DEVELOPING ACADEMIC RESILIENCE IN GRADE 8 BOYS THROUGH PROBLEM-SOLVING

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Abstract

In September 2017, a class of twenty-four Grade 8 boys participated in a mathematics problem-solving course. The boys were instructed that their answers were less important than their attempts and their thinking more important to show than their solution; together we tackled the six weeks of problems, and together we grew.

The preparation and development of a structured problem-solving course allowed this action research to evaluate the development of resilience in Grade 8 boys. Each of the chosen tasks refined a particular mathematical skill that would give a basis for both mathematical knowledge as well as personal life skill—resilience. This combination of skills being taught was in line with the IBSC theme of adaptability, as well as our own departmental focus on problem-solving and critical thinking.

When analysing the boys' feedback and observation notes, it was evident that resilience is a multi-faceted variable that requires a clear sense of focus and preparation to target successfully. Boys of varying abilities experienced this with varying levels of intensity. However, each boy I spoke with felt that he had shown grit and tenacity in the problem-solving course.

The results of this action research project highlighted in my mind as an educator the continuous need to strategize, plan, and reevaluate our goal of resilience through problem-solving as a mathematical and social skill that boys can develop. My own experience of growth through this project came in the self-evaluation of the lessons and feedback my students gave me in their experiences, and as a class we grew. Moreover, this growth is something I have shared with my department, my community of mathematics educators locally, and internationally.

Introduction

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The 2017/2018 IBSC topic, *Adaptability in a Changing World,* immediately made me ask myself the question, “Am I preparing my students for a changing world?” It offered me the opportunity to explore this question and observe how my subject could develop adaptability skills through problem-solving activities.

As the chair of the Mathematics Department it had been an intentional goal of mine and the Mathematics staff in the department to develop problem-solving skills and critical thinking as part of our teaching practice. This skill, we felt, was not only useful for our students to obtain a richer understanding in our subject, but it also equipped them with lifelong skills. It was with this foremost in my mind when I joined the action research cohort that I began to formulate the scenario that would answer the question: *How might participation in a mathematics problem-solving challenge develop academic resilience in Grade 8 boys?*

It was through the readings of the course, as outlined by Stringer (2008, 2014), that a model of effective action could be devised to run the action research. Along with this being a departmental goal it became evident too that the other stakeholders should also be actively engaged in this research (Stringer, 2014). Parents initially, and students continuously, would be part of the cyclical process of gathering and reflecting on responses and observations. Similarly, as the teacher in the room, I would also be involved in process and would need to be flexible enough to make changes and adjust my own teaching as the process developed. This 360-degree approach to the research would ensure the maximum benefit from the project could be obtained and the change in both student and teacher could be monitored and maximised.

Literature Review

Mathematics as a discipline of problem-solving relies heavily on content knowledge and also the adaptability to implement multiple strategies of content usage. Martin (2002) introduces the concept of academic resilience, which we can relate specifically to Mathematics. Martin argues that while motivation is critical to success, gains made by students can be lost if they are not resilient to setback. Martin also notes that it is important that students are motivated and resilient to academic pressures. One problem with boys who have underperformed is motivation. Motivation theory, sadly, has not been formulated in a way that provides educators and students

with a common language with which to develop motivation and academic resilience in the classroom. What is needed is a model to assist boys and teachers to find this common language in order to engage in problems when faced with adversity or lagging resilience.

Language is vital as Martin (2002) points out; however, Collie and Martin (2016) suggest that since teaching is by its very nature a novel, changing, and uncertain job on a daily basis, the choice of language is even more vital in the classroom environment. Being able to respond effectively to this change is known as adaptability. Collie and Martin (2016) go so far as to say that adaptability is vitally important for teachers, and boys, for their healthy and effective functioning at school. For this to happen, approaches for assessing adaptability need to be implemented by the teacher for the students to flourish.

Overholt and Ewert (2015) propose the development of resilience through participation and experience of learning through a disruptive event. Their research found that boys, in particular, did not benefit from learning experiences that were disruptive in nature. Rather, well-planned and well-structured programmes yielded the highest amount of resilience and persistence in activity for boys.

Wilson, Sibthorp, and Wilson (2016) found that playing is not a disruptive activity for boys, and further found that games can be used constructively to build resilience. Their groundwork for resilience was then expanded in the work of Carol Dweck (2017), who makes a persuasive argument for boys being able to view failure as a growth opportunity, rather than a perpetual barrier to success. This is often referred to as possessing a "growth mindset" Dweck (2017). Dweck expands this concept further to say that belief is a significant contributor to resilience in a growth mindset model. Building success out of failure requires a mindset of resilient behaviour and beliefs.

Problem-based approaches to learning and developing resilience have long been studied. Hmelo-Silver (2004) suggests that by having students learn through the experience of solving problems, they can learn both content and thinking strategies. The teacher in these classes acts to facilitate the learning process rather than to provide knowledge. Boys in these classes develop flexible knowledge, effective problem-solving skills, effective collaboration skills, and intrinsic motivation. These contribute actively to developing resilience.

Part of being in these classes as described by Hmelo-Silver (2004) is being able to engage in non-verbal communication skills as described by Kennedy, Carney, and Moree (2017). Non-verbal

communication skills include all behaviours performed in the presence of others or perceived either consciously or unconsciously. The way teachers express themselves in a non-verbal way contributes to the boys' ability to engage in content and to develop resilience in the tasks presented.

For some boys, problem-based, non-verbal communication will require a great deal of adaptability before any amount of resilience is developed. Martin, Nejad, Colmar, and Liem (2013) describe adaptability as "appropriate cognitive, behavioural, and/or affective adjustment in the face of uncertainty and novelty" (p. 729). They show that adaptability can predict academic and non-academic outcomes, and, in the focus of my action research project, resilience.

Coupled with student adaptability, I am aware that teachers of boys, in situations where boys are under pressure to be adaptable, need to be mindful of their own reflections in being adaptable as facilitators of learning. Vaughn, Parsons, Burrowbridge, Weesner, and Taylor (2016) suggest that adaptability from the teacher is a leading contributor to a student learning adaptability and this is a predictor of academic and non-academic success for students. They argue that without teacher adaptability and resilience, students will not be able to develop these skills in themselves either.

In our multicultural society of South Africa, it is important for teachers and boys to have intercultural communication skills. Williams (2016) found that two specific skills, intercultural adaptability and intercultural sensitivity, gave teachers and students the greatest tools for communication in a mix-culture classroom. Furthermore, the author found that students who experience the greatest diversity in classroom culture developed greater intercultural communication skills.

The literature highlighted that I needed to find multiple strategies to engage learners in developing resilience. My choice of language as well as my non-verbal communication would be vital in the process to develop resilience in the boys. Where possible, disruptions to "normal" learning needed to be kept to a minimum and disruptions from playing games needed to be seen from a growth-mindset. The problem-based approach to learning would require a great deal of teacher and student adaptability and this needed to occur in a multicultural environment where I was cognisant of all students' abilities, backgrounds, and needs.

Research Context

St. Stithians Boys' College is a leading South African boys' school established in 1953 on a 110-hectare estate in Sandton, South Africa. As a Methodist school striving for excellence in providing a relevant and rigorous education, and for best practice in the education of boys, we have a conscious focus on the “Saints Honour”, namely to 'Honour God, Honour others and Honour self".

“Seven pillars” (academics, sport, culture, community service, leadership, outdoor education and spirituality) support the life of every boy and through them we encourage boys to realise their maximum potential. Our mission, purpose, and passion is to walk the path towards manhood with our boys and support them as they emerge ready to serve, lead, contribute, and make a difference.

The college is made up of 800 boys in Grades 8 to 12. I chose to work with 26 of these boys who all took Grade 8 Mathematics. I did not have Grade 8 Mathematics on my timetable, so I was free to take these boys for the required sessions over the period September to December 2017. The class were of mixed mathematics ability and this allowed me to get a sample of boys across the marks spectrum in one class.

Information letters were sent home to the parents of the boys and permission was received via email from the parents to allow their sons to be part of the action research. Anonymity was assured, with students being referred to as Boy A, Boy B etc. in the write-up of the research.

The Action

Step One: Introduction

My first step was to introduce my students to the research process and what they could expect from me and what I could expect from them. Key to this was my description of how I expected them to show their thinking and how their participation was a vital part of the process. I described how the sessions would run and how we would be using the feedback from the sessions as well as the post interviews to learn together how best we could develop resilience through problem-solving.

This introduction allowed the students to feel like they were part of the learning and how they could also understand my research question. We discussed what they wanted to learn, how we were going to achieve this, and how they were going to mathematically show me their thinking.

Step Two: The Process

The boys and I tracked our sessions as they were planned and presented, and we spoke before and after each session to gauge how they were feeling about the problem-solving strategy they were about to learn. Students were given time to make note about the strategy after each session so that I could also read their feedback that they might not have been able to verbalise in the classroom setting. They also had the opportunity to look back at what they had written to me and reflect on that feedback in the post-interviews.

Step Three: The Result

Each boy was given a weekly work pack that had the problem-solving strategy and questions inside and a place for reflection at the end that he would measure himself against and offer open-ended responses to the session. The purpose of this was for the boys to start to be cognisant of their feelings towards difficult problems and how they felt before, and after, they were given the tools to handle the problems.

Data Collection

The journey of action research that I took with my Grade 8 class was one built on an open communication of expectations, my interest, and their part in the research. We began with a lesson dedicated to how we will be working together in this action research. Thereafter, I used note-taking in a journal, video recording of lessons, recorded interviews of participants, as well as student self-reflections sheets that contained a Likert scale option structure. The note-taking and lesson recordings and Likert scale questionnaires happened weekly over the course of my research, while the individual interviews happened afterwards in a one-on-one or two-on-one setting.

The note-taking and video recordings were used to recall events afterwards that I may not have noticed at the time and allowed me to relook at the way the class interacted with the process and with each other. The Likert scale allowed the students to give me a gauge of their reactions to the sessions as well as for them to feel that they are all part of the process of action research, and to get some feedback from them that they may have been too shy to share to the class.

Along with my own observations and notes, I had a teaching assistant in the room at all times taking their own notes and observations as well as the video recording of the sessions to compare my own notes with post session. In this way the data I collected and presented was verified as credible by two additional sources.

Data Analysis

The blend of structured and unstructured data collection techniques, both qualitative and quantitative in nature, gave me a spectrum of data that I could analyse as part of the research. I looked for patterns in terms of words the boys used to describe their approach to problems, as well as to how they perceived their abilities to solve problems they had never seen before (Stringer, 2014). I used the Likert scale data to put a measure to how individual boys tracked their own participation and resilience.

A combination of the self-reflection data as well as the recorded data key words and phrases then allowed me to create questions for the interviews which could better gauge the level of resilience through participation in the problem-solving course.

Discussion of Results

During the data collection process and especially in the analysis of data, four themes emerged as results of my actions on taking my Grade 8 boys through a problem-solving course. These themes were: the effects of a mixed-ability group of learners; the boys' accuracy of self-analysis and reflection on their own abilities; the boys' intrinsic love of mathematics versus mathematics for mark; and finally, how strong of a mathematics base the boys had coming into the challenge.

Effects of mixed-ability group

We have had a Mathematics department policy over the years of streaming Mathematics classes on ability in Grades 9 through 12, and so the decision to run this challenge in a classroom of mixed-ability boys was taken to get the full range of mathematics abilities exposed and to get feedback from a diverse group. That being said, the boys themselves were initially apprehensive of working in this environment. Boy A commented, "I don't want to look stupid in front of the smart boys," with Boy C summarising it well when he said, "I like maths, but maths doesn't like me, and if the smart boys see me struggle I feel bad, but I know other boys are struggling also which helps me feel better about myself." This initial worry in the classroom was definitely something I had in the back of my mind as I worked through the challenges. To counteract some of the worries of the boys, I made booklets that allowed each boy to show his own thinking without them feeling pressured to be correct in front of their peers. This led to some interesting observations, with Boy B stating, "I'm so used to doing this in my head and putting my hand up and getting the answer correct, do I have to write down my thinking?" or Boy D who said, "Sir, can't I just give you the

answer? I don't like writing down and the boys who are slower won't mind." It was further evidence for me that a class of mixed-ability students would affect each other both positively and negatively. The boys' resilience, however, was visible in two distinct forms. The "weaker" students rose to some of the challenge of being in a mixed group and they stuck at working diligently in their workbooks showing their thinking. Boy A said, "I like working in this book, Sir, if I make a mistake and you see it and help me I don't feel bad, and I will keep trying harder at the challenges." The "stronger" students had to get used to not doing it all in their heads and they could find multiple solutions to problems. Boy B said, "When I do work in my head and give the answer and someone else doesn't get it I get bored while the teacher tries to explain it, now I get a chance to try many answers and see if they work."

Accuracy of self-analysis and reflection

Part of my data collection looked at how boys would self-analyse their engagement in the challenge and offer written feedback to themselves and me as the teacher. What became evident from the first week of this was that the boys who perceived themselves as weaker mathematicians told me what they thought I wanted to hear. Boy E wrote in his journal, "I felt like I could do all the work today and I will use this in a test." This, sadly, was not the case as everything that Boy E had done to visualise his thinking was off the mark. He wasn't alone, with Boy G noting "Thank you, Sir, for today, I feel like I learnt a lot and I hope you like my answers." On looking at his work for the day, Boy G had also missed the core of the challenge and it was clear that they just wanted me to know they had tried. I asked these two boys in a follow-up interview what they had meant by their journal entry and Boy E said, "Sir, I just didn't want you to think I couldn't do it, or to think that I was dumb, Sir." This feedback struck a deep chord with me and it reminded me of the work of Hattie (2015) who noted that the number one effect on student achievement was how the teacher estimated student achievement. Could it be that resilience is similarly correlated?

Love for mathematics versus mathematics for marks

If there was to be one overwhelming theme that summarised all of the above themes it was encapsulated in the one question that I received every session: "Sir, is this for marks?" There was a genuine dread of the work in the boys' eyes in beginning when they thought this may be for marks. Boy E went as far as to say on his first session, "Sir, please don't tell my parents if I fail this," and Boy D asking, "Sir I've already passed my first test this term, can this replace it if I do better?" It was a double-edged sword also, as the more the boys attempted to do the work for the

pure love of mathematics, they would soon be asking me to please mark it if they did well. An influencing factor perhaps on how students view themselves is how they are ranked and marked on tasks they have completed. In one class, Boy A said, "Sir, please come look at this, and if it's right please mark is right so that I can show my parents." Even though none of the work had any sort of mark allocation attached, boys would be concerned about how much they could obtain. Boy C went as far to say, "Sir, but if it was for marks how much would you give me?" Some of them would go as far as to mark themselves out of a possible mark that they had guessed. It was only near the end of the challenge that they started to realise that I was not marking, it didn't count for marks, and all I wanted to see was their engagement and attempts. In the follow up interview, I probed this need for marks and Boy A said, "Sir, it's school, everything is for marks, even when teachers say it isn't." This trained response to activities makes me wonder how much of an impact on resilience marks have had on students.

Core mathematics ability

The final theme summarised how much resilience I was able to identify and it correlated almost entirely with the students own core mathematics ability, both actual and perceived. The students who classified themselves as weak, attempted fewer questions per session, engaged for shorter amounts of time on each question, and generally gave up sooner than those who classified themselves as stronger. In my follow-up interviews I asked both groups "What do you do when you get stuck?" Boy G, who would classify himself as weak, said, "Sir, it gets hard and I wait for you to come help me, but I also look back at what I have done, and I feel ok Sir," while Boy D, who would classify himself as strong, said " Sir, when I don't know what to do, I do what I can and try follow some basic rules, that always helps me." While the weaker students were not necessarily less resilient, they did need someone to guide them more often and for them to know that I would not judge them for needing help as often. The stronger students, although seemingly more resilient, needed reassurances also that they were on the right track and that they were not "wrong."

Conclusion

I began this research with a class that had already had 8 months in the grade they were in, and in hindsight perhaps, habits and class dynamics had already been created that may have affected my ability to gauge resilience. Within the class, the students who felt that they were weak had already been in that mindset for the entire year up to that point and the boys who considered themselves

strong were already used to being able to answer the questions immediately. I sat and spoke to a few of these boys in the follow up interviews. Boy A said, “Sir, I knew I wasn’t the best and all I wanted was time to get ready for the exams without the pressure of a maths challenge course.” Boy C also noted, “Yes, Sir, it’s not easy for us and we felt like the other classes were doing work and we were falling behind and that stressed us.” Boy B added, “Sir, my folks put so much pressure on me to get a good maths mark, I mean I can do it, but still, I just wanted to know what was coming up in the exams and be ready.” It seemed to make no apparent difference based on their maths abilities, the boys did not enjoy the timing of the challenge.

The participation in the problem-solving challenge did show some signs of resilience in the Grade 8 boys. It was clear to me that the mixed-ability context was important to give both strong and weak mathematicians scope for growth, it was good for the weaker boys to work in a class with the stronger boys. Lessons perhaps should be redesigned so that students of similar ability work on tasks appropriate for their level in groups and this differentiated group work would form a framework to enhance the environment and assist resilience further. Whilst there is never a best time to do this type of problem-solving challenge, a longer exposure to the course may prove to assist resilience and lessen the anxiety about time taken for the course over “normal” classwork.

Reflection

This has been a rollercoaster of effort and enjoyment, days of intense output and days of freefall. I’ve been teaching for 17 years and have enjoyed the process of upskilling myself in new ways of thinking and interacting with my students. The entire action research programme makes you a better teacher—of this I have no doubt. The calibre of people you interact with, and the mentorship and guidance you receive is the best in-service training you could sign up for as a teacher.

At times being the chair of the Mathematics Department and allocating time to doing the action research project well seemed mutually exclusive, but it was at those times that I thought of the students and how much they had grown with me that I pushed harder. It would also be remiss not to mention the key people in this process. My deputy in charge of academics at St Stithians Boys’ College for giving me this opportunity. My mentor, Ms Janetta Lien, whose patience and poise belied the number of grey hairs I am sure I gave her along the way. Janetta’s guidance was invaluable and this would not have been completed were it not for her. Finally, to my team in the mathematics department, thank you for running this race with me.

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