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**Research Article**

# Student Interest and Engagement in Mathematics After the First Year of Secondary Education

**Veronica Ryan** [1*]
0000-0002-3730-2980

**Olivia Fitzmaurice** [2]
0000-0002-2919-4078

**John O'Donoghue** [1]
0000-0003-0034-2441

[1] EPI-STEM–National Center for STEM Education and Department of Mathematics and Statistics, University of Limerick, Limerick, IRELAND
[2] School of Education, University of Limerick, Limerick, IRELAND
[*] Corresponding author: veronicaryan52@gmail.com

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**ABSTRACT**

The end of first year in secondary mathematics education is an important yet neglected milestone in the literature. It represents a crucial period in a students' mathematical lifetime when they have negotiated the physical, academic and emotional bridges between primary and secondary education, bridges which have been shown to impact considerably on students' performance and attitudes to mathematics. This study, which investigated students' motivation in mathematics and their willingness to engage in it including attitudes, emotions and self-related beliefs at the end of students' first year of secondary education in Ireland, formed part of a larger study on student transition in mathematics from primary to secondary education in Ireland. It is the first study of its kind since the introduction of a new mathematics curriculum in Ireland in 2010. Using a large sample of 304 students, the data was analyzed for all students and also for students grouped by gender. The results of this study show high levels of student engagement, motivation and positive self-belief in mathematics, despite recorded declines in mathematical performance after a full year's instruction. This study also highlights a gender disparity in mathematics self-beliefs, particularly in relation to self-efficacy, self-concept, and anxiety.

**Keywords:** self-efficacy, self-concept, self-belief, mathematics, interest, engagement, primary-secondary transition, maths anxiety

## INTRODUCTION

Insights into student mathematical knowledge and engagement at important stages in their mathematical trajectories can inform enriched, enduring outcomes for students as they continue to navigate through the education system (Cox & Kennedy, 2008; Deieso & Fraser, 2019; Galton et al., 1999; Smyth et al., 2004). This paper investigates the mathematical motivation and engagement levels of a large sample of students as they proceed into their second year of secondary education, a mathematics juncture often neglected in the literature yet one that has a substantial bearing on future student progress in mathematics (Deieso & Fraser, 2019; Vorderman et al., 2011). The research presented in this paper formed part of a larger study on student transition in mathematics from primary to secondary education in Ireland, which demonstrated that students scored significantly lower in mathematics on the same test instrument at the end of the first year in secondary education compared to their performance one year earlier at the end of primary education, despite an additional year of mathematics instruction (Ryan, 2018). On average, students' raw scores decreased by 7% from sixth class (final year of primary school) to first year of secondary education despite an additional year of instruction and extensive overlap of the both syllabi. In addition to academic performance, affective constructs were also examined in the study on transition in mathematics from primary to secondary school.

The affective domain relates to three main constituents: beliefs, attitudes, and emotions as well as related concepts that include confidence in learning mathematics, self-concept, self-efficacy, mathematics anxiety, causal attribution, effort and ability attributions, learned helplessness, and motivation (McLeod, 1992). Affective issues are central to teaching and learning (Casey & Fernandez-Rio, 2019). Attitudes, beliefs and emotions are important considerations when investigating students' interest in and response to mathematics (OECD, 2013a). Positive emotions towards mathematics provide a better platform for the learning of mathematics than negative emotions. Students who exhibit positive attitudes, emotions and beliefs towards mathematics predispose them to using mathematics in everyday contexts (OECD, 2013a). An important function of mathematics education thus is to cultivate attitudes, beliefs, and emotions in a way that not only encourages students to utilize and apply mathematics they currently know, but to inspire them to continue studying mathematics for personal, academic, and social gain (Al-Mutawah & Fateel, 2018; OECD, 2013a).

## RELEVANT LITERATURE

### Student Engagement and Motivation in Mathematics

Student engagement in mathematics is multifaceted and has affective, cognitive, and behavioral constructs and the level of engagement affects the quality of the learning outcome (Al-Mutawah & Fateel, 2018; Fredricks et al., 2004; Kong et al., 2003). When students believe that they will experience success in mathematics, they are more likely to engage in and enjoy the subject (Middleton & Spanias, 1999; Putwain et al., 2018). Cultivating student engagement is as important as the design of the curriculum itself (Kong et al., 2003). Evidence of motivation to engage in mathematics can be observed early in a child's education. Students in Kindergarten and first grade are motivated to engage and they relate success to a mix of effort and ability but this changes and by the middle grades, these students attribute success in mathematics to ability rather than effort (Kloosterman & Gorman, 1990). Student engagement in mathematics and attitude is directly related to the supportiveness of the teacher and the classroom environment (Ivowi, 2001; Lazarides et al., 2018; Middleton & Spanias, 1999; Valås & Søvik, 1994). According to Meece et al. (1990), students' performance expectancies predicted future performance in assessment, while student value perceptions predicted student intention to engage in a course involving mathematics in the future (OECD, 2013a). Motivation is what determines a person's drive and persistence towards the participation in or completion of a task and is categorized as either extrinsic, if it is determined by an external factor such as material gains, or intrinsic if a task is pursued or completed for one's own personal satisfaction (Fischer et al., 2019). The teacher plays a key role in the development of intrinsic motivation and this can be achieved by the teacher highlighting the usefulness and importance of the mathematical concepts being taught, aided by the use of real-life problem solving (Cronbach & Meehl, 1955; Ivowi, 2001; Middleton & Spanias, 1999). Lazarides et al. (2018) and Middleton and Spanias (1999) stress that motivation, while generally stable, is not simply the result of mathematical ability but can be changed through appropriate intervention strategies such as instructional practices and can lead to students enjoying and valuing the subject.

### Mathematics Behaviors, Intentions, and Subjective Norms

Students who engage in mathematics related behaviors including taking part in mathematics competitions, mathematics clubs, chess and computer programming are more likely to enjoy and value the subject (OECD, 2013b). Mathematics related intentions indicate the likelihood of students pursuing mathematics or mathematics related disciplines in higher (tertiary, post-secondary) education (OECD, 2013b). Subjective norms are the beliefs a student holds about themselves that are formed based on perceived societal/peer pressure (Kul & Celik, 2018). Students' subjective norms have a direct impact on behavior so if the people who are important to the student see mathematics as important, it is likely that the student also will see the value and importance of mathematics. The Program for International Student Assessment (PISA) seeks to compare the value, equity and effectiveness of schools across 70 participating countries. Information about the highest performing school systems may then allow governments to adapt their education policies and practices to improve national performance (OECD, 2013b). PISA is also concerned with equipping each student with the necessary skills to reach their potential, enter the workforce, and participate fully in society (OECD, 2013b). PISA examines the skills of 15 year olds in reading, mathematics, science and problem solving and the questions require students to apply their knowledge and understanding to both familiar and unfamiliar contexts (OECD, 2013b). PISA 2012 results show that Irish students are less likely to intend to have a career in mathematics or intend to study mathematics compared to students across all OECD countries (Perkins et al., 2013). In addition, Irish students are among the third lowest group, across all OECD countries, to participate in mathematics related activities such as mathematics clubs and competitions (Perkins et al., 2013). Research has shown that participation in mathematics club leads to improved performance in standardized tests in concepts, application and computation (Sherman & Catapano, 2011). Results from PISA 2012 on attitude have revealed gender differences in attitude towards mathematics and engagement with mathematics (Perkins et al., 2013). The theory of reasoned action posits that if an individual has a positive attitude towards the suggested behavior and if they perceive that people important to them would want them to perform the behavior, then this will increase their motivation to perform the behavior and consequently, the likelihood of the behavior being performed (Fishbein & Ajzen, 1977). Irish students have shown higher levels of subjective norms relating to mathematics than students from other OECD countries (Perkins et al., 2013). Therefore, the opinions on mathematics of the significant others in the lives of the students have a particularly strong influence on the importance Irish students attribute to the subject. Fishbein and Ajzen (1977) have shown that high levels of subjective norms increase motivation towards a desired behavior and the prospect of that behavior being exhibited. Parents' interest in the school and parents' level of satisfaction in mathematics is linked to students' belief in their own ability (Gladstone et al., 2018; Surgenor et al., 2006).

## Self-Beliefs

Student beliefs are a component of the affective domain (McLeod, 1992). They shape behavior and have significant consequences (Pitsia et al., 2017; Schoenfeld, 1992). Students' beliefs are evident in the classroom in the way students ask questions, answer questions, and how they approach and work on problems (Spangler, 1992). According to Schoenfeld (1992), students' beliefs about mathematics are generated through their experience in the mathematics classroom. These beliefs determine how students cope with uncertainty and manage contradiction and conflict (Fleener, 1996). According to Brassell et al. (1980), when the specific areas of self-concept and anxiety are taken in isolation, it can be seen that these areas impact performance. A moderate to strong correlation exists between mathematics self-beliefs and performance in mathematics (Perkins et al., 2013). This highlights the importance of promoting self-efficacy, self-concept, and minimizing mathematical anxiety.

The self-concept and self-efficacy components have been shown to have considerable effect on student performance, perseverance, motivation, and career choices (Bandura, 1977, 1982; Hackett & Betz, 1989; Kenney-Benson et al., 2006; Pajares & Miller, 1994; Stankov et al., 2014; Zimmerman, 2000). Mathematics self-efficacy, mathematics self-concept, and mathematics anxiety affect how students gauge their own performance, set learning objectives and the learning strategies they employ (Pitsia et al., 2017; Thomson et al., 2013). Mathematics self-efficacy affects students' motivation and determination on a mathematics task and refers to students' self-belief in their ability to learn mathematics (Thomson et al., 2013). If students believe in their own ability, they will devote time to learning strategies that will help them achieve success in mathematics (Karakolidis et al., 2016; Pitsia et al., 2017; Thomson et al., 2013). Mathematical anxiety occurs when students feel intimidated by the mathematical task and feelings of helplessness emerge.

Self-efficacy relates to how students believe they will succeed in a particular task and how students believe they will succeed are strong predictors of performance (Bandura, 1986; Pitsia et al., 2017). Mathematical self-efficacy is centered on student confidence in achieving success in mathematics given a specific task, while mathematical self-concept is a judgement of a student's success but not confined to that particular task (Pajares & Miller, 1994). Therefore, a student with low mathematical self-concept may show high mathematical self-efficacy in a particular topic in mathematics. Blumenfeld et al. (1982) found that a positive self-concept of ability was linked to frequency of positive academic feedback. In particular, students' efficacy beliefs are lower in classes with frequent teacher criticism (Parsons et al., 1982). Findings from an undergraduate study carried out by Pajares and Miller (1994) show that student mathematical self-efficacy is an important predictor of future performance. Indeed, they argue that self-efficacy assessments should be introduced early in the education of a student to inform interventions that may alter self-efficacy beliefs. Self-belief is a predictor of performance:

> "It should come as no surprise that what people believe they can do predicts what they can actually do and affects how they feel about themselves as does of that task" (Pajares & Miller, 1994, p. 200).

According to Bandura (1977), perceived self-efficacy affects participation in a situation or activity. Low perceived levels of self-efficacy lead to an individual avoiding the activity. Low levels of perceived self-efficacy also affect the coping efforts and persistence of the individual once the activity or situation has commenced (Bandura, 1977, 1982). According to Bandura (1977), a student who engages in a safe activity that they consider threatening gains corrective experiences that in turn strengthen their levels of self-efficacy. A student who does not engage or engages only for a short time holds on to their fears and low expectations. Self-efficacy is a powerful predictor of student motivation, learning, persistence, achievement and career choices (Bandura, 1977, 1982; Hackett & Betz, 1989; Kenney-Benson et al., 2006; Pajares & Miller, 1994; Pitsia et al., 2017; Zimmerman, 2000) and the importance of self-belief in achievement is evident by its inclusion in international assessments such as PISA (Khine et al., 2020; Parker et al., 2014). Research has shown that self-efficacy plays a key role in successful problem solving and students' beliefs about themselves are key predictors of performance (Kenney-Benson et al., 2006; Pajares & Miller, 1994).

Mathematics self-efficacy affects both performance and career choice (Hackett & Betz, 1989; Khasawneh et al., 2021; Pajares & Miller, 1994). In a US study of 280 university science students, Larson et al. (2015) found that university graduation status was significantly linked to mathematics/science self-efficacy from the first semester. Measures of mathematics aptitude and prior achievement contributed significantly less to graduation status than mathematics/science self-efficacy. In their longitudinal Australian study, Parker et al. (2014) reported that mathematics self-efficacy was a significant predictor of entry to university and mathematics self-concept was a significant predictor for the undertaking of STEM disciplines in higher education. Mathematics self-efficacy levels also determine the choice of college majors (Czocher et al., 2020; Evans et al., 2020; Hackett & Betz, 1989). Understanding how self-efficacy beliefs are developed is important as despite successful experiences and established mathematical skills, some students show an extreme lack of confidence in their ability (Pajares & Miller, 1994). According to Pajares and Miller (1994), many students may avoid math-related courses and careers because of inaccurate perceptions of their ability.

Given the far reaching effects of mathematics self-efficacy, Hackett and Betz (1989) urge teachers of mathematics to recognize the importance of self-efficacy and consequently

> "pay as much attention to self-evaluations of competence as to actual performance" (p. 271).

Self-efficacy affects persistence. Students who perceive that a task is beyond their capability are less likely to spend time and exert effort to complete the task (Bandura, 1982; Czocher et al., 2020; Pajares & Miller, 1994). Deficits in self-efficacy is a likely contributor to the low number of women pursuing STEM related disciplines and careers (O'Brien et al., 1999). Gender gaps in mathematics self-efficacy increase with age from early adolescence (Huang, 2013). Research shows ambiguous findings in relation to gender and self-efficacy (Kenney-Benson et al., 2006; Lapan et al., 1996; Pajares, 2005). In a longitudinal study in the US consisting of 101 university students, Lapan et al. (1996) found that mathematics self-efficacy plays an important role

> "in the developmental process through which women either embrace or reject math/science college majors" (p. 289).

They also found that females displayed lower levels of self-efficacy than males. However, the US study by Kenney-Benson et al. (2006) contradicts these findings and this study found no evidence of higher self-efficacy levels in males in their longitudinal study of 518 students in 5th grade and then again in 7th grade. On the other hand, in their meta-analysis featuring 187 studies, Huang (2013) found males exhibiting higher levels of self-efficacy than females.

According to Pajares (2005), there is no evidence of gender differences in self-efficacy in primary school but female confidence in their ability is undermined as they enter secondary school, and the perception of mathematics as a male domain is established. Similarly, by middle school Fennema and Hart (1994) found that girls tend to exhibit less confidence in their mathematical ability. Huang (2013) found no significant gender differences in mathematics self-efficacy levels in groups of students aged 6 to 10 years of age and 11 to 14 years of age. However, in all groups over 14 years of age, there is a statistically significant difference between female and male levels of self-efficacy with males exhibiting higher levels of mathematics self-efficacy. There may be an unwelcome price to pay for accurate self-evaluation because realistic or under-confident evaluation may affect participation and persistence in mathematics. According to Pajares (1996),

> "accurate self-perceptions may enable students to more accurately assess their problem-solving strategies, but the danger of "realistic" self-appraisals is that they may be purchased at the cost of lower optimism and lower levels of self-efficacy's primary functions—effort, persistence, and perseverance" (p. 340).

Anxiety affects affective engagement in mathematics (Kong et al., 2003). The mathematics anxiety construct is defined by Middleton and Spanias (1999) as a perception that mathematics is difficult and a tendency to steer clear of the subject. Students' willingness to engage in mathematics is weakened by experiencing failure in mathematics, by believing that failure is caused by lack of ability and also by learned helplessness (Kong et al., 2003; Middleton & Spanias, 1999). According to Fennema and Sherman (1976), high levels of anxiety in mathematics is associated with low levels of student confidence in mathematics. In addition, high levels of anxiety are related to lower levels of performance in mathematics (Perkins et al., 2013). Students who display medium and low levels of anxiety about mathematics attained a mean score in PISA 2003 testing that was significantly higher than those with high levels of anxiety (Perkins et al., 2013). Much of the interest in studying anxiety in mathematics has established gender differences in mathematics anxiety with female students displaying higher levels of mathematics anxiety than male students (Ashcraft & Faust, 1994; Baloglu & Kocak, 2006; Ho et al., 2000). Irish students, in particular females, have increased levels of anxiety relating to mathematics compared to OECD averages (Perkins et al., 2013).

## Work Ethic, Self-Responsibility for Failure, & Openness to Problem Solving in Mathematics

Self-responsibility for failure in mathematics requires students to imagine that they had performed badly on a series of short mathematics tests and to consider the possible explanations. PISA's self-responsibility index is based on these responses and students with a high value blame themselves for poor performance while students who record a low value on this index attribute failure to other people or factors. Typically, female students tend to attribute failure in mathematics to a lack of ability but they are not inclined to attribute success to ability (Degol et al., 2018; Middleton & Spanias, 1999). Successful students are often those who attribute their successes to ability whereas unsuccessful students are those who attribute failure to lack of ability (Middleton & Spanias, 1999). Consequently, students who believe that mathematics ability is not fixed and can be increased through effort experience more success in the subject and spend more time studying mathematics (Middleton & Spanias, 1999). The self-responsibility index shows that Irish students are more likely to blame external factors rather than themselves for failure in mathematics compared to other OECD countries (Perkins et al., 2013). However, there is a negative correlation between self-responsibility for failure and successful performance in mathematics (Perkins et al., 2013). Interestingly, it is the students who blame other factors than themselves for failure in mathematics who have higher results in mathematics than students who blame themselves for failure (Perkins et al., 2013). Students' openness to problem solving and work ethic are two further constructs measured by PISA. The objective is to investigate how students approach problem solving and if it is something they enjoy. Work ethic enquires how hard they work in class, at their homework and in preparation for examinations.

## Research Question

1. Using the questionnaire data, what can we learn about students' engagement and interest in mathematics, their motivation to study mathematics, their mathematics self-beliefs, and their perseverance in learning mathematics?

2. In which of the affective areas measured is there a difference between male and female students?

The research questions were pursued through an action plan based on multiple subsidiary questions related to each area leading to consideration of implications of findings, and recommendations for improving performance.

## RESEARCH DESIGN

### Sample

The authors adopted the design used in PISA assessment (OECD, 2014) to acquire their sample of first year students, attending school in the Republic of Ireland in 2015. The sample involved all 723 second level schools in receipt of funding from the Department of Education and Skills. All 723 schools were stratified by school types, namely: secondary, vocational, community and comprehensive[1]. This division provided new sub-frames for sampling. Approximately 61,196 first year students were included in the sampling frame. The researcher selected participating schools using probability proportional to size systematic sampling.

The projected sample size for the main study was 382 students, assuming a 95% confidence level and a 5% margin of error. This preliminary sample accounted for 20 schools and 11 of the 20 schools agreed to take part in the study. Nine replacement schools were then selected and of these replacement schools, four agreed to take part. One of these four replacement schools subsequently refused to participate which left the research team with 14 participating schools. As the sampling frame was ordered by school type, this ensured that the replacement schools were the same school type as the original school selected.

Within each of the 14 schools, there were multiple mixed ability first year classes. A single first year mathematics class from each school was chosen using a simple random sampling. All students from the selected class were included in the main sample. Due to absenteeism, 304 out of the 323 first year students who made up the sample completed the attitudinal questionnaire in May 2016. The students were given two hours on a regular school day to complete the survey instruments. The university associated with the authors granted ethical approval for the research (Code: 2015_09_01_S&E).

### Student Questionnaire to Assess Attitude

The student questionnaire used in this study was extracted from the PISA 2012 student questionnaire and examined students' engagement with mathematics by assessing their interest in mathematics, motivation to study mathematics and perseverance in learning mathematics. It assesses the students' self-beliefs and student anxiety which both influence performance. It also looked at learning strategies employed by students and how these strategies affect motivation, self-beliefs and academic success. Students' characteristics, self-responsibility for failure in mathematics and openness to problem solving, are examined. Predicted future engagement with mathematics is assessed through questions focusing on mathematics-related behaviors, mathematics-related intentions and students' subjective norms. The PISA 2012 student questionnaire draws on the theory of planned behavior model proposed by Ajzen (1991) to predict work ethic, intention, study behavior and mathematics performance. It achieves this by using questions based on students' attitudes, subjective norms and perceptions of control (OECD, 2013b). Attitude towards mathematics is examined through the PISA 2012 student questionnaire by analyzing students' interest in mathematics and students' willingness to engage in mathematics. Interest in mathematics is investigated by looking at present and future engagement in mathematics. Students' opinion of the usefulness of mathematics, students' interest in the mathematics they are studying in school, their intention to embark on further study or pursue a career that will require mathematics are all examined through the student questionnaire (OECD, 2013b). Students' willingness to engage in mathematics is gauged through questions on the attitudes, emotions and beliefs that predispose students to successfully employ the mathematics they have learned. If students are confident in their mathematics ability they are more likely to engage in mathematical activity outside of school. Mathematics anxiety, enjoyment of mathematics, confidence, self-efficacy, self-concept, student experience

[1] Secondary schools are privately owned and managed. Vocational schools are governed by the state through Education and Training Boards (ETBs) while Boards of Management manage community and comprehensive schools.

**Table 1.** Gender of students in sample

| | | Frequency | Percent |
|---|---|---|---|
| Valid | Female | 121 | 39.8 |
| | Male | 183 | 60.2 |
| | **Total** | **304** | **100.0** |

in class, student experience in tests, and the opportunity to learn are all examined in the student questionnaire to assess students' willingness to engage in mathematics (OECD, 2013b).

Students' engagement with mathematics is assessed under three domains–intrinsic motivations, extrinsic motivation, and perseverance. Students' beliefs about themselves were examined under mathematics self-efficacy, mathematics self-concept and mathematics anxiety. The student questionnaire examines memorization, elaboration, and control strategies as well as how students employ these strategies to process, integrate and apply their mathematical knowledge. Self-responsibility for failure in mathematics was measured by asking students to imagine that they had performed badly on a series of short mathematics tests. The students were then asked to attribute the cause to a list of possible explanations. A self-responsibility index was constructed based on these responses and students with a high value blame themselves for poor performance while students who record a low value on this index attribute failure to other people or factors. Students who engage in mathematics related behaviors are more likely to enjoy and value the subject (OECD, 2013b). Mathematics related intentions indicate the likelihood of students pursuing mathematics or mathematics related disciplines in higher education (OECD, 2013b). Students' subjective norms have a direct impact on behavior so if the people who are important to the student see mathematics as important, it is likely that the student also will see the value and importance of mathematics.

### Limitations of Study

The researcher relied on the cooperating mathematics teacher in each of the sample schools to administer the test. It was not possible to ensure that all students had the same experience of the test environment. It was not possible to ensure that the cooperating teacher adhered rigorously to the instructions for the testing and the administration of the questionnaire. Furthermore, the authors were constrained by the main study in relation to the sample used and also by the willingness of schools to participate in the study. Even though the sample was randomly selected, a smaller sample size than originally desired may mean that that findings of the study are not generalizable to the population of entire students.

## RESULTS

### Profile of Student Groups

304 first year students completed the student questionnaire. The mean age of participants was 13.47 years, which is the expected age for students at the end of their first year of secondary education in Ireland. The proportion of male students in the sample is higher than expected and this is due to the fact that four out of the 14 schools selected for the sample were all-boys' schools (**Table 1**).

### Student Responses: About Learning Mathematics and Problem Solving Experiences

#### *About learning mathematics*

The mean and standard deviation for the responses on 62 questions in relation to learning mathematics were calculated. Low mean scores indicate high level of student agreement on positively worded statements and low level of student agreement on negatively worded statements. The lowest mean score of 1.39 is attributed to the statement "my parents believe it's important for me to study mathematics" with 98% of respondents agreeing or strongly agreeing with the statement. The second lowest mean score is attributed to the statement "if I put in enough effort I can succeed in mathematics" with a mean score of 1.42. This corresponds to 96% of participants agreeing or strongly agreeing with the statement. The highest mean score of 3.9 is attributed to question "I participate in a mathematics club" with only 2% of respondents answering, *always* or *almost always*. 64% of students in this sample plan to take additional mathematics courses after school finishes and 73% are willing to study harder in their mathematics class than is required. 69% plan on pursuing a career that involves a lot of mathematics and 69% plan on studying a course at higher education institutions that requires mathematics skills, indicating a positive attitude towards mathematics. Students in this sample study mathematics by working out exactly what they need to learn (61%); learning as much as they can off by heart (42%); trying to figure out which ideas they still have not understood properly (46%); and going through examples again and again in order to remember the method for solving a mathematics problem (53%) (**Table 2**).

**Table 2.** Student responses about learning mathematics summary statistics

| | N | | Mean | SD |
|---|---|---|---|---|
| | V | M | | |
| 1. I enjoy reading about mathematics. | 303 | 1 | 2.44 | 0.73 |
| 2. Making effort in mathematics is worth it because it will help me in work that I want to do later on. | 304 | 0 | 1.46 | 0.56 |
| 3. I look forward to my mathematics lessons. | 304 | 0 | 2.30 | 0.86 |
| 4. I do mathematics because I enjoy it. | 302 | 2 | 2.39 | 0.89 |
| 5. Learning mathematics is worthwhile for me because it will improve my career chances. | 303 | 1 | 1.44 | 0.59 |
| 6. I am interested in the things I learn in mathematics. | 304 | 0 | 2.08 | 0.78 |
| 7. Mathematics is an important subject for me because I need it for what I want to study later on. | 302 | 2 | 1.67 | 0.76 |
| 8. I will learn many things in mathematics that will help me get a job. | 303 | 1 | 1.55 | 0.61 |
| 9. Mathematics is useful for dealing with tasks in everyday life. | 303 | 1 | 1.72 | 0.73 |
| 10. Most of my friends do well in mathematics. | 304 | 0 | 1.99 | 0.56 |
| 11. Most of my friends work hard at mathematics. | 303 | 1 | 2.10 | 0.66 |
| 12. My friends enjoy taking mathematics tests. | 301 | 3 | 3.10 | 0.67 |
| 13. My parents believe it's important for me to study mathematics. | 304 | 0 | 1.39 | 0.53 |
| 14. My parents believe that mathematics is important for my future career. | 302 | 2 | 1.51 | 0.64 |
| 15. My parents like mathematics. | 301 | 3 | 2.06 | 0.77 |
| 16. Working out from a train timetable how long it would take to get from one place to another. | 303 | 1 | 1.92 | 0.78 |
| 17. Calculating how much cheaper a TV would be after a 30% discount. | 303 | 1 | 2.10 | 0.92 |
| 18. Calculating how many square meters of tile you need to cover a floor. | 304 | 0 | 2.23 | 0.92 |
| 19. Understanding graphs presented in newspapers. | 303 | 1 | 1.80 | 0.81 |
| 20. Solving an equation like 3x+5=17. | 303 | 1 | 1.85 | 0.92 |
| 21. Finding the actual distance between two places on a map with a 1:10,000 scale. | 303 | 1 | 2.71 | 0.94 |
| 22. Simplifying an expression like 2(x+3)+(x+3) (x-3). | 304 | 0 | 2.24 | 1.03 |
| 23. Calculating the rate of petrol consumption of a car. | 304 | 0 | 2.45 | 0.89 |
| 24. I often worry that mathematics classes will be difficult for me. | 303 | 1 | 2.39 | 0.95 |
| 25. I am just not good at mathematics. | 303 | 1 | 2.07 | 0.90 |
| 26. I get very tense when I have to do mathematics homework. | 302 | 2 | 1.95 | 0.86 |
| 27. I get good grades in mathematics. | 302 | 2 | 2.02 | 0.77 |
| 28. I get very nervous doing mathematics problems | 301 | 3 | 2.10 | 0.83 |
| 29. I learn mathematics quickly. | 301 | 3 | 2.17 | 0.85 |
| 30. I have always believed that mathematics is one of my best subjects. | 302 | 2 | 2.32 | 1.13 |
| 31. I feel helpless when doing a mathematics problem. | 300 | 4 | 1.95 | 0.82 |
| 32. In my mathematics class, I understand even the most difficult work. | 302 | 2 | 2.53 | 0.88 |
| 33. I worry that I will get poor grades in mathematics. | 302 | 2 | 2.50 | 1.00 |
| 34. If I put in enough effort I can succeed in mathematics. | 302 | 2 | 1.42 | 0.56 |
| 35. Whether or not I do well in mathematics is completely up to me. | 302 | 2 | 1.86 | 0.80 |
| 36. Family demands/other problems prevent me from putting a lot of time in my mathematics work. | 303 | 1 | 2.03 | 0.88 |
| 37. If I had different teachers I would try harder in mathematics. | 301 | 3 | 1.88 | 0.94 |
| 38. If I wanted to I could do well in mathematics. | 301 | 3 | 1.81 | 0.82 |
| 39. I do poorly in mathematics whether or not I study for my exams. | 300 | 4 | 2.01 | 0.94 |
| 40. I'm not very good at solving mathematics problems. | 298 | 6 | 2.37 | 0.94 |
| 41. My teacher did not explain the concepts well this week. | 298 | 6 | 1.87 | 0.89 |
| 42. This week I made bad guesses on the test. | 298 | 6 | 2.10 | 0.96 |
| 43. Sometimes the course material is too hard. | 297 | 7 | 2.56 | 0.94 |
| 44. The teacher did not get students interested in the material. | 299 | 5 | 2.08 | 0.99 |
| 45. Sometimes I am just unlucky. | 298 | 6 | 2.26 | 1.06 |
| 46. I have my homework finished in time for mathematics class. | 299 | 5 | 1.45 | 0.69 |
| 47. I work hard on my mathematics homework. | 298 | 6 | 1.74 | 0.69 |
| 48. I am prepared for my mathematics exams. | 298 | 6 | 1.87 | 0.75 |
| 49. I study hard for mathematics tests. | 296 | 8 | 2.09 | 0.80 |
| 50. I keep studying until I understand mathematics material. | 297 | 7 | 2.07 | 0.80 |
| 51. I pay attention in mathematics class. | 295 | 9 | 1.66 | 0.61 |
| 52. I listen in mathematics class. | 294 | 10 | 1.60 | 0.59 |
| 53. I avoid distractions when I am studying mathematics. | 296 | 8 | 2.13 | 0.85 |

**Table 2 (Continued).** Student responses about learning mathematics summary statistics

| | N | | Mean | SD |
|---|---|---|---|---|
| | V | M | | |
| 54. I keep my mathematics work well organized. | 296 | 8 | 1.85 | 0.78 |
| 55. I talk about mathematics problems with my friends. | 297 | 7 | 3.48 | 0.76 |
| 56. I help my friends with mathematics. | 297 | 7 | 2.78 | 0.83 |
| 57. I do mathematics as an extracurricular activity. | 292 | 12 | 3.58 | 0.75 |
| 58. I take part in mathematics competitions. | 296 | 8 | 3.61 | 0.80 |
| 59. I do mathematics more than 2 hours a day outside of school. | 297 | 7 | 3.67 | 0.65 |
| 60. I play chess. | 297 | 7 | 3.26 | 1.00 |
| 61. I program computers. | 296 | 8 | 3.43 | 0.90 |
| 62. I participate in a mathematics club. | 297 | 7 | 3.90 | 0.46 |

Note. V: Valid; M: Missing; SD: Standard deviation

**Table 3.** Student responses about problem solving experiences summary statistics

| | N | | Mean | SD |
|---|---|---|---|---|
| | V | M | | |
| 1. When confronted with a problem I give up easily. | 292 | 12 | 2.20 | 1.05 |
| 2. I put off difficult problems. | 293 | 11 | 2.42 | 1.08 |
| 3. I remain interested in the tasks that I start. | 292 | 12 | 2.46 | 1.04 |
| 4. I continue working on tasks until everything is perfect. | 292 | 12 | 2.60 | 1.10 |
| 5. When confronted with a problem I do more than what is expected of me. | 294 | 10 | 2.97 | 1.05 |
| 6. I can handle a lot of information. | 291 | 13 | 2.53 | 1.10 |
| 7. I am quick to understand things. | 290 | 14 | 2.48 | 1.15 |
| 8. I seek explanations for things. | 290 | 14 | 2.49 | 1.07 |
| 9. I can easily link facts together. | 291 | 13 | 2.64 | 1.07 |
| 10. I like to solve complex problems. | 291 | 13 | 3.17 | 1.30 |
| 11. I press every button possible to find out what is wrong. | 283 | 21 | 2.49 | 1.03 |
| 12. I think about what might have caused the problem and what I can do to solve it. | 287 | 17 | 1.86 | 0.78 |
| 13. I read the manual. | 283 | 21 | 2.82 | 1.04 |
| 14. I ask a friend for help. | 285 | 19 | 2.14 | 0.90 |
| 15. I read the zoo brochure to see if it says how to get there. | 285 | 19 | 2.08 | 0.97 |
| 16. I study a map and figure out the best route. | 286 | 18 | 2.40 | 1.03 |
| 17. I leave it to my brother to worry about how to get there. | 286 | 18 | 1.96 | 0.96 |
| 18. I know roughly where it is, so I suggest we just start driving. | 283 | 21 | 2.52 | 0.91 |
| 19. I check how similar it is to other ticket machines I have used. | 283 | 21 | 2.05 | 0.84 |
| 20. I try out all the buttons to see what happens. | 284 | 20 | 2.27 | 1.01 |
| 21. I ask someone for help. | 282 | 22 | 2.01 | 0.87 |
| 22. I try to find a ticket office at the station to buy a ticket. | 283 | 21 | 2.01 | 0.91 |

Note. V: Valid; M: Missing; SD: Standard deviation

The mean and standard deviation for the responses on 22 questions in relation to problem solving experiences were calculated. The lowest mean score of 2.20 is attributed to the statement "When confronted with a problem I give up easily" with 69% of respondents identifying with the response "not much like me" or "not at all like me". The highest mean score of 3.8 is attributed to the statement "I like to solve complex problems" with 13% of respondents responding "very much like me". The lowest mean score of 1.86 is attributed to the statement "I think about what might have caused the problem and what I can do to solve it" with 83% of respondents likely to take this approach. The highest mean score of 2.82 is attributed to the statement "I read the manual" with 36% of respondents likely to take that approach (**Table 3**).

## Motivation to Learn Mathematics

Students' motivation to learning mathematics was assessed using three clusters of items:

1. intrinsic motivation to learn mathematics (**Table 4**),
2. instrumental motivation to learn mathematics (**Table 5**), and
3. perseverance in learning mathematics (**Table 6** and **Table 7**).

**Table 4.** Intrinsic motivation questionnaire results

| Intrinsic motivation | Participants who agree or strongly agree |
|---|---|
| I enjoy reading about mathematics. | 56.1% (female=54.5%, male=57.1%) |
| I look forward to my mathematics lesson. | 62.5% (female=61.2%, male=63.4%) |
| I do mathematics because I enjoy it. | 54.3% (female=50.0%, male=57.1%) |
| I am interested in the things I learn in mathematics. | 74.0% (female=69.4%, male=77.0%) |

**Table 5.** Instrumental motivation questionnaire results

| Instrumental motivation | Participants who agree or strongly agree |
|---|---|
| Making an effort in mathematics is worth it because it will help me in the work that I will do later on. | 96.7% (female=95.9%, male=97.3%) |
| Learning mathematics is worthwhile for me because it will improve my career prospects and chances. | 95.0% (female=91.7%, male=97.3%) |
| Mathematics is an important subject for me because I need it for what I want to study later on. | 88.1% (female=84.3%, male=90.6%) |
| I will learn many things in mathematics that will help me get a job. | 95.0% (female=93.3%, male=96.2%) |

**Table 6.** Perseverance questionnaire results-1

| Perseverance | Participants who agree or strongly agree |
|---|---|
| I remain interested in the tasks that I start. | 58.6% (female=53.4%, male=61.9%) |
| I continue working on tasks until everything is perfect. | 49.3% (female=44.3%, male=52.5%) |
| When confronted with a problem I do more than is expected of me. | 32.3% (female=29.3%, male=34.3%) |

**Table 7.** Perseverance questionnaire results-2

| Perseverance | Participants who disagree or strongly disagree |
|---|---|
| When confronted with a problem, I give up easily. | 68.8% (female=60.9%, male=74.0%) |
| I put off difficult problems. | 58.0% (female=55.7%, male=59.6%) |

Students in this sample show an eagerness to learn and show high levels of intrinsic motivation, instrumental motivation and perseverance. Similar levels of intrinsic motivation exist for both male and female students in this study.

Male students record higher perseverance levels than female students in all measures of perseverance in this study.

Over one quarter of male students are likely to identify as giving up easily when confronted with a problem, compared to almost 40% of female students.

In summary, intrinsic motivation, instrumental motivation, and perseverance results combine to show students who are motivated and determined to succeed in the subject. Almost all students (96.7%) believe that making an effort in mathematics is worth it because it will help in the work that they will do later on. Three in every four students are interested in the things they learn in mathematics while 58.6% of students remain interested in the tasks that they start. Males showed higher levels of instrumental motivation, intrinsic motivation and perseverance than females on every question.

## Students' Learning Strategies

The student questionnaire examines memorization, elaboration, and control strategies as well as how students employ these strategies to process, integrate and apply their mathematical knowledge. Elaboration strategies may involve integration of new and existing knowledge and the application of the new knowledge to other situations. It necessitates an understanding of the new material. Control strategies relate to how students manage how they learn. Students need to self-assess what they have learned already and what they need to learn. This study showed students favoring a traditional approach to learning mathematics. 42.1% of students' study for a mathematics test by learning as much as they can off by heart. 45.7% try to figure out which ideas that they still have not understood properly when studying mathematics. 61.4% study mathematics by working out exactly what they need to learn. 53.1% go through examples again and again in order to solve a mathematics problem.

## Mathematics Self-Beliefs

Students' mathematics self-beliefs were assessed using three clusters of items:

1. mathematics self-efficacy,
2. mathematics self-concept, and
3. mathematics anxiety.

Self-efficacy, self-concept, and anxiety affect engagement with mathematics in the short and long-term. Overall, the self-concept and self-efficacy indicators show students as having positive self-belief. In this study, students are, in general, confident in applying their mathematical skills to real-life situations.

80.5% of students are confident or very confident in understanding graphs presented in newspapers and 79.5% of students are confident or very confident in their ability to work out how long it would take to get from one place to another from a train timetable. Students were less confident in working out the petrol consumption of a car (49.7%) and finding the actual distance between two places on a map with a 1:10000 scale (38.0%). The self-efficacy questionnaire results reveal considerable differences in male and female levels of confidence relating to specific tasks in mathematics. It also reveals that one third of students are not confident in applying a 30% discount to an item. Only 61.2% (female=50.4%, male=68.3%) identify as confident or very confident with the statement: "calculating how many square meters of tile you need to cover a floor".

In terms of self-concept, two thirds of students believe they learn mathematics quickly and 76.5% identify as getting good grades in mathematics. 57.9% of students in this sample believe that mathematics is one of their best subjects. The self-concept questionnaire results reveal considerable gender differences with male students showing considerably higher levels of self-concept than their female counterparts. 35.5% of females compared to only 19.2% of males agree or strongly agree with the statement "I am just not good at mathematics".

However, anxiety indicators show less favorable results. One fifth of students get very tense when doing their mathematics homework and one fifth of students feel helpless when doing a mathematics problem. Almost half of all the students in the sample worry that they will get poor grades in mathematics and 45.5% of students worry that that they will experience difficulties in mathematics class. All students, but particularly female students, experience high levels of anxiety in relation to mathematics, worrying about homework, solving problems, class material and grades. 45.5% (female=56.2%, male=38.5%) agree or strongly agree with the statement "I often worry that it will be difficult for me in mathematics classes" and 49.0% (female=59.5%, male=42.0%) agree or strongly agree with the statement "I worry that I will get poor grades in mathematics".

## Students' Work Ethic, Openness to Problem Solving, & Attributions of Failure in Mathematics

Students, at the end of first year of secondary education, show a strong work ethic indicating high levels of preparedness and engagement. 95.9% of respondents answered always or almost always to the statement: "I listen in mathematics class". 93.0% (female=87.2%, male=96.7%) of students agree or strongly agree with the statement "I have my homework finished in time for mathematics class". 89.3% (female=89.7%, male=89.0%) of students agree or strongly agree with the statement "I work hard on my mathematics homework".

Less than one third of students identify as enjoying solving complex problems which are problems requiring application of knowledge and can often be presented in an unfamiliar context. Also in relation to problem solving, approximately half of all the students in this sample identify as being able to handle a lot of information, being quick to understand things, seeking explanations for things and easily linking facts together. 47.1% of students believe they can easily link facts together and the lowest score of 32.0% is the percentage of students who like to solve complex problems. Male students are more open to problem solving than female students. 11.1% more males than females like to solve complex problems, 11.7% more males than females believe they can easily link facts together and 10.7% more males than females identify as being quick to understand things.

49.5% of students are likely or very likely to attribute the test failure to the course material being too hard. 44.6% of students are likely or very likely to attribute failure in tests to themselves- "I'm not very good at solving mathematics problems". We know from research literature that higher achievement results are linked to students who blame other factors than themselves for their failure in mathematics (Perkins et al., 2013).

Similar to the findings of Middleton and Spanias (1999), this study shows that female students are more likely to attribute failure to lack of ability.

### Students' Mathematics Related Behaviors, Students' Intentions to Study Mathematics Further, & Students' Subjective Norms

Three clusters of items were considered for this section:

1. mathematics-related behaviors,
2. mathematics-related intention, and
3. subjective norms.

In this study, 10.1% (female=11.2%, male=9.4%) of students responded always, almost always or often with the statement "I talk about mathematics problems with my friends". However, almost three quarters of the students in the survey identify as willing to study harder in their mathematics classes than is required. Students in this sample are unlikely to have mathematics related behaviors. Just 2.7% participate in a mathematics club. Only 9.6% do mathematics as an extracurricular activity. The mathematics related activity with the highest score of 31.0% was attributed to students helping their friends with mathematics. 11.2% more male students than female students identified with this statement.

Students' desires to study mathematics in the future are high at the end of their first year. The majority of students in this sample intend to pursue mathematics after school, either in college or by taking additional mathematics classes, and throughout their career. 68.9% (female=66.0%, male=70.6%) of students agree or strongly agree with the statement "I am planning on pursuing a career that involves a lot of mathematics". 63.7% (female=65.5%, male=62.6%) of students agree or strongly agree with the statement "I plan to take additional mathematics courses after school finishes".

Students believe their parents and friends value the importance of mathematics and 80% believe their friends work hard at mathematics, eager to succeed. 93.4% (female=89.9%, male=95.6%) of students agree or strongly agree with the statement "my parents believe that mathematics is important for my future career". Students in this study recorded extremely high levels in each of the questions relating to subjective norms. 98.4% of students agree or strongly agree that their parents believe it's important for them to study mathematics, 93.4% of students agree or strongly agree that their parents believe mathematics to be important for their future career and three quarters of students surveyed believe that their parents like mathematics. These students also judge that their friends do well in mathematics (87.5%) and work hard in mathematics (77.9%).

### Gender Differences in Questionnaire Responses

A difference of more than 10% in male and female answering occurred in the following questions. A difference of -20% means that female students in the sample recorded a value 20% lower than male students in the sample and a difference of +20% means that female students in the sample recorded a value that was 20% higher than male students in the sample for that particular question (**Table 8**).

## DISCUSSION

This study provides an insight into students' disposition towards mathematics for 304 students at the end of their first year of secondary education. In general, the results point to students who have a positive disposition towards the subject and who are motivated to succeed in mathematics. Research has shown that a positive emotional disposition towards the subject is linked to success in the subject, is a key school outcome and affects the career intentions of the students (Haladyna et al., 1983). Overall, the self-concept and self-efficacy indicators show students as having positive self-belief, a valuable finding as self-efficacy is an important predictor of future performance (Pajares & Miller, 1994).

The majority of students in this study plan on pursuing a career involving mathematics. They are eager to learn mathematics and show high levels of preparedness and engagement. This finding is in contrast to those of PISA (2012), which showed that Irish students are less likely to intend to have a career in mathematics or intend to study mathematics compared to students across all OECD countries (Perkins et al., 2013). The

**Table 8.** Gender differences in questionnaire responses

| Question | D | QT |
|---|---|---|
| Calculating how much cheaper a TV would be after a 30% discount. | -20.20% | SE |
| Finding the actual distance between two places on a map with a 1:10,000 scale. | -19.20% | SE |
| Calculating how many square meters of tile you need to cover a floor. | -17.90% | SE |
| Working out from a train timetable how long it would take to get from one place to another. | -17.20% | SE |
| I learn mathematics quickly. | -15.80% | SC |
| Calculating the rate of petrol consumption of a car. | -15.20% | SE |
| When confronted with a problem I give up easily. | -13.10% | P |
| I have always believed that mathematics is one of my best subjects. | -12.60% | SC |
| I can easily link facts together. | -11.70% | OPS |
| I help my friends with mathematics. | -11.20% | MSB |
| I like to solve complex problems. | -11.10% | OPS |
| I am quick to understand things. | -10.70% | OPS |
| I feel helpless when doing a mathematics problem. | 13.90% | A |
| I get very nervous doing mathematics problems | 13.90% | A |
| I am just not good at mathematics. | 16.30% | SC |
| I worry that I will get poor grades in mathematics. | 17.50% | A |
| I often worry that mathematics classes will be difficult for me. | 17.70% | A |

Note. D: Difference; QT: Question type; A: Anxiety; MSB: Mathematics' students' behaviors; OPS: Openness to problem solving; P: Perseverance; SC: Self-concept; & SE: Self-efficacy

majority of students believe their friends and parents value mathematics which are important findings as parents' interest in the school and parents' level of satisfaction in mathematics is linked to students' belief in their own ability (Surgenor et al., 2006).

Almost three quarters of the students in the survey identify as willing to study harder in their mathematics classes than is required however they are unlikely to have mathematics related behaviors. Just 2.7% participate in a mathematics club. This is disappointing given that research has shown that participation in mathematics club leads to improved performance in standardized tests in concepts, application and computation (Sherman & Catapano, 2011). It echoes the findings of PISA in 2012 that showed Irish students are among the third lowest group across all OECD countries to participate in mathematics related activities such as clubs and competitions (Perkins et al., 2013).

Students' approaches to studying mathematics are less than satisfactory. This sample of students indicate they study mathematics by working out exactly what they need to learn (61%); learning as much as they can off by heart (42%); trying to figure out which ideas they still have not understood properly (46%), and going through examples again and again in order to remember the method for solving a mathematics problem (53%). Memorization strategies are important in retrieving information but not generally conducive to an in-depth understanding of the information and an ability to apply the mathematics to other contexts (O'Brien, 1999). According to O'Brien (1999), memorization strategies are essentially 'parrot math' and have been shown to be detrimental to student performance in mathematics. An activity based approach is favored, which would involve skills such as problem solving, generalizing and hypothesizing. Elaboration strategies may involve integration of new and existing knowledge and the application of the new knowledge to other situations. It necessitates an understanding of the new material. Control strategies relate to how students manage how they learn. Students need to self-assess what they have learned already and what they need to learn. The preferences for studying mathematics uncovered are also not consistent with the ethos of the relatively recently introduced secondary school curriculum (2010) entitled "Project Maths," which endorses teaching and learning for understanding and the use of problem solving strategies.

Gender differences are evident in perseverance, mathematics self-efficacy and mathematics anxiety. Male students show higher levels of self-efficacy and perseverance and lower levels of mathematics anxiety compared to their female counterparts. The greatest levels of gender differences in responses related to the student self-belief section of the questionnaire with females recording significantly higher levels of anxiety and lower levels of self-efficacy and self-concept. 17.5% more females than males worry that they will get poor grades in mathematics and 17.7% more females than males worry that that they will experience difficulties in mathematics class and 15.8% more males identify as being able to learn mathematics quickly. These findings are mirrored in PISA 2012 results which found anxiety levels of Irish students to be higher than the OECD average (OECD, 2013b). Research has shown that self-efficacy is strongly associated with performance and students with high levels of self-efficacy record significantly higher levels of achievement than those who reported low levels of self-efficacy (Close & Shiel, 2009). There is a significant difference in performance between students reporting high levels of anxiety and students reporting low levels of anxiety (Close & Shiel, 2009). Students who report high levels of anxiety are more likely to record low achievement and girls who completed PISA in 2012 showed significantly higher levels of anxiety than their male counterparts (Perkins & Shiel, 2016). The PISA 2012 results on anxiety are mirrored by this study. High levels of anxiety in mathematics have been shown to lead to avoidance of mathematics (Ashcraft, 2002) and compromise the development of higher level mathematical skills (Maloney et al., 2011). Close and Shiel (2009) suggest that stronger performance by male students is related to stronger levels of self-efficacy and lower levels of anxiety. In addition, PISA 2012 found a moderate to strong correlation between mathematics self-beliefs and performance (Perkins et al., 2013).

Fishbein and Ajzen (1977) have shown that high levels of subjective norms increase motivation towards a desired behavior and the prospect of that behavior being exhibited. Given the positive emotional disposition students have displayed towards mathematics in this. The openness to learning suggests that approaches to learning other than memorization may be embraced by students. This study further highlights a gender disparity in mathematics self-beliefs, particularly in relation to self-efficacy and anxiety. This has implications for future female participation in STEM disciplines.

Finally, it is important to consider the findings on student interest and willingness to engage with mathematics within the context of the larger study on academic performance, between the end of primary school and the end of the first year of secondary school. The larger study shows student failure to successfully negotiate transition in mathematics. On average, out of the 119 questions on the test, students scored 8 marks less than they had scored a year previously, despite covering a very similar curriculum in sixth class and first year. The losses incurred in mathematics in first year found in this study were far more pronounced than both national and international comparable studies (Cox & Kennedy, 2008; Galton et al., 1999; Smyth et al., 2004). This is a critical finding because despite student performance worsening, this study has shown that students are still interested in mathematics and eager to succeed in the subject. Given the positive emotional disposition students have displayed towards mathematics, this research establishes that first year in post-primary school represents and offers a huge opportunity for educators to develop students' mathematical skills, understanding, interest and appreciation of the subject. The questionnaire results show that students are engaged and motivated to learn mathematics so it is vital that students are not allowed to regress and ultimately disengage with the subject. More directed attention to students' academic performance in mathematics in the first year of transition has the potential to secure bigger gains based on better early performance in post-primary education.

## CONCLUSIONS AND RECOMMENDATIONS

The role of the teacher in the learning of mathematics is of paramount importance (Attard, 2010; Feldlaufer et al., 1988; Galton et al., 2000; Midgley et al., 1989) and the transition from primary education to post-primary education in particular is a critical time for our young people (Akos et al., 2007; Anderson et al., 2000; Eccles et al., 1991; Smyth et al., 2004). Academic self-image becomes more negative over the transition to post-primary school for both male and female students, however, gender differences broaden between the ages of nine and thirteen in relation to academic self-image and anxiety measures. Smyth (2016) found poor self-image arising in students who had difficulty negotiating the transition to post-primary school and reported that student self-image is significantly associated to the relationships student have with their teachers. Students who experience praise and positive feedback tend to have positive self-image and similarly, students who are chastised by their teachers tend to have poorer self-image. Thus it is vital that all teachers are made aware of the difficulties students experience in making the transition and the need for increased praise and positive feedback in their interactions with first year students. This research echoes the recommendations of Smyth (2017) who advised the promotion of positive teacher-student interactions to form part of school development plans and initial and continuous teacher training. While teacher training should be designed to improve outcomes for all students, there needs to be a special focus on recognizing the problems that specifically female students face at this significant point in their education. The transition is a pivotal point for female students and it is important that the stereotype of mathematics as a male domain is challenged while students are making the transition. Further research into this area, with a larger sample over an extended period of time, is warranted.

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