# Reducing Mathematics and Examination Anxiety Using the Five Question Approach

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Mathematics anxiety and examination anxiety affect student well-being, engagement, and performance in the mathematics classroom. An increase in confidence in the mathematics classroom leads to a decrease in anxiety. This paper reports on the Five Question Approach (FQA) to teaching mathematics which provides teachers with a method of reducing these anxieties. This case study draws on data collected in three Australian secondary classrooms using the FQA as an intervention. Findings indicate that when added to normal classroom practice, the Five Question Approach alleviated these anxieties to some extent and increased engagement and academic performance.

Mathematics anxiety is a significant issue for many students and varies from other anxieties as it is specific to mathematics (Li et al., 2021). Much research has been conducted on mathematics anxiety in both teachers and students, with some research providing suggestions to assist in the alleviation of mathematics anxiety, including reinforcement activities, time for students to develop understanding, class discussions, formative assessment, timely feedback, and linking the level of difficulty of the questions to the students' level of understanding (Passolunghi et al., 2016; Pizzie et al., 2020; Russo et al., 2020). This paper proposes that the Five Question Approach (FQA) may be a pedagogical strategy that could not only reduce mathematics anxiety and examination anxiety but also increase engagement and academic performance in the mathematics classroom.

## Literature Review

### Mathematics Anxiety

Mathematics anxiety is a feeling or an emotional response to the challenge of completing a mathematical task, and it often takes the form of irregular breathing (Allen & Stambaugh, 2023). There are many definitions of mathematics anxiety, but it is accepted to be a feeling of fear, apprehension, and tension that negatively influences a student's ability to solve mathematical problems (Justicia-Galiano et al., 2016; Li et al., 2021). Mathematics Anxiety is specific to mathematics content, is separate from other anxieties, and can occur before the student commences the mathematical task (Moustafa et al., 2021). Students suffering from mathematics anxiety may not attend mathematics classes or avoid selecting classes that involve mathematics (Justicia-Galiano et al., 2016)

There is a discussion on which comes first, the mathematics anxiety or the poor performance; whatever the direction, an increase in performance through greater confidence could result in a reduction in mathematics anxiety (Fernandez-Blanco et al., 2023; Rossi et al., 2022). Mathematics anxiety reduces working memory by diverting cognitive resources away from procedural execution thus reducing the students' ability to solve mathematical problems (Girelli et al., 2000). Interventions like deep breathing exercises and positive affirmation can reduce mathematics anxiety and a change to teaching that allows students to correct conceptual misunderstandings, practice procedural skills with a view to automatisation, and solve problems in groups could also reduce mathematics anxiety (Allen & Stambaugh, 2023). Achievement, engagement, and enjoyment of mathematics are all impacted by mathematics anxiety, and improving students' mathematical skills is essential for a reduction in mathematics anxiety (Li et al., 2021). As the FQA is designed to improve achievement, engagement and the enjoyment

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of mathematics then this paper suggests that the FQA may then potentially reduce mathematics anxiety.

## Five Question Approach (FQA)

Mathematics anxiety is heightened by many factors but crowded curriculum and restrictive time to develop understanding without personalised assistance are major issues (Ma & Xu, 2004; Mann & Walshaw, 2019; Putwain & Wood, 2023; Wang, 2024). Many current NSW mathematics classes use a traditional teaching approach with a prevalence of teaching mathematics with procedural questions, little opportunity for problem solving, a restrictive linear delivery of curriculum and not revisiting any student problem areas (Sullivan, 2011). The FQA was designed by the author to allow teachers to take small steps towards a change in practice without completely changing their entire approach to teaching. The FQA evolved as a means of not just consolidating procedural knowledge but also developing conceptual knowledge and increasing student confidence and engagement. The FQA does not replace the teacher's normal lesson but is meant to be one of the tools at the teacher's disposal to potentially increase positive learning outcomes and student confidence, thus potentially reducing mathematics anxiety. The FQA varies from the traditional teaching approach as multiple opportunities are provided over a period of time for students to consolidate their mathematical understanding of previously taught content areas and procedures, with a focus on building confidence, problem solving and conceptual understanding.

The FQA consists of four procedural questions and one conceptual question. The questions are presented at the commencement of the lesson and a new set of five questions are provided every lesson. The basis for the first four questions being of a procedural nature is threefold. Firstly, they are designed to develop procedural fluency, to decrease the load on working memory when problem solving potentially reducing mathematics anxiety (Mann & Walshaw, 2019). Secondly, they are developed from previously encountered material as direct revision and consolidation, aligning with the view that reinforcement activities reduce mathematics anxiety (Mehmet & Hulya, 2021). Thirdly, they are used to prepare students for future content areas by providing the procedural basis for future topics. The first four questions are usually based on one question from the previous lesson, two questions from previous content areas, and one question preparing for upcoming topics. The purpose is to provide time for the students to revise and develop understanding and confidence in all content areas. The procedural questions are not decontextualised right/wrong questions but the questions are carefully chosen based on student areas of difficulty as perceived by the teacher. Often, they are chosen from material that the students should have understood from previous classes or that they have not had time to fully understand. This aligns with the research by Mehmet & Hulya (2021) where a lack of understanding from a previous class was a significant factor in mathematics anxiety along with teachers not completing reinforcement activities. Putwain and Wood (2023) state that individualised learning matched to the student, while possibly difficult in the classroom can result in a decrease in mathematics anxiety. The first four questions are designed to address these issues through careful selection based on student needs. The complexity and degree of difficulty of the first four questions are progressively increased as student understanding increases using repetition with variation (Rohrer et al.,2020), thus providing reinforcement of the areas of student difficulty.

The fifth question is an open-ended conceptual problem-solving question on any topic that provides the opportunity for a deeper understanding of that concept which could result in a decrease in mathematics anxiety (Ma & Xu, 2004). By providing opportunities for students to discuss their solutions to question five with multiple strategies for solution may reduce mathematics anxiety (Mann & Walshaw, 2019). Students are required to complete the questions in order, from one to five, to ensure that they do not omit the questions that they were less

confident in or, did not want to do. While the students are attempting the questions, the teacher moves about the room, providing assistance, if required, and giving positive diagnostic feedback. The one-on-one interaction between the teacher and the student is a factor that may reduce mathematics anxiety (Mehmet & Hulya, 2021). As the questions are based on student need every application of the FQA is a formative assessment opportunity with immediate diagnostic feedback, which may reduce mathematics anxiety (Wang, 2024).

The table shows an example of the FQA for the Year 8 class and includes the purpose of the question relating to the FQA description. The students only receive the question.

**Table 1**

*Sample Five Questions*

| | |
|---|---|
| 1 | Write 35 : 20 as a ratio in simplest form: A revision question |
| 2 | Find 17 ½ % of $540: Preparation for the next topic |
| 3 | Solve $5 - 3x = 2x - 10$: A revision question |
| 4 | Find the length of the hypotenuse in a right-angled triangle with sides of 8 cm and 11 cm: Current topic |
| 5 | Write 5 scores that have a mean of 4, a median of 3, and the mode is not 3. How many solutions are possible? Add another aspect that will reduce the number of solutions: Revision and consolidation |

Given that students work and learn at different speeds, the first four questions are selected so that the majority of students can complete them successfully within the time allocated by the teacher. The purpose is to develop procedural fluency, assist in developing understanding, and increase student's level of confidence, thereby potentially reducing their mathematical anxiety (Mehmet & Hulya, 2021). Question five may be superficially answered by some students and deeply investigated by those completing questions one to four more quickly, allowing for differentiation in the classroom. While the teacher usually gives the answers to the first four questions, students are selected to present their solutions to question five to the class, providing the opportunity for students to learn from each other (Mann & Walshaw, 2019). Students with a superficial answer would be selected first and then students with a more extensive answer, allowing all students the option of presenting solutions over time.

The first four questions in the FQA have the questions increase in difficulty and complexity as students show that they understand the method of solution or solutions. The questions are not chosen to foster rote learning but to provide an opportunity to use memorisation, repetition with variation, and spacing to consolidate required mathematical skills, and to connect with other areas of knowledge (Rohrer et al., 2020). The teacher must make decisions about how often a question is repeated from lesson to lesson before the level of difficulty is increased. It is the level of knowledge of the individual student and the class group that must be considered by the teacher in the progress of question development (Pawley et al., 2005). By using this approach, there is an attempt to make the learning personalised within the classroom environment, which may assist in reducing mathematics anxiety (Putwain & Wood, 2023). For example, the equation questions in the FQA example would have begun as one-step equations, moved to two-step, and then continued as the student's competence increased to the equation given in question three.

While moving about the room the teacher will support any students that may still require assistance as the questions are being attempted so that all students are successful. Student success then builds confidence, and as a result, may increase student engagement and potentially reduce mathematical anxiety (Carey et al., 2016; Putwain & Wood, 2023; Skemp, 1989). The repetition of questions and the development of greater complexity at a rate tailored to student needs, through the FQA, provides students with success and positive feedback every lesson and as such provides an opportunity for both confidence and competence to grow. According to Skemp (1989), when students are working within their region of competence

(domain), they feel confident and secure. When working outside of this region they may feel frustration and anxiety. The FQA allows students to gradually move to the limits of their region of competence and beyond by using a careful selection of questions to gradually extend students' mathematical knowledge and competence beyond their Zone of Proximal Development (ZPD) (Vygotsky, 1978).

## Methodology

The FQA was introduced to the participating classes as an intervention designed to improve engagement, academic performance, enjoyment of mathematics and reduce mathematics anxiety. As the FQA requires time to be effective, data was collected from two schools over a school year. Focus group discussions with students, teacher interviews, and classroom observations were used to collect qualitative data on perceived academic performance, enjoyment of mathematics and levels of mathematics anxiety, at the end of terms 1, 2, 3, and 4. The examination performance of each student was analysed using data from the end of year examination in the previous academic year, compared with the half yearly and yearly examinations in the current academic year.

### Contexts

Two Catholic Systemic schools both with seven graded mathematics classes in each year level 7 to 10 were chosen for data collection. Both schools graded their mathematics classes based on the students' results in the yearly examination of the previous academic year, with potential student movement based on half yearly examination performance.

School 1 allocated the second-highest graded Year 8 class, taught by two teachers who shared the class: one working three days and the other two days per week. While both teachers were mathematics trained, they both had less than five years of teaching experience. School 2 provided a Year 9 and a Year 10 class, which was the fifth-ranked graded class. Both teachers were mathematics trained with more than ten years of experience.

### Data

All teachers received two days of training in the FQA at the beginning of the year. There were four follow-up half days during the year where fine-tuning of the writing of the questions and the application of the approach took place along with the teacher interviews. During the first three weeks, the teachers emailed the five questions daily for feedback. Quantitative and qualitative data on academic performance, engagement, anxiety level, and attitude to mathematics were collected. The quantitative data was collected by comparing the rankings of each student in comparison with all of the students writing the examination at that year's level compared with each student's ranking in the year level in the previous year's final examination. A student with a higher ranking would indicate academic improvement.

The qualitative data was collected through classroom observations, teacher interviews, and student focus group interviews which took place four times during the year. For each participating class the teacher selected a sample of six students from the class and they participated in the focus group discussions. The sample was stratified by selecting female and male students across a broad range of academic performance, engagement, and mathematics anxiety levels based on the teacher's knowledge of the students. All teachers had been at their current school for at least two years and had general knowledge of most students. The level of engagement and mathematics anxiety, at the commencement, was based on the classroom teachers' perception of the students. The Year 8 class engagement ranged from disengaged to highly engaged while the Year 9 and 10 classes ranged from highly disengaged to moderately engaged. The student focus group sample for each class along with their rankings in the final examination of the previous year is shown in Table 2.

**Table 2**

*Focus Group Student Name and Rank Details*

| Year 8 | Year 7 rank (out of 177) | Year 9 | Year 8 rank (out of 180) | Year 10 | Year 9 rank (out of 180) |
|---|---|---|---|---|---|
| Brenda | 53 | Jim | 121 | Allan | 107 |
| Sue | 39 | Allie | 137 | Joe | 92 |
| Corey | 46 | Shane | 148 | Sonia | 136 |
| Ella | 37 | Gina | 102 | Alison | 115 |
| Gemma | 73 | David | 164 | Sara | 106 |
| Lewis | 25 | Steven | 133 | Evan | 139 |

There were four focus group meetings of one hour duration and the focus group questions were written beforehand. The questions centred around the students' perceptions of their mathematical ability, how the teaching and learning in their class was different from the previous year, how they felt about the five questions, any change in their level of engagement or enjoyment of mathematics, the level of stress or anxiety they felt about mathematics and the examinations and their perceived academic performance. The questions were used as a stimulus for discussion. The questions in the teacher interviews were similar and the discussion was extensive usually taking one hour for each teacher.

## Findings and Discussion

The FQA allowed teachers that have not used problem solving strategies to slowly introduce these into their day-to-day teaching. The discussion around the fifth question was found to be the beginning of using student voice in the classroom. All teachers described how allowing students to explain their solution strategies for question five resulted in an improvement in understanding for some students and could reduce mathematics anxiety (Wang 2024).

As students are continually revising materials, through repetition with variation, providing reinforcement to reduce anxiety (Mehmet & Hulya, 2021), their level of confidence increases along with their success in class, and this has the effect of reducing their mathematical anxiety and particularly their examination anxiety (Mann & Walshaw, 2019). Most of the students in the focus groups for Year 9 and Year 10 classes initially stated that they had little confidence in mathematics, were not good at it, and found the classes stressful, but these aspects made a positive change over time. The students in the Year 8 focus group mostly felt confident about their mathematical abilities and related that to the fact they were in the second highest class in the year level.

### Teacher Perceptions

All three teachers made comments about the increase in confidence and the reduction in stress and anxiety of the students as the school year progressed. The classroom observations, taken four times during the year confirmed the teachers' comments as the students were observed to be more interested and engaged in their learning and there was a significant positive change in the engagement of students overall. Many behavioural issues such as disruptive behaviour, students making negative comments about the material in class, and refusal to attempt questions decreased in the Year 9 and 10 classes. While the Year 8 class was always very compliant, there was a noticeable increase in engagement, which was evidenced by more students offering to provide answers and an increase in the number of students willing to present their solutions to the class. The opportunity for the teachers to spend additional time focussing on the problem areas as identified in class or at the end of a topic allowed additional time for the students to develop understanding, possibly reducing anxiety (Mehmet & Hulya, 2021). The level of engagement was directly observed to have increased through the classroom

observations, and the student and teacher interviews provided additional confirmation. According to the Year 10 teacher, when discussing the yearly examination, "They built their confidence, and they were more prepared for the examination as they now had more confidence in mathematics." The teacher meant, when stating they were more prepared, that the students were both academically and emotionally ready, and she felt, from the student feedback from the examination, that they were also less anxious.

## Student Perceptions

The focus group students commented that the additional time spent on questions after the topic had officially been completed enabled them to have sufficient time to develop their understanding thereby increasing their confidence and reducing anxiety. The focus group students stated that the opportunity to continually revisit problem areas until they understood made them less anxious about mathematics and the examination (Mann & Walshaw, 2019; Mehmet & Hulya, 2021). The Year 8 focus group students felt that the FQA was significant in their improved results. Gemma said, "The five questions helped me get through the exams and achieve a higher mark." Ella, "I answered all the questions and when unsure, thought back to a similar question in the five questions"

In the first Year 9 focus group interview, David expressed that he was not good at mathematics; it made him stressed, and he wasn't interested. In the final focus group, he said, "It's making [me] a lot more confident and more—what's the word—engaged in it now. I can study easier, and with the five questions, it makes it a lot easier for me to be ready for the exam" By stating he was less stressed, David is indicating a decrease in anxiety.

The Year 10 final focus group had many comments about the examination as they had received their results and were quite pleased. Allen said, "The five questions helped me be less stressed about the exam because I knew I had a revision in the five questions." Evan said, "It feels like an exam when you are doing them (FQA) so you're not stressed when you are going into the exam." The comments from both students indicated a reduction in mathematics and examination anxiety as a result of the FQA.

## Academic Improvements

Many of the Year 9 and 10 focus group students indicated that they did not like mathematics and found the classes stressful, indicating a high level of anxiety. All of the classes in the study made significant academic improvements for many of the students, along with an increase in engagement and enjoyment, possibly indicating a reduction in any anxiety. The Year 9 class comprised the same students from the Year 8 class in the previous year and was taught by the same teacher. While there are many factors affecting student performance, the biggest change for this class and this teacher was the introduction of the FQA. When comparing the rankings from the Year 8 yearly with the Year 9 yearly examination thirteen students showed significant improvement, three of whom were ranked three classes higher. Three students improved slightly, with two staying the same and three performing below expectation. Considering that as a student moves up, then a student performing the same but previously ranked higher will move down one place, it is possible that all students except one showed improvement. The Year 10 class had a similar level of academic improvement.

The Year 8 class had nine students ranked in the top 20 in the yearly examination, indicating significant academic improvement. Twenty students performed above expectations, and eight performed below expectations.

Following the Year 8 half yearly examination two students, Gemma and Sue were moved up into a class taught traditionally, and one student, Zelda moved down into the class using the FQA. Zelda was added to the final focus group interview to provide the view of someone moving into the class using the FQA. Zelda made this statement about the FQA, "it (FQA) gives

you confidence in the fact that you have already learnt it" and made this comment about the yearly examination, "I think it (FQA) made a huge difference … quality not quantity was important … I think it is very helpful." Both Sue and Gemma felt that the lack of FQA in their new class was a significant factor in their poorer performance in the yearly examination. Their rankings in the half-yearly and yearly examinations are displayed in Table 3

**Table 3**

*Half-Yearly and Yearly Year 8 Rankings*

| Student | Year 7 yearly ranking | Year 8 half yearly ranking | Year 8 yearly ranking |
|---|---|---|---|
| Gemma | 73 | 7 | 67 |
| Sue | 39 | 7 | 52 |
| Zelda | 29 | 63 | 5 |

Sue, who moved from the class using the FQA to one that didn't, made this comment that indicates a significant increase in anxiety when not in the class utilising the FQA:

> While I was in the exam, I skipped so many questions and ended up coming back to them, and I was freaking out because I thought I knew what I was doing. I just didn't have any of the confidence I had doing the last exam, it was just a lot of stress; but I never had any of that in the FQA class.

## Conclusion

The FQA made a difference in the anxiety levels, academic performance, and engagement of many students. It is well documented that the traditional teaching approach as discussed earlier has some challenges with student engagement and enjoyment. Traditional teachers follow a linear scope and sequence that sets the order of topics and the time allowed to complete each topic usually with concentrated revision before examinations. The restricted time frame of the linear scope and sequence restricts the time students have to develop an understanding of each topic. This may exasperate the anxiety level of many students. The FQA could change how traditional teachers teach by revising topic areas after they have been completed in the linear scope and sequence allowing additional time for students to develop their understanding and introducing problem solving style questions into the classroom. This change in teaching approach may then result in a decrease in mathematics and examination anxiety for some students. Students in a classroom using the FQA have shown improvement in perceived academic performance, engagement, and enjoyment and the quantitative analysis shows an increase in academic performance.

Given the factors mentioned earlier concerning achievement, engagement, and enjoyment it has been shown that the FQA can enhance all three factors so it could be that the FQA may contribute to a reduction in mathematics and examination anxiety. Further research specifically targeting mathematics anxiety and the FQA may be beneficial.

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