Mathematical Resilience Workshop

Conference or Workshop Item

Mathematical Resilience Workshop

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What do we know about Mathematical Resilience?

Mathematical Resilience is a positive stance towards learning mathematics, which is characterised by:

- having a growth mindset – the resilient learner understands that they can improve their own mathematical understanding through their own efforts and appropriate support from others. They do not accept that they cannot do mathematics, although they will readily agree that they cannot do certain areas of mathematics yet!
- understanding the personal value of mathematics and that they are a valued member of the community of mathematics learners. This is ultimately about inclusivity and stands against the elitist idea that only some people are able to do mathematics and if you cannot it does not matter. Resilient learners understand that mathematics will empower them; being willing to engage with numbers prevents many ways that unscrupulous people try to defraud or cheat; the systematic thinking, the logic and reasoning required allows them to problem-solve in their lives and careers. Resilient learners know mathematics has value and they also know that their ideas and understanding are valued and useful as the community of which they are part struggles to learn mathematics.
- knowing that mathematics requires struggle to learn and that with the right support success will come. The idea that mathematics, with its abstractions and symbolism, can throw up barriers is understood, and a resilient learner will accept challenge and persevere until they succeed, as they have succeeded before. Resilient learners do not expect their teacher or peers to smooth the path, rather to support them as they overcome difficulties.
- understanding how to seek and get appropriate support that will enable learners to succeed. This may mean talking to adults and peers in their groups, and therefore they can expect their teacher to help them to develop language suitable for talking about mathematical ideas. However, it also may mean accessing help from books or from the internet. Someone mathematically resilient knows they have the right to understand. Hence, if one form of support does not work they seek another.

Working to develop mathematical resilience is important as a result of myths that have circulated within UK society and in many other countries. For example, when faced with mathematics, many people believe they have to remember how to do each separate move in a process and to reproduce these moves substituting different numbers. They feel they just cannot remember all the moves, therefore they 'cannot do mathematics'. Others feel that mathematics is something that only an elite can do and they are not part of that elite so once again they do not expect to be able to do mathematics. A further common myth is that only the teacher knows the one 'right

way', and therefore asking other people will not help if they cannot understand what the teacher says.

However, we think that mathematics is a connected subject. Therefore if you can do one bit you can make a start on doing something else. We consider that asking someone to 'remember' and especially to 'remember quickly' is counterproductive as it often provokes a 'freeze, fight or flee' response, whereas giving time to think and calmly remember or reconstruct is likely to result in success. We also consider that everyone is able to improve their understanding of mathematics, with effort, help and support. Everyone can become sufficiently numerate, unless they have a rare learning disability, to prevent them being easily defrauded and in that way mathematics can be useful and empowering for everyone.

We argue against 'one right way', we contend that there are many, many ways to approach any mathematics problem. We understand that some ways are more efficient and elegant than others but if the learner uses their way to get the answer then it is good enough for now. Of course we want learners to develop efficient and fluent ways to engage with mathematics but we believe that such ways are the result of being willing to seek understanding and apply reasoning. Learners need to feel part of a community where it is safe to make mistakes and to acknowledge that they are stuck. Such a community offers just the right amount of help and support so that the learner knows that they succeeded. Resilient learners are able to experience the joy of overcoming barriers and succeeding.

Group 1: Building Mathematical Resilience using awareness of perezhivanie

Participants worked with us on what Vygotsky had to say about emotion in relation to cognition, environment and learning effectively, to reflect on experiences of learning and teaching mathematics and develop our ideas about mathematical resilience. We introduced Vygotsky's notion of 'perezhivanie' as involving a significant experience, which determines the influence of the physical and social environment in later events and which can be a powerful tool for reintegrating emotion and cognition.

> An everyday reading of perezhivanie brings to our attention what is happening in the environment, and how the situational characteristics are being experienced by the [learner] (Fleer 2016: 36).

Perezhivanie is an integrated unit: on the one hand, it involves the environment, that which is being experienced, on the other hand, how that environment is perceived (Vygotsky, 1978). We asked participants to reflect on how much account is taken of perezhivanie in mathematical learning by both teachers and learners. We used the example of Bonnie, who had a preference for drama and her personality was outgoing and empathetic; she was a confident mathematical learner until she was 14. That year she found her mathematics classroom inhumane. The teacher seemed to lack empathy, and Bonnie has been frightened of mathematics since then. Her previous perezhivanie was relatively positive which indicates her experience of that mathematics environment was very significant and resulted in a changed perezhivanie in relation to mathematics.

Developing mathematical resilience may involve a complete transformation of the learner's perezhivanie by changing the prism through which the learner sees and understands her situation. This is much more than just adopting a positive approach as there is extensive emotional struggle involved.

> The concept of perezhivanie is intriguing for educators as it raises questions about the totality of the lived experiences of students within our classrooms and how

> these experiences might be cultivated for the most meaningful forms of learning. (Davis and Dolan, 2016: 51)

In the discussion, we noted that the concept of perezhivanie and the mutual relationship between cognition and emotion was seen as fairly new. Some delegates expressed their own experience of perezhivanie as students when they had found some mathematics teachers cold and without empathy. Some felt that they have grown into cold mathematics teachers as a result. For example, one teacher reported finding it extremely difficult to adapt his approach. He had been told he is cold and clinical by one of his students, who reported feeling as though they are being taught by a 'patronising teacher'. He does not want to be like this. He realised that this student had regressed in mathematics and he provided them with one-to-one support to help gain back their interest. This raised the question how to support teachers to transform their own perezhivanie.

During the group work, similar conversations were observed about the participants' mathematics departments' policies, linking them to the idea of perezhivanie. An example was given of students receiving lunch time detentions due to lack of homework when the lack was because students could not access the work. Conversations moved towards teachers' intervention and support to transform students' perezhivanie. The question was posed, "To what extent can the teacher provide intervention and support to transform the situation?" Support should enable learners to reach the stage at which they can overcome both their cognitive and emotional difficulties and, therefore, regulate their own learning and emotions. Points which may be worth exploring further are: the collaboration between teacher and learners to transform the perezhivanie (not only the teacher giving direction and the learners accepting and following them), how teachers can support learners to develop skills to transform their perezhivanie independently and learners' past perezhivanie due to summative assessments and how can teachers support them to transform this.

Group 2: Perseverance: balancing challenge and support

This workshop explored two issues related to developing mathematical resilience: the need for learners to understand how to work at mathematics – particularly a willingness to struggle and persevere (Bandura, 1994) and the need to carefully balance challenge with support and scaffolding to avoid anxiety and disengagement.

The need to balance challenge and support can be represented through the Growth Zone Model (Lee and Johnston-Wilder, 2013). For many learners, studying mathematics is a source of anxiety – which can lead teachers to over-support due to a keenly felt wish to reduce the discomfort of learners. Such over-support tends to keep learners within their comfort zone and reduces the potential for new learning. In contrast, not supporting enough means learners are allowed to flounder, which is likely to take them into their red zone – anxious, frustrated and disengaged.

The solution lies in the teacher stepping back, being less directive and letting learners struggle and take responsibility for their own learning, while accessing the support of peers and others. It also requires teachers to be sensitive to the needs of each learner, judging when scaffolding is required, and to create a positive classroom climate where all learners feel emotionally safe and are able to ask honestly for what they need to thrive.

Motivation to persevere is also part of Bandura's (1994) notion of self-efficacy. The more students feel self-efficacious the more they will persevere. Bandura's four sources of efficacy beliefs are: mastery experiences – the experience of success, and

particularly success achieved through effort and struggle; social modelling – observing role-models who have achieved mastery despite adversity; social persuasion – having others who provide opportunities for mastery in a safe and purposeful manner; and physiological states – how we interpret our emotions in response to stress, struggle, or mistakes. Workshop participants were asked to reflect on these beliefs whilst discussing how their actions might influence learners' self-efficacy a) when introducing a task, b) during the task, c) while reviewing the task. Suggestions included:

Before	**During**	**After**
Establish a positive/'safe' atmosphere where learners feel happy to make mistakes, answer questions and get stuck Set and maintain ground rules for behaviour and ways of working Provide clear criteria for success (which should be process focused) Ensure clarity – so learners can explain what they need to do Ensure teachers know which pre-requisite knowledge and skills are required to enable learners to succeed and have ways to establish that the students have that knowledge or those skills Provide low threshold-high ceiling tasks that are accessible to all	Allow quiet thinking time at the start Use exploratory questions (Have you seen a similar problem before? Are there any resources that would help you? What strategies have you tried or could you try?) Ask learners to talk through and share approaches that they have tried Provide prompts around the room to refer to (e.g. Brain, Book, Buddy, Boss, or C3B4ME – see three before me) Provide a 'help desk' or 'tool box' of resources for learners to draw on Praise processes and effort (not results or answers) Ask learners to convince each other that their methods or answers are appropriate Encourage flexible thinking to avoid getting 'in a rut'	Time for reflection – make this important! Reflect and unpick the processes used – identify what worked well (What did I overcome? How did I get unstuck?) Share ideas and normalise error-making as part of the process Encourage learners to make videos of how to solve a problem/overcome a difficulty Make links to similar problems Feedback on the process – not just the solution Recognise success – how is it marked or identified so you can look back at it? Plan ahead - what will I do next time? Celebrate success!

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