HEARING BOYS' VOICES: DEVELOPING SELF-EFFICACY IN YEAR 8 BOYS IN MATHEMATICS THROUGH REFLECTION

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Abstract

This action research project investigated the development of self-efficacy in Grade 8 boys through a self-reflection process that allowed them to assess their learning. The research ran over eight weeks and students participated on a voluntary basis. At St David's Marist Inanda, the Grade 8 boys are timetabled for Mathematics every day and this allowed me to work with them daily on their self-reflection. I investigated how a self-reflection process helped them to develop self-efficacy in the Mathematics classroom by asking them to write in their Mathematical journals and fill in questionnaires. They reflected on this process in their exit interviews, which I video-recorded, and in further questionnaires that concluded the research. I hope this research will inspire others to reflect on the teaching of Mathematics not just as an outcomes-orientated process but as a continuous reflection on the development of new concepts.

Introduction

One of the greatest challenges I have faced over many years of teaching Mathematics is how to motivate boys to own their learning. The main intention of my action research was to investigate how to empower boys in the learning of Mathematics. To answer my research question, "How does a reflection practice develop greater self-efficacy in Mathematics in Grade 8 boys?" I investigated what strategies helped the boys to take ownership of their learning—for them to feel like they have choices to effect change. So often boys try to shift the blame—to teachers, parents, the School—when in fact they themselves need to take responsibility. They need to ask for help, test their own understanding, and grapple with new concepts—be brave enough to tackle unseen tasks and develop problem solving skills that will help them way beyond the Mathematics classroom. I let them express their thoughts and concerns in their journals so that they could develop a belief that they can be heard and that their opinions (and maybe in Mathematics, their methods) matter and can be valid and different to the traditional, and that they can succeed.

Literature Review

The topic of the IBSC Action Research 2019-2020 was *Developing Agency - Boy Voice and Choice*. My action research focused on techniques to develop agency in a Mathematics classroom of sixteen 13- to 14-year-old boys. Boaler (2003, as cited in Andersson & Norén, 2011) emphasises "the importance for Mathematics learners to have an empowering identity in relation to school Mathematics" (p. 2). Cognitive psychologist Vygotsky (as cited in Albert & Antos, 2000) insisted that students reach higher level thinking processes by becoming active learners.

This literature review focuses on boys' self-efficacy beliefs, writing about their learning (both with respect to the process and the mastery of the mathematical topics), self-reflection in the Mathematics classroom and the development of a mastery goal orientation compared to performance-approach goals. The literature helped develop my understanding of how the techniques of self-reflection through interviews, journalling and discussion might develop agency in the Mathematics classroom.

One of the factors that influenced my choice of action research question was poor motivation among many young adolescent boys in learning Mathematics. Cox (2018) notes:

> Basically, boys resist motivation because of the stress involved in trying very hard at something. This principle applies to all kinds of tasks, even those of obvious value. When the person is already pushing up against the limits of his capability, the effort required is even more stressful - inherently unpleasant. (p. 102)

Furthermore, Linnenbrink and Pintrich (2002, cited in Schippers, 2012). state that:

> Self-efficacy is different from self-concept or self-esteem beliefs in that it measures confidence in performing a specific task, such as solving a one-step algebra equation, instead of referring to an overall general ability in mathematics. (p. 21)

Hackett and Betz (1989, cited in Schippers, 2012) investigated the relationship between Mathematics self-efficacy and student performance and reported that students with positive or high Mathematics self-efficacy possessed positive attitudes toward Mathematics, displayed higher performance, and were more likely to choose future Mathematics education and career choices when compared with students with negative or low self-efficacy.

Pugalee (2001, as cited in Schippers, 2012) advocates the use of writing in the Mathematics classroom as one way to promote metacognition and self-regulation. Adolescent boys are "anxious about others seeing and judging the way they think" (Cox, 2018, p. 2). Allowing boys to explore their beliefs about learning Mathematics in a journal and allowing them to share information on their own terms gives them a safe environment to explore their methods, express their anxieties about mastery and consider strategies for improvement.

At St David's Marist Inanda, we are faced with the challenges of a multilingual classroom. Getting the boys to write about their understanding helped identify problems they were experiencing in understanding the mathematical language used, as well as problems in translation from their home language to English, the language of instruction. Writing aspects of a mathematical autobiography also highlighted historical challenges in their learning of Mathematics.

Previous research by Gifford & Rockliffe (2012, as cited in Alderton and Gifford, 2018) "pointed to the need to consider such children as individuals with unique mathematical profiles" (p.56). By allowing boys to write and discuss their experiences of learning Mathematics they were able to "see themselves positively as learners of Mathematics" (Alderton & Gifford, 2018, p.66).

Guillaume and Kirtman (2010) describe how pre-service teachers"

> Noted events and memories that they characterized as happy or positive and sad or painful during their Mathematics histories. ...As described in a later section, peaks and valleys were often precipitated by participants' reactions to particularly powerful teachers, by their reaction to content (e.g., geometry or algebra), or by significant experiences such as course examinations or particular phases in their own social or emotional development. The combination of the positive and negative experiences of the vast majority of participants contributed to their overall view of Mathematics. (p. 129)

Some reflection on the pre-service teachers' personal stories of Mathematics included home influences, their parents' perceptions of the value of Mathematics, and some experiences of learning to count change or calculate differences in sports scores. "Some included stories of fights with parents stemming from Mathematics, and some told of the pressure that they experienced as their families grew concerned about their school performance" (Guillaume & Kirtman, 2010 p. 130).

Guillaume and Kirtman (2010) comment that of the 98 participants who discussed the power of the teacher, 73 (75%) argued that one teacher changed their view of Mathematics in ways that had long-lasting effects on their views of Mathematics. One of the boys who was part of my action research cohort referred to this in his journal too.

If you ask the average boy in a Mathematics classroom to set a goal for the term, he would usually respond with something like, "I would like to improve my mark by 10% by the end of the November exams." Seldom would he have proposed, "I would like to demonstrate competently and explain how to solve a quadratic equation using a k-substitution."

"Teachers who engage in mastery-oriented instructional practices tend to create learning environments where all students can feel successful and feel a sense of task mastery and improvement." (Anderman & Maehr, 1994, p. 291) Teachers who set small tasks for their children that are easy to achieve, but working towards a greater goal, help build confidence in their children to learn Mathematics. Mastery-orientated practices build success among weaker students.

Meyer, et al. (1997) found that two motivational patterns emerged among students in Mathematics: a pattern of challenge and that of challenge avoidance. A pattern of challenge was characterised by high levels of self-efficacy and challenge avoidance by low levels of self-efficacy. Through my research I hoped to challenge this narrative and set the boys onto a path of challenge rather than continuing along a path of challenge avoidance.

Research Context

St David's Marist Inanda is an independent Catholic boys' school situated in the heart of Sandton, an affluent residential suburb and central business district of Johannesburg. The campus incorporates a pre-primary, preparatory school and college that caters for over 1200 boys. Although the majority of the boys come from privileged homes, the core values of a Marist education are simplicity, modesty and humility. We have over 60 boys on scholarships and all boys are encouraged to get involved with service opportunities that include S. M. I. L. E., an initiative that teaches literacy and numeracy skills weekly to primary school children from a neighbouring township, a soup kitchen, and Hands of Champagnat that raises money and builds a home for a single parent headed household.

I worked with my Grade 8 Mathematics class of 16 mixed-ability boys aged between 13-14 years with whom I had daily contact. The boys and their parents provided written consent for their

participation, which allowed me to video, photograph, and interview them throughout the research project. I undertook to keep their journals and discussions confidential.

The South African education system is driven by the need to prepare boys for a final matriculation exam at the end of Grade 12, especially in the competitive private schools' market. As teachers we need to keep in mind the process and not just the performance and results required. This action research was a reminder to concentrate on the process, not just the outcome and that it is important to include strategies in the classroom that encourage self-efficacy in the learning of Mathematics.

The Action

Over a period of 6 weeks, I asked the Grade 8 boys to keep a journal and write about their experiences of learning Mathematics while completing the topic of Pythagoras' Theorem and area and perimeter. Both sections were introduced in Grade 7 and we continued to build on the basic concepts in Grade 8. The intention of my action research was to develop self-efficacy by teaching the boys to reflect on their own learning experiences, past and present. I wanted them to develop a mastery goal-orientation and move away from a performance-only approach. Usually their goal setting is about the marks they would like to achieve in the next test/ exam; rather, I wanted them to develop goals to master particular concepts or procedures. I wanted to help them become participants in their own progress. The boys kept a journal reflecting on their learning of a section of Mathematics in Grade 8. I discussed their entries with them, and they filled in questionnaires to aid the reflection process. The action was concluded with exit interviews and further questionnaires which helped sum up their reflections.

Data Collection

I used a mixed-methods approach and collected both quantitative and qualitative data. I did this in various ways. Each boy was given a notebook to record their reflections. After a test I asked them to reflect on their results with the following prompts: What preparation had they done; what brought them to this point in their learning; and why they thought they got the mark they did. I collected in these journals from time to time and recorded their thoughts.

I followed this with a journal entry outlining their goals for the next test on a new section on area and perimeter, and Pythagoras' Theorem. We discussed strategies to develop a mastery goal orientation and to move away from common quantitative goals like, "I want to get 60% for the next test." I discussed changing the narrative to, "I would like to be able to demonstrate my

understanding and use of Pythagoras' theorem by being able to complete the following example." I hoped this would help them determine the steps needed to develop their own understanding of a particular section and help them self-assess their understanding of new concepts before they were assessed in the next test.

After the next test, I gave them a structured multiple-choice questionnaire that I could code and then categorise their responses and quantify their choice of answers. I conducted one-on-one semi-structured interviews and called the boys in pairs and small groups to share their thoughts on the process so far. I developed a rating scale so they could quantify their opinions and give their voices some clarity.

Data Analysis

I started the analysis and coding of boys' responses once data collection was complete, paying particular attention to boys' voices and choices. I was able to quantify the selection of different responses in the multiple-choice questionnaire, and categorised their responses from the interviews and analysed common threads. I discovered common trends in their responses in the interviews and used this to analyse whether the self-reflection process had had an impact on their learning and the development of self-efficacy.

The test analysis feedback form consisted of 8 choices to reflect on their performance in the test. The boys could choose none or more than one and could choose as many different attributes as they liked for each of the 5 questions in the test and 9 questions in the revision paper.

I organized the boys' responses into an Excel spreadsheet. Eight boys handed in their responses for the Pythagoras and area and perimeter test. "Careless mistake" was selected 20 of the 40 possible selected attributes among the 5 questions while no-one selected "Never been taught this" or "ran out of time." The next highest attribute selected was "Could not remember" but not significant at 5/40 possible responses.

Seven boys handed in their responses for the Revision of Paper 1: " Careless mistake" was selected 27 of the 63 possible selected attributes among the 9 questions while no-one selected "Never been taught this" or "ran out of time." The next highest attribute selected was "Could not remember" but more significant at 18/63 possible responses because the boys had not done a lot of revision for the November exams at this point and so they demonstrated some understanding that they needed to include some sections in their revision programme.

Some general comments were made in the feedback form to summarise the boys' current feelings about their performance in Mathematics. Student A commented, "I need to look at questions more carefully and don't make stupid mistakes," student G commented, " I found it fairly easy but unlike in the last test I did not take shortcuts," and student D said, "A good result but wanting to improve in the exams so lots of hard work to be done."

The third questionnaire demonstrated that the boys had developed greater self-efficacy than at the start of the research. They responded that they were able to help themselves more often and relied less on outside explanations. They had learnt to grapple with new concepts before resorting to an outside intervention. They still struggled to express their mathematical concerns clearly and lacked the depth of language to fully explain what they need to still learn.

The data I collected were both quantitative and qualitative. The journal entries described the boys' preparation for the assessment and outlined reasons for their current level of attainment in the subject. Their responses lacked depth in understanding and description. The feedback questionnaires were quantitative in that I could add up how many boys selected each attribute.

Through data analysis I identified 3 recurring themes:

- Communication in the Mathematics classroom
- Internal versus external attributes for success
- Reading comprehension

Discussion of Findings

The boys' journal entries included reflections on their preparation for the test on this section and what had brought them to this point in their learning. They also reflected on why they attained a particular mark for this section. Only 10 of the 16 boys in the class wrote entries in their journals on a regular basis. Some of these boys demonstrated a resistance to writing about themselves and their work. They are used to Mathematics being a process-orientated subject, algorithmic in nature, and little attention is given to the development of writing in the subject in particular to do with the development of their understanding of new concepts. Much of their reflection showed a lack of maturity or depth of understanding of the task. Student F commented: "I think I can improve by studying a bit more and focus more on the concepts." Many of the comments were similar to this.

The boys filled in three feedback forms and I conducted exit interviews to conclude the research. We discussed some questions and some responses were videoed.

Communication in the Mathematics Classroom

The boys lacked the communication skills needed to fully develop self-efficacy in the Mathematics classroom as they found it difficult to express their understanding in words or they had difficulty expressing a particular concept in words. This theme tends to recur in later years when the boys are required to write journal entries or descriptive pieces for portfolio work in Grades 11 and 12. Often the boys can do the Mathematics but cannot express the concepts in words or translate from mathematical notation into words. The boys are typically able to tell they are making a mistake but cannot put this mistake into words describing their conceptual understanding or misunderstanding. Research into developing mathematical language would make an interesting addition to this research.

Internal versus External Attributes for Success

Some boys attributed the learning of the work to outside factors. Student A remarked: “I knew that this test was going to be a success because we had great teaching before the test. I would have felt confident going into the test without doing any studying.” Many remarks were along the lines of student V’s comments: “I feel very confident with perimeter. I am able to work out the perimeter of a square, circle, rectangle and a triangle."

Reading Comprehension

Nine boys attributed many of their mistakes to lack of reading comprehension. Student B remarked: “I need to master rereading the question.” Student I commented: “I also don’t think I read it properly, I got very confused.” Beilock (2008) suggests that a high-stress situation creates worries about the situation and its consequences that compete for working memory normally available for performance.

The conceptual density of Mathematics reading is one of the major reasons for students' difficulties. A student's prior knowledge is the single most important resource in learning with texts. Students need to construct meaning—to grapple with how a concept such as prime numbers is similar to and yet different from other classifications of numbers that they have learned. Students often think that they know what a word or concept is in Mathematics, but then have difficulty expressing it in words or applying it in a new context in a Mathematics question.

Conclusions

The introduction of a self-reflection process was interesting and informative for all involved. The boys developed greater self-awareness and were able to think in greater depth about their learning. It became evident that the boys struggle to fully express the development of their learning of a particular mathematical concept and that historical challenges to self-confidence remain. Critical thinking skills of analysis and evaluation were developed. The boys were able to demonstrate improved self-efficacy; a life-long skill that they will use to increase ownership of the learning of new concepts. They gave voice to their learning and discussed the processes not just the outcomes. A further action could help equip the boys with the means to express themselves more confidently and eloquently.

Reflection Statement

When I first applied to the IBSC action research programme, I was uninspired by my teaching and was at a crossroads in my career. I was bored in my work and was looking for new challenges. After I was accepted into the programme, I was promoted to Head of Subject: Mathematics and took over the coordination of a team of 15 Mathematics teachers who varied from those with more than 25+ years of teaching experience to those with little experience—either interns or newly qualified teachers. I struggled to find time for the research and together with some personal challenges throughout the programme, I wondered if I would ever complete the journey. Thanks to the ongoing support of my team leader Janetta Lien and my mentor Colleen Kennedy, I have managed to learn so much through this opportunity. The support of previous members of the IBSC action research programme, Kristy Carlisle and Tammy Bechus inspired me to continue when I was overwhelmed with school and home commitments. Over the past 18 months, I have learnt a lot about myself, the boys I teach and the teaching and learning of Mathematics. I have read interesting articles and been encouraged and inspired by researchers from all over the world. I thank the IBSC and the leadership of St David's Marist Inanda for this very valuable learning opportunity. Thank you to all those that have helped to support me over the finishing line.

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