

The Impact of an Intervention Program on Student Approaches to Learning: A Case Study

Bernadette Long

St Carlo Borromeo Primary School & Monash University

<blong@scgreenvale.catholic.edu.au>

This paper reports on an intervention program, 'Prepare 2 Learn', that was designed taking into account a range of components from other successful intervention programs. The program is focussed on year 6 students from a school in Melbourne, Australia, who are falling approximately 6 months behind with the hope that extra help at an early stage may result in them reaching the required standard and realising their potential. While the students' academic results moved substantially a more pleasing result was the noticeable improvement in the students' approaches to their learning.

A Fairfax Media Analysis into Australia's recent performance in the Programme for International Student Assessment [PISA] study stated "Australia recorded one of the largest declines in maths (sic) among OECD countries since 2000" (Preiss & Butt, 2013). Thomson more specifically stated in a report in "The Scan" that Australia's falling achievement could be partly attributed to a decline in high performing students in mathematical literacy as well as an increase in the proportion of low performing students (Dec, 2013). It is these low achieving students that were the impetus for this study, an aspect of which is reported in the following.

As a mathematics leader I am concerned that many students who are 'at risk' in mathematics do not receive the help they need due to resource constraints. In schools the tendency is to offer intervention programs only to the most 'at risk' students. While this is necessary, there is a band of students that are presently falling up to 6 months behind that often receive no extra help. Schools hope that these students may be able to make up the lost ground in the mainstream classroom. However, without early intervention, it seems that this gap is likely to grow (Sullivan & Gunningham, 2011). The study, aspects of which are reported here, sought to design an intervention program, taking into account components of other successful intervention programs, which would provide much needed help for these students outside the mainstream classroom. The program, termed 'Prepare 2 Learn', had two main objectives: firstly to prepare the students for their mainstream lessons, ensuring they had the necessary prior knowledge; and secondly to make the students aware of the impact they can have on their own learning through their actions and attitudes.

Identifying Key Elements of Current Intervention Programs

The 'Prepare 2 Learn' program was developed after reviewing a number of successful intervention programs. Four main components were identified that would allow 'at risk' students to improve academically in mathematics as well as become more competent learners. The components were: increasing mental computation fluency; building prior knowledge of mathematical language concepts and skills in order to prepare students for their mainstream sessions; encouraging a 'growth mindset' (Dweck, 2008); and developing students' metacognitive strategies. These components have potential not only to help

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students achieve at the current content of their mathematics learning but also to assist them to develop the orientation and skills to continue to improve after the intervention program ends. This latter aspect is about building the students' capacity for learning and making them aware of their responsibilities in the learning process.

The focus of this report is on the impact of 'prior knowledge', 'growth mindset', and 'metacognitive strategies' on the students' approaches to their learning. These three components were specifically included in the program to change the students' self-efficacy as mathematics learners. Hattie (2012) describes self-efficacy as "...confidence or strength of belief that we have in ourselves that we can make the learning happen" (p.41). The development of such beliefs is one of the intended goals of the 'Prepare 2 Learn' program.

In terms of developing students' self-efficacy, an important influence was the GRIN (Getting Ready In Numeracy) program. GRIN is based around the belief that "In the most general sense, the contemporary view of learning is that people construct new knowledge and understandings based on what they already know and believe" (Bransford, Brown, & Cocking, 2003, p.10). Sullivan and Gunningham (2011) argued that many 'at risk' mathematics students lacked the necessary pre-requisite knowledge to enable them to construct new knowledge and understandings from the experiences in their mainstream classes. This rationale is based on cognitive load theory (Bransford et al., 2003) which is grounded in the belief that we have limited capacity in working memory. Working memory processes information before it is stored in long term memory. If the working memory tries to process too much information it becomes overloaded. The GRIN intervention program was designed to lessen the cognitive load for 'at risk' students of mathematics by providing basic pre-requisite knowledge of language, skills and concepts needed for the next topic that the students would be taught in their mainstream classroom. The intention is to 'get students ready' to be able to participate fully in the typical learning experiences of the mainstream classroom, so that this focused prior learning would ensure working memory did not become overloaded.

A second rationale of the GRIN program was based on recognition that classrooms are social environments and that students have a need for social connectedness (Sullivan & Gunningham, 2011). As such, when given an insight into the next lesson, students would feel more confident to join in the classroom learning experiences.

One of the foci of the 'Prepare 2 Learn' program is to encourage 'at risk' students to understand the need to actively join in classroom experiences. The approach is based on a 'growth mindset' derived from the work of Dweck (2008) who spent 20 years studying how thoughts and beliefs about oneself profoundly affect the way we lead our lives and ultimately what we achieve. Her studies revealed that people hold one of two mindsets: a 'fixed mindset'; or a 'growth mindset'. People with a fixed mindset believe that their "...qualities are carved in stone" (Dweck 2008, p. 6). They believe they have a certain amount of talent and that no amount of work will increase this talent to any real degree. In contrast a person with a 'growth mindset' believes that human qualities, such as intellectual skills, can be cultivated through effort.

It was anticipated that developing a 'growth mindset' would result in students showing greater participation in the classroom as they would understand that it is through their actions of practising skills, persisting with difficult tasks, joining in classroom experiences and participating in mathematical conversations that they would be more likely to be able to construct new mathematical understandings.

Another perspective, based on the work of Caswell and Nisbet (2005) was the intention to develop these students metacognitive strategies. Caswell and Nisbet initiated an intervention program called ‘Enhancing Mathematical understanding Through Self-Assessment and Self-Regulation of Learning’ that focused on developing meta-awareness. As Caswell and Nisbet (2005) suggested “...the challenge exists to engage students in reflection that raises their consciousness of both cognitive and affective factors that affect their learning potential” (2005, p. 209). The program’s aim was to encourage students to assess what or where they needed to improve to progress in their learning of mathematics, and what might be the barriers impeding this learning.

In short, the ‘Prepare 2 Learn’ program assisted at risk students to take further advantage of mainstream classroom mathematical experiences by providing relevant prior knowledge, encouraging a ‘growth mindset’ and teaching metacognitive strategies.

The Research Context

‘Prepare 2 Learn’ is an intervention program conducted over 15 weeks. Three year 6 students were selected based on their achievement being approximately 6 months behind what would be expected for that year level, as well as discussion with the class teacher. Considerations such as regular school attendance, willingness of students and or parents to be part of the program, and participation in other programs were some of the issues taken into account when selecting students.

The sessions were developed by the author as the intervention teacher taking into account the lessons to be taught by the classroom teacher during the week. As the mathematics leader in the school, I was able to meet regularly with the classroom teacher to ensure the planning of the tutorial sessions were in line with the proposed classroom lessons. The idea behind the sessions was to prepare the students for their mainstream lessons while developing an awareness of the actions of good learners. It was hoped that such a program might encourage students to participate more fully in their classroom mathematics lessons. As such the tutorial sessions were conducted in addition to the mainstream classroom lessons.

Before the program began the students watched some short videos on the role of the brain and its impact on learning. These videos were then discussed in relation to the value of practice in allowing the brain to preserve information in long term memory. At the next session students were asked to brainstorm what they believed were actions of good learners. This information was collated into a checklist. The checklist was pasted into the students’ mathematics books. At the end of each mainstream lesson this checklist was marked by the students. The purpose was to get students to evaluate their learning behaviours and to write down any area they needed more help with. In short this was a self-reflection tool for their learning behaviours. This self-reflection tool was used by the students for the first three weeks of the program.

The program ran for 15 weeks with the students attending three 40 minute sessions per week. The structure of the tutorial sessions was as follows:

- **5 minutes:** Mental computation activities based on the intended topic
- **5 minutes:** Looking at the self-reflection checklist. Teacher and students look at the students’ checklists, discussing how to be an effective learner using metacognitive strategies.
- **25 minutes:** Teacher establishes what prior knowledge the students actually have and then introduce the necessary mathematical language, concepts, basic skills etc. that they will need in order to participate in the mainstream lesson/s.

- **5 minutes:** Summary - students reflect on what they will need to know to be able to engage in the follow-up mainstream lesson

At the end of the program the students discussed with the intervention teacher what they had learnt from the program and what changes they now intended to undertake to improve their ability to learn.

Instruments

The methodology informing the data presented below, included elements of both design and action research, and used a mixture of both quantitative and qualitative data. Before the program began a variety of pre-data were collected. The students were given a relevant PAT Mathematics Test (Progressive Achievement Test) in order to establish their academic level on a standardised test. The teacher completed a questionnaire asking about the learning behaviours of the students. Through an interview, students were presented with a vignette in which the use of a story stimulated a discussion on learning actions that encourage academic success in mathematics. Lastly students completed the ladder instrument (Mornane, 2010) which consisted of three quotes written by three hypothetical children on how they believed they learnt mathematics best. The students were given these three statements and were asked to rank them in descending order on the ladder rungs using their own beliefs of how they learnt mathematics best. All of these data, along with other data not referred to in this paper, were intended to give a rich picture of each student's academic level as well as their actions and attitudes towards learning mathematics.

At the end of the program the teacher completed a written questionnaire about the learning behaviours of the students. The students, for a second time, were presented with both the vignette on actions of good learners and the ladder instrument. As well they were also interviewed about the 'Prepare 2 Learn' program. All of the student data were collected via a recorder and later transcribed. Parents of the students were also asked to complete a questionnaire.

Results

The PAT Mathematics Test (Progressive Achievement Test) showed that all students had improved further than the expected 12 months in achievement, and for two of the students, substantially more. While this confirmed the immediate value of the intervention, the qualitative data revealed significant changes in the ways each of the students approached their learning. It is these changes that are the focus of this report.

After examining the responses of all three students, an improvement in three key elements could be seen. These elements were: increased confidence in class and in mathematics; greater participation in learning experiences; and more responsibility taken by students for their learning. Each of these elements was identified as an area of significant change within the students' learning. To ensure that sufficient detail of the changes are presented, and recognising the limitations in the size of this report, representative data from just one of the students are presented. For the purpose of this report I refer to that student as Elise.

Increased Confidence in Class and in Mathematics

Like the other students, there was a marked improvement in Elise's confidence from the initial to the final data. When Elise began the program the pre data collected indicated

that she lacked confidence and the teacher seemed to be concerned by this. The following statements highlighted the teacher's concerns:

What concerns me about Elise is that she's very timid, very sensitive. So I'm hoping to see her grow in confidence and clearly stick to what she knows ...

Elise is generally a shy girl, as far as concentrating though she looks at me and seems to be taking in what I say. So concentration is not a problem but I would like to see more motivation from her.

I need her to gain more confidence and be happy with what she's doing.

The use of terms such as "timid", "sensitive", "shy", "like to see more motivation", "need her to gain more confidence", collectively communicate that the teacher had a view of the limited extent to which Elise asserted herself and engaged in the learning process.

In contrast, in the post intervention interview the teacher noted a change in Elise's classroom confidence by making statements like:

... her increased confidence in her maths abilities has enabled her to share her strategies and computations...

I have noticed that when I have been teaching using the white board, Elise has given me more eye contact and nodded with her head to let me know that she has come to the same answer and that I have her full attention.

In this case the use of words such as "increased confidence", "share her strategies", "more eye contact", "full attention" are indication of a student who has changed substantially in her confidence.

This change in levels of confidence were also evidenced in Elise's own interview responses. For example, when asked by the intervention teacher, "So if I give you a worded problem do you feel more confident that you would be able to do it?" Elise replied:

Yes because you told us, like not tricks, but ways to do it, like focusing on key words and everything so now I know what to do, when I read the question.

This response suggests that Elise has developed strategies that she can use when answering problems. She believes these strategies allow her to know what to do. These strategies seem motivating and confidence building as Elise is able to be self-directed when given a mathematics problem. The data confirms that her confidence has improved.

Greater Participation in Learning Experiences

The data also indicate that the students showed an improvement in their level of participation in learning experiences. The importance of this cannot be underestimated. Classroom teachers design learning experiences for students to engage in, discuss, learn from one another and then construct new knowledge and insights (Sullivan, Mousley, & Jorgenson, 2009). Students who are reluctant to participate in classroom activities are likely to be disadvantaged in comparison with students who do participate.

In comparing the pre and post interview of the classroom teacher we see changes in the level of participation Elise displays. Initially Elise's teacher explains her participation in learning experiences with statements like:

If I have to ask you [her] to do an individual thing or explain a strategy she's not one of my children who will put up her hand to share. She'll sit back and let everyone else do the talking

[If there is] More than one person she'll be the person to pull back and just listen to everyone else...

She won't get all her work finished and usually some of the more challenging tasks are towards the end of the activities.

I really need to see her taking more actions and challenging herself.

The teacher uses words such as “will not put her hand up to share”, “let everyone else do the talking”, “pull back”, she needs to take “more action”, “challenge herself”. These comments suggest Elise is not fully engaging in the mathematical learning experiences by working with others, sharing her thoughts and ideas. She is not part of the mathematics ‘conversation’.

In contrast the post teacher interview shows a different, more involved student. The teacher commented:

Elise has enjoyed working more with her peers and has been good at reasoning and explaining her strategies.

...has enabled her to share strategies and computations in a full class situation and when working with another student in pair work and in small groups.

...used her reasoning and thinking skills to persist in solving harder problems.

...tried sharing her results with others, both students and teachers...

...maths mentor for her peers, as many students have called upon her for assistance or as a partner.

In these comments we see words such as “share strategies”, “sharing results”, “working on a difficult task”, “maths mentor”, and “called upon her for assistance”. These comments suggest that Elise is now willing to join in even challenging classroom experiences, sharing her thoughts and ideas with individuals, groups or the class. From the “very shy”, “timid” student who was “slow to finish her work” and “sit back and let everyone else do the talking”, it would seem Elise has changed and is now a more active participant in the classroom learning experiences.

More Responsibility Taken in Learning

From the pre to the post data all of the students could be seen to be placing a higher emphasis on taking more responsibility for their learning. The term responsibility is taken to refer to actions they as learners could undertake to ensure a better chance of achieving. Actions such as concentrating more, practising skills, listening intently, asking for help, persisting with challenging tasks, trying a range of strategies and reflecting on their work. Elise’s teacher’s initial interview had mentioned these in a number of instances, as areas she had hoped might be improved through the program:

Her willingness to reflect is a bit of an issue.

She may need to push herself a bit more...I really need to see her taking more action.

In looking at the use of words such as “willingness to reflect...an issue”, “need to push herself”, “more action” indicate a student whom the teacher believes needs to change some of her learning actions in order to achieve more in mathematics.

In contrast the post teacher interview shows a picture of a different learner. This can be seen in phrases like:

I have her full attention.

...has been good at reasoning and explaining mental strategies...

When working on a difficult task, Elise will attempt many ways to come to solve the problem and has become better at checking her own work...

In reading these phrases, words such as “full attention”, “good at reasoning and explaining”, “attempt many ways”, “better at checking” suggests a student who is now taking responsibility for her learning through the actions she is displaying.

The post data not only reflected changes the teacher had observed but in the evidence collected from Elise there was also indications of an increased emphasis on Elise's understanding of her role in the learning process. For example in the initial data Elise was given three statements by some hypothetical students on how they learnt mathematics best. Elise was asked to read the statements and put them in order of how she believed she learnt mathematics best. The three statements were as follows:

Julie said "I learn maths best when I listen carefully to the teacher and do the problems exactly as the teacher suggests"

Corey said "I learn maths best when the teacher lets me work out my own way to do the problems"

Aimee said "I learn maths best when the teacher puts us in groups to work out how to do the problems"

Initially Elise responded that both Julie and Aimee's responses were most like how she learnt best. Then as a last preference she put Corey's answer. This showed she considered that she learnt mathematics best when the teacher told her exactly what to do and when she was able to work in groups with her peers discussing ideas. In the post data however she altered her opinion of how she learnt mathematics best. Before beginning the program, she reported that the teacher and others helped her learn mathematics best. By the end of the program, she said that trying things herself and working in groups with others was now how she learnt mathematics best. Perhaps she had started to appreciate that she has many valuable and worthwhile mathematical strategies that when discussed with others allows her to construct her own mathematical thinking. She did add that if after trying to learn this way she was still confused she would like the teacher to show her what to do.

Elise also shows that from the start of the program to the end of the program she has added to her list of actions of good learners. This can be seen in the vignette data the students were given before and after the program. The vignette was a picture of two girls, Sally and Bridie. The students had been told that in year 3 both of these girls were achieving the same mathematics results but by year 6, Bridie was doing much better. The students were asked to suggest why this may have happened. Elise in the pre data speaks about Bridie who is performing better, as perhaps practising more, listening more intently to the teacher and asking questions when she needs help. All of these answers showing Elise began the program with a solid appreciation of the actions needed to be a good learner. However in the post vignette she again mentions all these actions but adds to them. This can be seen in comments such as:

Maybe she cares more about the maths, like caring more about understanding it.

...and then if she still doesn't get it keep trying and not give up on it.

Because like maybe Sally gets distracted easily...maybe Bridie concentrates harder on her learning...

Phrases such as "caring more about understanding", "keep trying", "not give up", "gets distracted easily", "concentrates harder", show Elise has added to her list of the actions of good learners. She is now adding the need for understanding, persistence, and concentration to her list of the requirements of good learners.

The teacher's post data comments mention Elise now reflecting on her work. Elise also speaks about this in her post interview, when she is asked whether she believed ticking the checklist of 'Actions of Good Learners' at the end of her mainstream mathematics lessons was a worthwhile activity. She replies:

Yes because you would tick it and you could look back on things that perhaps you didn't do that would help you to learn better. And if you put a cross you could look at it and go back and realise things that you need to do better to improve on your learning.

The words "realise things you need to do better" clearly show that Elise is now reflecting on what she can do to improve her learning. She is understanding that her actions can initiate better results in her mathematics.

Conclusion

The data collected from this initial intervention program suggests that not only has Elise been able to improve academically but she has changed the way she approaches her learning. This was also apparent with the other students in the program. They now seem to have a deeper appreciation of the role they are required to play. This is evident by the students increased level of confidence, improved participation in classroom experiences and greater responsibility taken by them throughout the learning process. As Middleton and Jansen (2011) suggested, as educators we should encourage

...students to cope with academic struggle...to believe that effort matters more than ability, realize that struggling to understand is a normal part of learning rather than evidence of intellectual deficit, and be persistent in the face of struggle and challenge. (p. 85)

The 'Prepare 2 Learn' program may have the potential to develop these actions and attitudes in 'at risk' students and equip them with the skills to learn now and into the future.

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