practice to mean. The idea that “you can’t remember things quickly so you have to think” indicated that students were trying to remember mathematical facts or rules. The statement “you have to have time to remember” linked to having to think of the basic facts and through continued discussion it was established that this is what Kava was trying to remember when he was observed thinking – he was trying to remember his multiplication facts to help solve the problem he was working on.

Listening to how other children solved the problem was a practice identified by two of the students. Although during the observation of students working, listening to how others solved a problem appeared evident in all three students practice. On the surface students appeared to be mirroring the teacher’s beliefs but with further exploration a difference in the purpose of the practice was identified. Kava was only interested in following what his classmates were saying while he had work to mark. Mata was interested in how many he got right not if he could see a better way of solving the problems. Sila was comfortable with other students having difficulty in following his explanation, possibly because of the teachers validation.

To conclude the group interview students were asked if there was one practice they thought more important to engage in if they were to be successful in learning mathematics. They all agreed on working with others to solve problems. When challenged to develop a strategy to help them implement this they stated that they wanted the teacher to let them work on their own for about ten minutes. They then wanted to be told to put down their pencils and share their ideas with others at the table. They identified the following questions as ones they could use:

- What have you found / done?
- How did you get that answer?
- Show me what you did.
- What will you do next?

**DISCUSSION**

The students in this study appeared to take responsibility for their own learning and had a positive attitude towards the learning of mathematics. They accepted not being in the top mathematics group as they considered the top group was only for students who classed mathematics as their favourite subject. As in previous studies (Kershner & Pointon, 2002; Kloosterman, Raymond & Emenaker, 1996) the practices the students identified as important for succeeding in learning mathematics mirrored those advocated by their teacher. On the surface all three students knew and could describe the practices they
needed to engage in to succeed in learning mathematics, yet these students were underachieving in mathematics. This would indicate that when investigating reasons for under achievement in mathematics what students say is only part of what needs to be taken into consideration (Perger 2007).

The difference in the students’ espoused theory and their theory-in-use identified in this study aligns with that found by Argyris and Schon (1974) and Robinson and Lai (2006) when working with adults. All three students could identify practices they considered important for succeeding in the learning of mathematics, and confidently shared these. Yet when observed working in their mathematics class, only two or three of the five practices they had identified as important were evident. For example, all three students identified practices involving working with others in their five most important practices yet only two students appeared to be putting it into practice. This could indicate that they held a different understanding of what this entailed or they did not really understand how to work co-operatively in a group and this was a skill students needed to be taught (Peter-Koop, 2002; Vosniadou, 2001).

Similar to findings in previous studies involving adults (e.g., Argyris & Schon 1974; Robinson & Lai 2006) these students were unaware of the differences between what they said (espoused theory) and what they did (theory-in-use) until challenged in the group interview. Once the differences were brought to their attention students were able to provide reasons (constraints) for not using the practices identified in the initial interviews. When the practice of working with others was explored further the ‘listening to how others solved a problem’ became more ‘listening for the answers’ so as to mark their work. The discussion around the practice of working with others highlighted a number of reasons why this practice had not been observed in class. These constraints involved interrupting others’ thinking: for example, “you can’t remember things quickly so you have to think,” and you can’t interrupt someone when they are doing this because “you can’t think and talk.” Even though students considered the practices they listed important, until the constraints identified are addressed it is unlikely they will be able to make changes to the way they work (Robinson, 1993).

Through involving students in the process of comparing what they said with what they did and providing them with the opportunity to discuss the findings as a group, they were able to construct a plan. The plan they developed was to address the constraints that had stopped them implementing their chosen practices. This plan included opportunities to use other recognised practices; for example, having time to think and being asked questions that mirrored those of their teacher. The students recognised themselves as participants in their own learning, and when given the opportunity to defend their actions, took responsibility for their own learning (Angier & Pover, 1999). When planning an intervention they acknowledged that they required the ‘help’ of their teacher.

CONCLUSION

As students are the major stakeholders in the learning process, to further understand their learning experience, it is critical that their perceptions are considered (Bishop, 2003, Forman & Ansell, 2001; McCullum, Hargreaves, & Gipps, 2000). Yet if a true picture of what they perceive is to be found we need to go further than just listening to what they say, or observing what they do.
Through comparing what is said (espoused theory) with what is done (theory-in-use) and then allowing participants to respond to the differences, a better understanding of what is perceived as appropriate practice emerges (Argyris & Schon, Robinson & Lai, 2006). The three boys in this study thought they were doing what the teacher promoted as best practice, but it was only through further observations and discussion that a different understanding of what the practice entailed was found. The students demonstrated that they ‘knew’ what to do and were able to identify the constraints that stopped them using the practices they had identified. They were able to plan a course of action to bring their espoused theory and theory-in-use closer together, but acknowledged that this required teacher support (Peter-Koop, 2002; Vosniadou, 2001).

The students in this study were prepared to take responsibility for their own learning. However, they recognised that they required help from the teacher to implement practices they had identified as important for succeeding in the learning of mathematics. They regarded it their duty to ensure that they achieve in mathematics. In the words of one student “cause the teachers teach you and the parents make you do your homework so it has to be you.” If they are prepared to take on this responsibility then as teachers we must be prepared to ensure they have the knowledge and skills to do so successfully. As teachers we need to share useful practices to learn with the students we teach. We need to be explicit in what these practices entail so that we build a shared understanding of what and how they promote learning. We also need to ensure students have the skills required to put these practices into action and where necessary spend time teaching these skills.

References


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