Investigating gender differences in mathematics performance and in self-regulated learning

An empirical study from Malta

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Abstract

Purpose – The purpose of this paper is to investigate gender differences in mathematics performance and in self-regulated learning (SRL) in Malta.

Design/methodology/approach – A representative sample of 400 Grade 11 students (aged 14-15) attending Maltese mixed-ability schools undertook a mathematics test and responded to a questionnaire. The resulting performance and SRL measures were used to answer four questions empirically.

Findings – Girls performed significantly better than boys ($r = 0.2$) and this difference is mainly owing to the weaker performance of low-achieving boys. While all SRL components identified by factor analysis (self-efficacy, intrinsic value, test anxiety and SRL strategy use) produced a significant main effect on performance, girls reported greater use of SRL strategies, boys claimed to be more self-efficacious and intrinsically motivated while no significant gender difference was reported for test anxiety. Finally, the students' use of SRL strategies accounts for the differential performance in mathematics of Maltese boys and girls.

Originality/value – This empirical study confirms that gender differences constitute a potentially important source of variation in students' mathematics performance and in their SRL. The issue of increasing the students' use of SRL strategies emerges as a possible strategy aimed at combating gender differences in mathematics performance as well as the underachievement of students, particularly that of the low-achieving boys in Maltese secondary schools.

Keywords Malta, Secondary schools, Girls, Boys, Self-managed learning, Mathematics

Paper type Research paper

Introduction

Mathematics is one of the core subjects in the Maltese National Curriculum, the acquisition of which is deemed central to enhancing one's life both materially and intellectually (Bynner and Parsons, 1997). This study which is based in Malta explores gender differences in mathematics performance and in self-regulated learning (SRL) and attempts to determine whether the students' involvement in SRL accounts for the differential performance in mathematics of boys and girls in Maltese secondary schools.

Malta is situated in the centre of the Mediterranean Sea. It has an area of approximately 316 km^2 and a population of approximately 400,000 inhabitants. It gained its political independence from the UK in 1964 and was declared a Republic in 1974. The residents in Malta are mostly Maltese (95.6 per cent), Catholic and can speak both Maltese and English. Malta became a full member of the European Union in 2004. In Malta, the educational system is divided into three main branches: primary education (age 5-10), secondary education (age 11-16) and tertiary education. Primary and secondary schooling are compulsory and parents can opt to send their children to state, church or independent schools. Towards the end of secondary schooling, pupils can choose to sit for the Secondary Education Certificate (SEC) examinations. The National Minimum Curriculum and the National Minimum Regulations for all schools

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are established by the state according to the rights given by the Education Act (1988). Malta has one university which is recognised by the major foreign universities. The Maltese educational system is currently undergoing major changes[1].

This study comes at a time when in Malta there is a great deal of concern from educationalists and policy makers on the differential performance of boys and girls in academic subjects including mathematics (*cf.* MATSEC Examinations Board, 2009). In fact, marked and consistent gender differences where girls perform better than boys in mathematics have been reported in the primary and secondary end-of-year school examinations from as early as age 8 (*cf.* Borg, 1996; Borg and Falzon, 1995) and in national examinations which include the 11+ junior lyceum (state grammar school) examination (Educational Assessment Unit, 1995-2009) and the SEC examination (MATSEC Examinations Board, 2003-2009).

The SEC examination is a prominent feature of the local educational landscape. An analysis of data provided by the SEC reports in the last six years reveals that from the 16-year-old cohorts that sat for the mathematics examination between 2003 and 2008, 52.2 per cent of the females obtained Grades 1 to 5 (the grades required to give students access to sixth form) whereas only 37.7 per cent of the males managed to do so. This relatively lower percentage of Grades 1 to 5 achieved by the boys in a compulsory subject like mathematics should be a matter of concern, considering that the SEC examination reflects "local educational developments", and one of its aims is to "widen access to post-secondary and tertiary education to put Malta on a par with European levels" (MATSEC Examinations Board 2009, p. 1).

This pre-occupation about the boys' underachievement at the compulsory school level is by no means limited to Malta, as similar trends have been reported in many countries around the world (*cf.* Foster *et al.*, 2001). While it is understandable that this trend has become a cause for concern, some major limitations in the Maltese studies should be noted.

The vast majority of studies that examined gender differences in performance in Maltese secondary schools were conducted in one of the two types of state secondary schools: the junior lyceum (grammar school) which caters for students who passed the 11+ junior lyceum examination or the area secondary school (non-grammar) which caters for those who failed this selective examination. So these schools represent two relatively distinct homogeneous groups in terms of attainment. Thus, it is critical not to generalise from these selective populations to the general population (*cf.* Hyde, 1994). Another bias in the junior lyceum population is that a number of boys who pass the junior lyceum examination and who obtained a relatively high performance ranking in the common entrance examination (the church school 11+ examination catering for boys only) may prefer to enter a church school. Thus, "the remaining boys' sample in the junior lyceum may lack much more of the best elements in that sex group than the girls' sample" (Borg, 1996, p. 6) and so the findings reported in the junior lyceum "may be an artefact of a potentially biased boys' sample" (Borg, 1996, p. 17). Thus, the pattern of results reported in the secondary state schools may not be necessarily repeated in general samples taken from mixed-ability populations.

An analysis of gender differences based on SEC examination results has two major limitations that might bias results: a higher proportion of boys than girls do not sit for this examination (*cf.* MATSEC Examinations Board, 2009) and there is an issue of differentiated examination papers by gender (*cf.* Chetcuti and Ventura, 1999), where a higher proportion of boys opt for Option A (designed for the more academically able students, with pass grades ranging from Grade 1, the highest, to Grade 7, the lowest) than Option B (designed for the less academically able students with pass grades ranging from Grade 4, the highest, to Grade 7, the lowest) due to the tendency of girls to "play safe", thus limiting themselves to a Grade 4 when they could have obtained a higher grade if they had chosen Option A.

Thus, the pattern of results reported in Maltese state secondary schools and in the SEC examination may not necessarily be repeated in general samples taken from mixed-ability populations. To overcome this limitation, this study aims to extend the local research on gender differences in mathematics performance by focusing on those students attending Maltese mixed ability schools – that is, those schools in Malta that guarantee primary and secondary schooling upon entry and where students do not need to take an examination to determine placement. Thus, the population considered is not relatively homogeneous in terms of attainment and should include students who might not sit for the SEC examination in mathematics. In other words, the first aim of this study is to confirm or contradict the existence of a gender gap in mathematics performance in Maltese secondary schools.

Another limitation in the local studies is that the research conclusions are in the form of suggested explanations, with very little empirical basis and all directed at explaining the gender gap in school performance. So, in the presence of a significant gender difference in mathematics performance, an attempt will be made to determine whether the students' involvement in SRL accounts for the differential performance in mathematics of boys and girls in Maltese secondary schools. Thus, any explanations that are provided in this study are supported by empirical evidence. The implications of the findings are discussed.

Literature review

In this section I give an overview of the existing foreign literature that contributes to the framework of this empirical study. Although any broad generalisations about gender and SRL are problematic (*cf.* Pintrich and Schunk, 2002), there are some trends that should be noted.

Trends in gender differences in mathematics performance

In a meta-analysis based on 1,500 cross-cultural studies, Maccoby and Jacklin (1974) reported that clear and consistent gender differences emerge after age 11, with girls becoming superior in verbal abilities and boys in mathematical and visual-spatial abilities. The male domination of "spatial subjects" reflected a popular perception that, whilst males possess higher analytical abilities and consequently are more orientated towards mathematics, science and computing, females possess greater linguistic abilities and consequently are more orientated towards languages.

In another meta-analysis, Friedman (1989) focused on studies published between 1974 and 1987. At first, no gender difference was found in mathematics performance but younger students pre-dominated the 98 studies used in this meta-analysis. In fact, when high school samples were considered separately, the analysis showed once again that males performed better than females in mathematics and this finding was also supported by later reviews using more sophisticated meta-analysis techniques (e.g. Cleary, 1992; Willingham *et al.*, 1997). These findings continued to support the stereotypes about female inferiority in mathematics (*cf.* Hyde *et al.*, 1990) and many studies reported the adverse effects such stereotypes have on mathematics achievement (Spencer *et al.*, 1999), on self-perceptions of competence in specific domains (Marsh *et al.*, 1988) and on career choice (Catsambis, 1999).

Researchers who specifically addressed the question of trends over time indicated that the difference in favour of males appeared to be decreasing with time (Hall *et al.*, 1999;

Hyde *et al.*, 1990). Hyde (1996) determined from meta-analysis that the magnitude of the gender difference in mathematics ability decreased by half in two decades between 1974 and 1996. However, the gender gap became wide again when mathematics was broken down into specific content areas such as geometry and algebra (e.g. Hyde *et al.*, 1990; McGuiness, 1994; Penner, 2003) and when highly selective samples (e.g. gifted pupils) were used (e.g. Robinson *et al.*, 1996; Swiatek *et al.*, 2000). These findings supported the male variability hypothesis (*cf.* Maccoby and Jacklin, 1974) – that males are more variable than females in some or all mental abilities and this explains the surplus of males in the upper and lower tails of the mathematics performance distribution (Hyde, 1994).

More recent studies conducted in the USA indicated that there were no gender differences in the middle school and high school students' mathematics test scores and grades (Catsambis, 1999; Hyde *et al.*, 2008; NCES, 2001) while others started to provide evidence that it was actually the boys whose academic performance suffered (e.g. Kenney-Benson *et al.*, 2006; Pomerantz *et al.*, 2002). These findings contradicted the stereotype that females are inferior in mathematical abilities and supported the gender similarities hypothesis (*cf.* Hyde, 2005) – that males and females are similar on most, but not all, psychological variables. Hyde and Linn (2006) argued that an emphasis on gender differences reinforces stereotypes that girls lack mathematical and scientific aptitude. They suggested that the use of gender as a proxy for mathematical ability is not a particularly effective evaluator. Additionally, gender differences via effect sizes (which measure the magnitude of the gender difference) are not sufficient to explain the disparity in the participation of females in mathematics, science and engineering. Hence, it would be more profitable if educators and researchers increase awareness of similarities in mathematics and science performance and in their ability to succeed, rather than focusing on gender differences.

As we progress through the twenty-first century, studies conducted in Australia, England, Hong Kong, New Zealand, Pakistan and many other countries around the world generally show that girls are performing better than boys in mathematics at the compulsory school level (*cf.* Downing *et al.*, 2008; Foster *et al.*, 2001; Gorard *et al.*, 2001; Rowe and Rowe, 2002; Saeed and Bushra, 2005) and fears about underachieving boys at the compulsory school level continue to shape educational discourse (QCA, 2003). Many studies in the UK reported that the boys "laddish" behaviour was acting as an impediment to the progress of both boys and girls at school (Francis, 1999, 2000; Warrington *et al.*, 2000). At school, "hegemonic masculinity is pervasively constructed as antithetical to being seen to work hard academically" (Frosh *et al.*, 2002, pp. 197-8). Epstein (1998) explains this construction by locating hegemonic masculinities within a structure of gender/sexual power relations. She argues that it is within these gender/sexual power relations that boys define their own identities against the other category for femininity, and so boys must avoid any activities associated with femininity. Such theories on hegemonic masculinity relate well to displays of machismo, where "nerdish" behaviour is frowned upon by boys. There is evidence that academic work is perceived as "feminine" and working hard is inconsistent with the models of masculinity in many schools (Epstein, 1998; Frosh *et al.*, 2002). So, if boys want to avoid the verbal or physical abuse, they must avoid academic work (e.g. rejection of hard work) or at least they must appear to avoid academic work (e.g. explicitly stating to peers not to have worked hard at something they actually had). As a result, academic success is more valued by girls and so girls take school more seriously than boys (*cf.* Tinklin, 2003). This is in accordance with other research evidence that girls tend to be better prepared, more conscious, cooperative, organised and respectful at school, while boys are seen as ill prepared, competitive, disruptive, overconfident and less attentive (e.g. Warrington *et al.*, 2000). It also lends weight to research on the influence of different peer cultures experienced by girls and boys (e.g. Tinklin *et al.*, 2001).

Finally, a recent cross-cultural study by Hyde and Mertz (2009) found that countries that have little or no gender gap in mathematics performance are in fact those countries that have the greatest gender equality. They also argued that the greater male variability hypothesis with respect to mathematics is not ubiquitous since the ratio of girls to boys that excel in mathematics correlates highly with the country's gender equity. Thus, any gender gap in mathematics performance is cultural not biological. Mertz (as cited in University of Wisconsin-Madison, 2009) adds that girls (and boys) are more likely to perform better in those countries where people value mathematics highly and view mathematics performance as being largely related to effort rather than to an innate talent.

Self-regulated learning

A self-regulatory activity that is receiving particular attention in the research literature is SRL. SRL encompasses "cognitive, affective, motivational and behavioural components that provide the individual with the capacity to adjust his or her actions and goals to achieve desired results in the light of changing environmental conditions" (Zeidner *et al.*, 2000, p. 752). It is a subset of self-regulation – the higher-order expansive construct, which "refers to students' self-generated thoughts, feelings and actions, which are systematically oriented towards attainment of their goals" (Schunk and Zimmerman, 1994, p. ix). This constellation of beliefs, knowledge and skills allow self-regulated learners to be independent and to manage their own learning across a variety of academic contexts (Wolters, 2003).

According to Pintrich (2000), SRL is guided and constrained both by personal characteristics of the learner and by contextual features of the environment. He argued that the emphasis is with "being strategic" rather than "having" a strategy. It is one thing to know what a strategy is and quite a different thing to be inclined to use it and modify it as task conditions change.

Attempts to categorise and measure SRL have been many and varied (e.g. Garcia and Pintrich, 1994; Pintrich and De Groot, 1990; Wolters, 1998, 2003; Zimmerman and Martinez-Pons, 1990). What these models of SRL emphasise is the importance of examining the motivational-cognitive interface in the classroom context, where both motivational and cognitive factors operate simultaneously (Zimmerman and Schunk, 2001). As Pintrich and De Groot (1990, p. 33) put it:

> Knowledge of cognitive and metacognitive strategies is usually not enough to promote student achievement; students must also be motivated to use the strategies.

SRL is generally measure via self-report instruments and probably one of the most established inventories used by researchers is the Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich and De Groot (1990). In this model, the SRL strategies that seem especially important for classroom learning and performance are cognitive strategies, meta-cognitive strategies and self-regulatory (or resource management) strategies. Additionally, the three types of motivational beliefs that are linked to the three corresponding dimensions of SRL are self-efficacy (an expectancy component), intrinsic value (a value component) and test anxiety (an affective component). These motivational and SRL components of classroom academic learning are described in further detail below.

Self-efficacy. The basic construct in the expectancy component of students' motivation involves "students' beliefs that they are able to perform the task and that they are responsible for their own performance" (Pintrich and De Groot, 1990, p. 33). Self-efficacy can be distinguished from self-perceived competence since "self-efficacy may vary as a function of personal or environmental differences" whereas self-perceived competence is more global and "less concerned with micro level instability of beliefs" (Pintrich and Schunk, 2002, p. 165).

In general, studies show that students who believe that they are able and that they can and will do well are more likely to be motivated in terms of effort, persistence and behaviour than students who believe they are less able and do not expect to succeed (Pintrich, 2003). These confident students are more likely to use cognitive and metacognitive strategies and are more likely to persist in a task than a person who does not believe that he or she can perform the task (*cf.* Pintrich and De Groot, 1990; Schunk, 1994; Wolters, 2003; Zimmerman and Martinez-Pons, 1990).

Studies have also examined gender differences in the expectancy beliefs. In most cases where a gender difference is found, the difference is that females have lower expectation beliefs than males in mathematics (e.g. Eccles *et al.*, 1998; Marsh, 1989; Skaalvik and Skaalvik, 2004; Watt *et al.*, 2006; Wigfield *et al.*, 1996). A surprising aspect is that in many cases, females perform on par or outperform males in mathematics attainment and yet studies still show females as having lower self-perceptions of competence (e.g. Pintrich and Schunk, 2002; Watt *et al.*, 2006). This discrepancy between expectation beliefs and actual performance might be due to a response bias, with boys being more self-congratulatory and girls being more modest (*cf.* Wigfield *et al.*, 1996). Another possible explanation is that sex stereotypes may influence the boys' and girls' self-perceptions for mathematics independently of achievement. In fact, Eccles *et al.* (1998) found that males have higher self-perceptions in mathematics since mathematics is stereotyped as a male domain. They also reported that the gender difference in perceptions of competence is also moderated by how much the individual student endorses the cultural stereotype.

Intrinsic value. The value component of student motivation involves "students' goals for the task and their beliefs about the importance and interest of the task" (Pintrich and De Groot, 1990, p. 34). Intrinsic motivation refers to motivation to engage in an activity for its own sake. It is derived from factors that are inherent in task completion and can be achieved by engaging in cognitive operations that are part of the task. Thus, sources of intrinsic motivation would include students' perception of value of course material, personal interest and feelings of mastery, which accompany learning. In contrast, extrinsically motivated students engage in an activity as a means to an end and this motivation typically comes from teacher praise, grades or other external rewards contingent on doing better than others. Pintrich and Schunk (2002) argued that it is more accurate to think of intrinsic and extrinsic motivation as two separate continuums rather than two ends of a continuum.

Studies show that students who are intrinsically motivated persist longer, tend to be more deeply engaged, use more cognitive and metacognitive strategies and show more achievement outcomes than extrinsically motivated students (Ames, 1992; Pintrich and De Groot, 1990; Wolters, 1998).

Studies that examined gender differences indicate that girls are generally more intrinsically motivated than boys (e.g. Bouffard *et al.*, 1995; Jacobs and Newstead, 2000), but for mathematics, boys are more intrinsically motivated than girls (e.g. Skaalvik and Skaalvik, 2004; Watt *et al.*, 2006). It is generally acknowledged that boys like mathematics more than girls (*cf.* Fredricks and Eccles, 2002; Watt *et al.*, 2006), and according to Marsh (1989) this may be due to the fact that sex stereotypes influence the boys' and girls' motivation for mathematics independently of achievement.

Test anxiety. One of the most important affective reactions, relevant in a school-learning context, and which impacts on SRL differently to self-efficacy and intrinsic value is test anxiety (*cf.* Pintrich and De Groot). Test anxiety refers to "feelings of fear, anxiety, stress and related cognitions of doubt and worry regarding test performance" (Pintrich and Schunk, 2002, p. 408).

The negative relationship between test anxiety and achievement in mathematics classes has been a consistent finding in the literature (*cf.* Bandalos *et al.*, 1995; Musch and Broder, 1999; Pajares and Miller, 1994). Benjamin *et al.* (1981) found that highly anxious students often use appropriate cognitive strategies for achievement but appear to be very ineffective and inefficient learners and anxiety drains their cognitive resources. In another study, Wolters and Pintrich (1998) found students who use their test anxiety to maintain cognitive strategy use; however, these students are less likely to use metacognitive strategies when compared with less anxious students and this leads to poor grades.

Comparisons between males and females have revealed consistent gender differences in test anxiety levels, with females scoring higher anxiety levels than males in mathematics tests (e.g. Hembree, 1990; Ho *et al.*, 2000; Zeidner, 1996). However, most of the anxiety measures are based on self-reports. In a review of literature, McDonald (2001, p. 93) points out that "that this difference is due to the girls being more willing to report experiencing anxiety (e.g. Hill and Sarason, 1966)" and argues that "of the various approaches to assessing the extent of test anxiety, only the use of standardised tests with established cut-off scores can provide actual prevalence estimates". Turner *et al.* (1993) used this approach and found that test anxiety was equally prevalent in boys and girls, thus contradicting the general finding (as mentioned earlier) that girls are more test anxious than boys.

Cognitive strategies. Cognitive strategies are those strategies "used to understand text, to learn new material, and to think and problem solve" (Pintrich and Schunk, 2002, p. 403). Many researchers (e.g. Garcia and Pintrich, 1994; Pintrich, 2003; Pintrich and De Groot, 1990; Warr and Downing, 2000; Wolters, 2003) have followed the work by Weinstein and Mayer (1986), who identified rehearsal, elaboration and organisational strategies as important cognitive strategies that are related to classroom academic performance.

Rehearsal involves the reciting of items to be learned or the reciting of words aloud as one reads a piece of text (Warr and Downing, 2000). These strategies help the student attend to and select important information from lists and texts and keep this information active in working memory (Garcia and Pintrich, 1994). As such it illustrates a "surface" approach to learning rather than a "meaning" orientation (Richardson, 1990) and is viewed as emphasising performance rather than intellectual mastery of the subject (Fisher and Ford, 1998).

Organisation involves the identifying of key issues and creating mental structures which group and inter-relate elements to be learned (Warr and Downing, 2000). Organising the material to be learnt includes selecting the main text, outlining the material to be learnt, using a variety of specific techniques for selecting and organising the ideas in the material and preparing a written summary of the themes that have been selected and structured.

Elaboration involves the examining of implications and the making of mental connections between material to be learned and existing knowledge. These elaboration strategies reorganise ideas in contrast to passive, linear note taking and go further than fitting different aspects together (as in organisation), since such procedures seek to increase understanding by changing the way the material is viewed in the context of other information (Warr and Downing, 2000).

Metacognitive strategies. Metacognitive strategies are used to actually control and regulate cognition (Pintrich and Schunk, 2002). Most models of SRL include three types of metacognitive strategies: planning, monitoring and regulating.

Planning activities include setting goals for studying, retrieving relevant domain-specific knowledge and skills (e.g. how to do division), sequencing problem-solving strategies (e.g. division of hundreds, tens and units in mental mathematics, skimming a text before reading, generating questions before reading a problem and doing task analysis of a problem). These planning strategies help the learner to plan the use of cognitive strategies, activate relevant aspects to prior knowledge, thus making organisation and understanding of material much easier.

Monitoring strategies "alert the learner to breakdowns of comprehension that can be subjected to repair through the use of regulating strategies" (Garcia and Pintrich, 1994, p. 144). They include the tracking of attention when reading a problem, monitoring the understanding of a lecture, self-testing by questioning text material or a given task and test-taking strategies (like monitoring speed and adjusting to time available). Pintrich and Schunk (2002) add that monitoring strategies result in motivational enhancements because when people realise what they do, they may react to this knowledge and alter their behaviour.

Regulation strategies are closely tied to monitoring strategies. For example, when learners ask themselves questions as they read in order to monitor comprehension, and then go back and reread a portion of a text, the re-reading is a regulatory strategy. Other examples of self-regulating strategies include: slowing down when confronting harder text or a more difficult problem, reviewing lecture notes, past papers and texts while studying for an exam, skipping questions during a test and then returning to them later. These strategies are assumed to improve learning by helping students correct their studying behaviour and repair deficits in their understanding.

Researchers have found that metacognitive strategies promote deeper processing of material (Pintrich, 2000) and are instrumental in challenging tasks in mathematics as they allow students to use the acquired knowledge in a flexible and strategic way (Lucangeli *et al.*, 1998).

Self-regulatory strategies. These resource management strategies concern those strategies that students use to manage their environment and their effort (Garcia and Pintrich, 1994; Pintrich and De Groot, 1990; Wolters, 1998). Three self-regulatory strategies that received particular attention in related research are help seeking (from parents, teachers or friends), time management and volition (the tendency to keep focused and avoid distractions). These are not cognitive or metacognitive strategies that may have a direct influence on eventual learning, but they are general strategies that can help or hinder the students' efforts at completing the academic task. In line with the general adaptive approach to learning, these strategies help students adapt to their environment as well as changing the environment to fit their goals and needs, thus maintaining their cognitive engagement to the task, enabling them to perform better (Garcia and Pintrich, 1994).

Studies support the belief that students who use SRL strategies show higher levels of performance than other students (Fuchs *et al.*, 2003; Garcia and Pintrich, 1994; Pintrich and De Groot, 1990; Wolters, 1998; Zimmerman and Martinez-Pons, 1990).

As for gender differences, some studies found that females make greater use of SRL strategies than males (e.g. Ablard and Lipschultz, 1998; Joo *et al.*, 2000; Zimmerman and Martinez-Pons, 1990) while others reported no differences (e.g. Pintrich and De Groot, 1990; Rao *et al.*, 2000).

Proposed framework

In view of the above, this study will examine the interaction between gender, SRL and mathematics performance in Malta. More specifically, in a sample of mixed-ability students attending Maltese secondary schools, the following four research questions will be tested empirically.

RQ1. Is there a significant gender difference in mathematics performance?

RQ2. Does performance in mathematics vary as a function of the SRL components of classroom academic learning?

RQ3. Do significant gender differences exist in the SRL components of classroom academic learning?

RQ4. Is the gender difference in mathematics performance moderated by the students' level of involvement in SRL?

The flowchart in Figure 1 provides a succinct overview of the procedures adopted in this study.

Sampling procedure

In Malta, there are 15 mixed-ability schools that provide primary and secondary schooling and where pupils do not need to take an examination to determine placement. In this study, students were required to undertake a mathematics test and to respond to a self-response questionnaire. It was not easy to obtain permission to conduct research within the participating schools, even though it was made clear from the outset that the information obtained from the schools would be confidential and that the names of participating schools and students would not be revealed. In fact, seven schools declined while the other eight which consisted of four single sex schools (two-boys only and two-girls only) and four co-educational schools granted me permission to conduct the research within their schools.

After preliminary discussions, permission was granted to conduct the research with Form IV (Grade 11) students instead of Form V (Grade 12) students, since it was argued

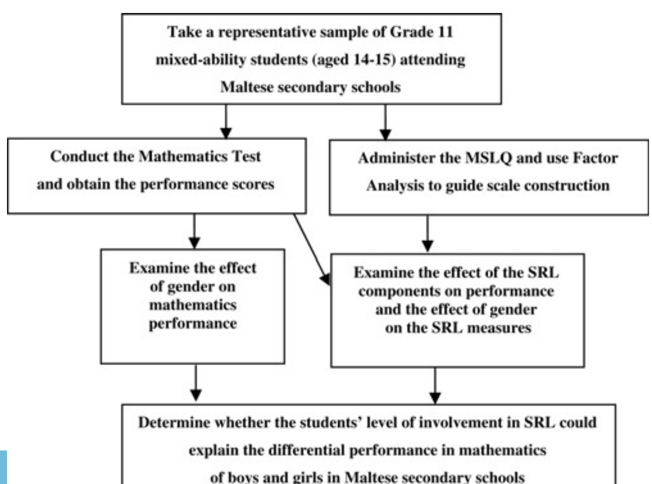

Figure 1. Flowchart – an overview of procedures

by the heads of the participating schools that at the end of Form V, students take the SEC examinations. A number of meetings were held with the heads of the mathematics department and the teachers to discuss the way ahead. A decision was taken to conduct a series of short mathematics sub-tests and these would form part of the continuous assessment strategy plan adopted by the schools. This had the advantage that it was possible to assess students over a wide range of topics highlighted in the SEC syllabus for mathematics. The teachers in the respective schools played an important role in the construction of the test, as they had to ensure that the items considered were appropriate for their students and that they would benefit from them. The test items were designed in a problem-solving format and cover a wide span of difficulty. These items were adapted with permission from the SEC examination past papers (MATSEC Examinations Board, 1996-2004) and from the tests designed for secondary school students by the "concepts in secondary mathematics and science" team (Hart, 1981). Each of the ten subtests required 20 minutes and was conducted during normal mathematics lessons, spread throughout the scholastic year. All students participating in this study were given the same subtests. To avoid problems associated with inter-rater reliability, sum-scores were used (i.e. a correct answer was awarded a "1", otherwise a "0" was awarded). All scores were inputted into a spreadsheet after correction.

With regards to the tests, the heads informed me that no parental/student permission was needed. However, with regards to the questionnaire, the parents were informed in writing about the nature of the study and the voluntary nature of their co-operation. It was stressed that the participants would not risk any harm, that the confidentiality of data was ensured and that the students would be free to withdraw at any time without prejudice or consequence. Once parents were informed and no objections were raised, the students were asked whether they were willing to participate in the survey. Upon mutual consent, they were presented the questionnaire on a specific day and time. All testing was conducted during the scholastic year 2004/2005.

To estimate the sample size required for the study, Russ Lenth's online software for power and sample size (Lenth, 2006-2009) was used. After specifying a 95 per cent confidence level, a variability of 1.26 units (based on a pilot test sample) and a desired precision of 0.2 (one-fifth of a unit on the rating scale), the minimum sample size required with the preset criteria was 135. However, one of the intentions of the present study was to conduct exploratory factor analysis on the MSLQ items and so it was evident that a sample size of 135 was not sufficient. Comrey and Lee (1992) provide the following sample-size guidance for factor analysis: 100 = poor, 200 = fair, 300 = good, 500 = very good and 1,000+ = excellent. Based on this, a decision was taken to select 400 participants (200 boys and 200 girls) at random from the participating students who provided a complete data set. The final sample ($n = 400$) used in the analysis represents 36 per cent of the population ($n = 1{,}106$) in question.

Results and discussion

1. Is there a significant gender difference in mathematics performance?

Performance in mathematics was based on the composite score of the ten subtests. Figure 2 shows the total score distribution plot. This plot provides insights into how the students performed on the test as a whole. In fact, it reveals that the test generated a wide range of scores and that the total score distribution is normal. A Kolmogorov-Smirnov (KS) test, which tests whether or not a difference exists between the distribution of the data set and a normal one, confirmed that the test scores are normally distributed (KS statistic $= 0.988$, $n = 400$, $p = 0.284$).

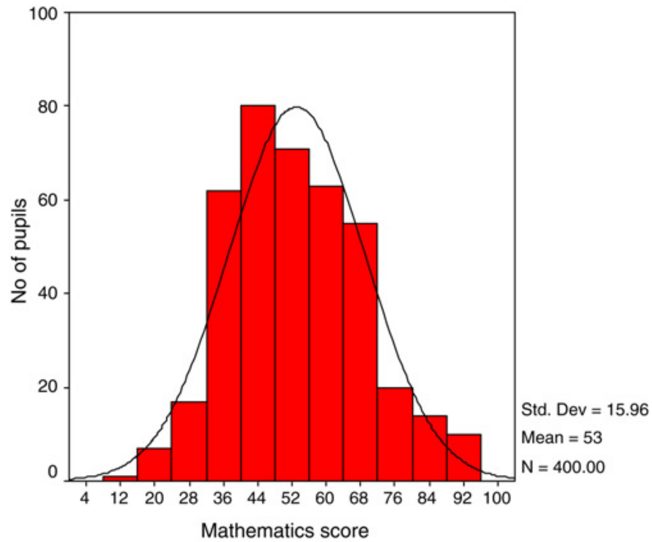

Figure 2. Total score distribution plot

Summary statistics for performance by gender revealed that on average, the girls (mean ($\bar{x}$) = 56.23 per cent, standard deviation (SD) = 14.86) performed better than the boys ($\bar{x}$ = 49.91 per cent, SD = 16.47). The box-plots in Figure 3, which illustrate the performance distributions for boys and girls, indicate that girls performed better than boys.

To verify whether the difference in the average scores was statistically significant (i.e. it is unlikely to have occurred by chance), the analysis of variance (ANOVA) test was used. The difference in means was statistically significant ($F(1,398) = 16.24$, $p < 0.01$) and according to Rosnow and Rosenthal (2002), it represents a small to moderate sized effect (effect size $r = 0.2$). Thus, the null hypothesis was rejected and I concluded that in a representative sample of Grade 11 pupils attending mixed ability schools in Malta, girls performed significantly better than boys in mathematics. This

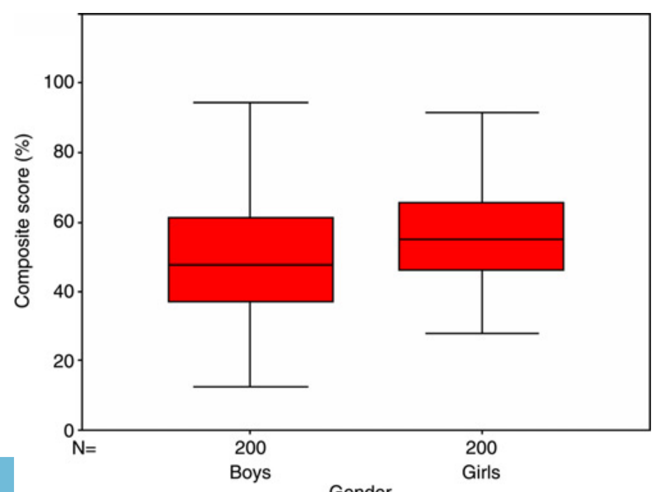

Figure 3. Box-plots – the mathematics performance distributions for boys and girls

finding is consistent with the pattern of results reported by other Maltese studies and appears to be a continuation of a trend reported in the primary and secondary end of school examinations from as early as age 8 (e.g. Borg, 1996; Borg and Falzon, 1995) and in national examinations that include the junior lyceum 11+ examination (Educational Assessment Unit, 1995-2009) and the SEC examination for mathematics (MATSEC Examination Board, 2003-2008).

The SDs also suggest that the scores of the boys are more widely spread. In fact, the variance ratio (VR) which is the male variance divided by the female variance is 1.23. This VR differs significantly from 1 and is higher than those reported by Machin and Pekkarinen (2008) for the USA (VR = 1.19) and for England (VR = 1.06). This supports the male variability hypothesis and other studies that consistently report that males are more variable than females on measures of mathematics performance (e.g. Gorard *et al.*, 2001; Hyde and Mertz, 2009). The box-plots in Figure 3 indicate that the gender gap is not evenly distributed across the achievement range, but slanted towards lower levels. This prompted me to examine gender differences at the top 25 per cent and bottom 25 per cent of the performance distribution. While the F-statistic was neither statistically ($F(1,98) = 0.983$, $p = 0.30$) nor practically significant (effect size $r = 0.03$) at the upper end, it was statistically ($F(1,98) = 9.11$, $p = 0.003$) and practically (effect size $r = 0.35$) significant at the bottom end of the distribution. In other words, the gender gap in mathematics performance is mainly owing to the weaker performance of the low achieving boys.

Before moving on with the analysis, a two-way ANOVA was used to verify whether the type of school setting (single-sex vs co-educational) changes the form of the relationship between gender and performance in mathematics. However, neither the interaction term ($F(1,396) = 1.98$, $p = 0.16$) nor the main effect of school setting ($F(1,396) = 0.50$, $p = 0.48$) was statistically significant.

2. Does performance in mathematics vary as a function of the SRL components of classroom academic learning?

To measure students' involvement in SRL, the MSLQ (Pintrich and De Groot, 1990) was used. In preliminary analysis, a factor analysis was conducted on the students' responses to the MSLQ questionnaire, since it was administered in different contexts (mathematics instead of science, Malta instead of the USA) and with a different age group. Factor analysis addresses the problem of analysing the structure of the interrelationships among a large number of variables by defining a set of common underlying dimensions, known as factors (Hair *et al.*, 1998).

The Kaiser-Meyer-Olkin measure of sample adequacy (KMO = 0.94) indicated a "meritorious" level of sampling adequacy (*cf.* Hair *et al.*, 1998), thus supporting the continuance of factor analysis. After deriving the initial solution, four eigenvalues greater than one emerged and these accounted for 44.5 per cent of the total variance. A summary of item loadings on each of the four VARIMAX factors is presented in Table I.

Interpretation of the VARIMAX rotation factors was quite straightforward: Factor 1 consisted of all items pertaining to "self-efficacy"; Factor 2 consisted of the cognitive, metacognitive and resource management strategy use items and was termed "SRL strategy use", Factor 3 consisted of the intrinsic value items while Factor 4 consisted of the test anxiety items. Although cognitive/metacognitive strategy use and self-regulatory strategy use were intended to be separate constructs (*cf.* Pintrich and De Groot, 1990), this was not supported by factor analysis. Two items (Q27 and Q37) produced unstable factor structure

Factor 1	Factor 2	Factor 3	Factor 4
Q13 (SE) 0.793	Q34 (CM) 0.627	Q17 (IV) 0.695	Q12 (TA) −0.745
Q18 (SE) 0.769	Q28 (CM) 0.619	Q15 (IV) 0.691	Q20 (TA) −0.731
Q9 (SE) 0.767	Q23 (CM) 0.609	Q7 (IV) 0.633	Q3 (TA) −0.715
Q2 (SE) 0.741	Q30 (CM) 0.592	Q5 (IV) 0.628	Q22 (TA) −0.652
Q8 (SE) 0.760	Q40 (CM) 0.590	Q21 (IV) 0.508	Q27 (CMS) 0.452[a]
Q11 (SE) 0.655	Q36 (CM) 0.573	Q14 (IV) 0.461	Q37 (CMS) 0.438[a]
Q16 (SE) 0.648	Q35 (CM) 0.545	Q1 (IV) 0.445	
Q19 (SE) 0.614	Q39 (CM) 0.542	Q4 (IV) 0.401	
	Q25 (CM) 0.538		
	Q24 (CM) 0.524		
	Q29 (SR) 0.515		
	Q42 (CM) 0.512		
	Q43 (SR) 0.511		
	Q44 (CM) 0.503		
	Q33 (SR) 0.471		
	Q31 (CM) 0.405		
	Q41 (CM) 0.392		
	Q10 (SR) 0.384		
	Q32 (SR) 0.383		
	Q27 (SR) 0.338		
	Q26 (CM) 0.331		
	Q38 (SR) 0.323		
0.93[b]	0.87[b]	0.82[b]	0.80[b]

Notes: [a]Unstable factor structure; [b]Cronbach alpha coefficients: SE, self-efficacy; IV, intrinsic value; TA, test anxiety; CM, cognitive/metacognitive strategy use; SR, SRL strategy use

Table I. VARIMAX rotation loadings (sorted)

and so they were eliminated. The Cronbach alpha coefficients are exemplary (*cf.* Robinson *et al.*, 1991), and this confirms the internal consistency reliability of the questionnaire.

The next step was to determine the relationship between the four constructs and performance in mathematics. Table II displays the zero-order correlations for self-efficacy, intrinsic value, test anxiety, SRL and performance in mathematics.

These correlations indicate that higher levels of self-efficacy ($r = 0.438$, $p < 0.01$), intrinsic value ($r = 0.308$, $p < 0.01$) and SRL strategy use ($r = 0.691$, $p < 0.01$) are associated with higher levels of student performance. On the contrary, higher levels of test anxiety ($r = -0.442$, $p < 0.01$) are related to lower levels of performance.

Pearson correlation	Self-efficacy	Intrinsic value	Test anxiety	Use of SRL strategies	Performance in mathematics
Self-efficacy	1	0.605*	−0.541*	0.463*	0.438*
Intrinsic value	0.605*	1	−0.333*	0.388*	0.308*
Test anxiety	−0.541*	−0.333*	1	−0.389*	−0.442*
Use of SRL strategies	0.463*	0.388*	−0.389*	1	0.691*
Performance	0.438*	0.308*	−0.442*	0.691*	1
N	400	400	400	400	400

Note: *Correlation is significant at the 0.01 level (two-tailed)

Table II. Zero-order correlations between SRL components and performance

Before using ANOVA, the four-component scales were dichotomised via median splits into four high/low categories. These were then used as independent variables and mathematical performance as the dependent variable. In the presence of no interaction effects, the main effects were interpreted directly. The main effects plot (see Figure 4) reveals that all four components had a direct impact on the performance means across the high/low categories, with SRL strategy use producing the greatest impact on mathematics performance.

ANOVA and effect size r confirmed that all the four components produced both statistically and practically significant main effects on performance; self-efficacy produced a small but significant effect ($F = 8.662$, $p < 0.01$, effect size $r = 0.15$); intrinsic value produced a small to moderate but significant effect ($F = 5.548$, $p = 0.02$, effect size $r = 0.2$); test anxiety produced a small but significant effect ($F = 7.995$, $p < 0.01$, effect size $r = 0.14$); while SRL produced a "jumbo-sized" and significant effect ($F = 371.023$, $p < 0.01$, effect size $r = 0.70$). A summary of the ANOVA which tests between-subjects effects on performance is presented in Table III.

Thus, I conclude that all the four SRL components (self-efficacy, intrinsic value, test anxiety and use of SRL strategies) had an independent significant effect on mathematics performance. This finding has confirmed that apart from knowledge or skill concerning various SRL strategies, high performing students generally exhibit an array of motivational beliefs and attitudes that include high levels of self-efficacy and intrinsic value and low levels of anxiety (Pintrich, 2000). Thus, students need both the "will" and the "skill" to be successful in the classroom (*cf.* Pintrich and De Groot, 1990).

3. Do significant gender differences exist in the SRL components of classroom academic learning?

Multivariate analysis of variance (MANOVA) was used to test the null hypothesis that gender has no effect on the four components. In preliminary analysis, it was ensured that the assumptions of homogeneity of the variance-covariance matrices and the correlation among the dependent variables were not violated. The box-M test statistic ($M = 8.864$, approx. $F = 0.877$, $p = 0.554$) confirmed the homogeneity of the variance-covariance matrices and this allows the researcher to interpret the results without having to consider group sizes, level of covariance in the group, and so forth (Hair *et al.*, 1998). The Bartlett test of sphericity (approx. $\chi^2 = 437.43$, df $= 6$, $p < 0.001$) revealed a significant level of correlation between the independent measures, thus satisfying the necessary level of inter-correlation to justify MANOVA.

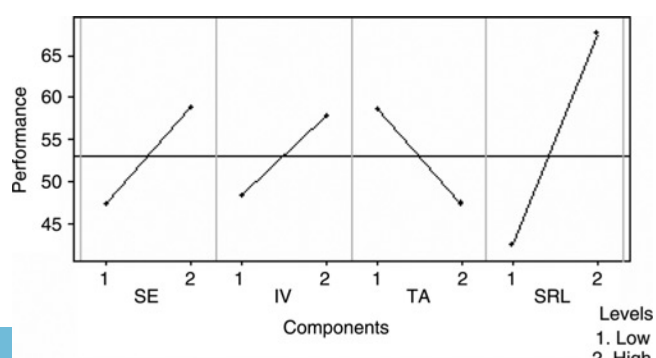

Figure 4.
Main-effects plot – the component levels vs mathematics performance

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	67,407.01[a]	15	4,493.8	50.042	<0.01
Intercept	786,104.6	1	786,104.6	8,753.911	<0.01
SE	777.871	1	777.871	8.662	<0.01
IV	498.182	1	498.182	5.548	0.02
TA	717.984	1	717.984	7.995	<0.01
SR	33,318.01	1	33,318.01	371.023	<0.01
SE × IV	15.818	1	15.818	0.176	0.68
SE × TA	37.824	1	37.824	0.421	0.52
IV × TA	22.241	1	22.241	0.248	0.62
SE × IV × TA	1.282	1	1.282	0.014	0.91
SE × SRL	96.528	1	96.528	1.075	0.30
IV × SRL	226.225	1	226.225	2.519	0.11
SE × IV × SRL	0.305	1	0.305	0.003	0.95
TA × SRL	1.431	1	1.431	0.016	0.90
SE × TA × SRL	23.06	1	23.06	0.257	0.61
IV × TA × SRL	4.047	1	4.047	0.045	0.83
SE × IV × TA × SRL	14.712	1	14.712	0.164	0.69
Error	34,483.35	384	89.8		
Total	1,228,470	400			
Corrected total	101,890.4	399			

Note: [a]$R^2 = 0.662$ (Adjusted $R^2 = 0.648$)

Table III. ANOVAs – tests of between-subjects effects on performance

The MANOVA model revealed a significant Wilk's statistic (Wilk's statistic = 0.899, $S = 1, n = 196.5, F(4,395) = 10.987, p < 0.001$) and so univariate tests were performed to determine the source of this significant Wilk's statistic. These revealed that in mathematics, boys are more self-efficacious ($F(1,398) = 4.87, p = 0.01$) and intrinsically motivated than girls ($F(1,398) = 11.84, p < 0.01$), that boys are as test anxious as girls ($F(1,398) = 1.44, p = 0.231$) and that girls make a greater use of SRL strategies than boys ($F(1,398) = 17.04, p < 0.01$). The significant differences represent a small sized effect for self-efficacy ($r = 0.11$) and intrinsic value ($r = 0.17$) and a small to moderate sized effect for SRL strategy use ($r = 0.2$). As expected, the effect size for test anxiety was negligible ($r = 0.06$).

The finding that boys are more self-efficacious and intrinsically motivated than girls seems contradictory, given that the girls performed significantly better than boys in the test coupled by the fact that positive and significant linear relationships emerged between self-efficacy, intrinsic value and mathematics performance. However this pattern is not particularly surprising as it has also been reported in many foreign studies (e.g. Fredricks and Eccles, 2002; Pintrich and Schunk, 2002; Watt *et al.*, 2006). For instance, Wigfield *et al.* (1996) argued that the discrepancy between self-perceptions of competence and actual achievement in mathematics can be explained by a response bias, with the boys being more self-congratulatory and the girls being more modest. Others studies have also reported that self-perceptions of competence are more directly linked to career choice than actual competence (Catsambis, 1999; Eccles *et al.*, 1998). As for intrinsic value, Marsh (1989) argued that gender may moderate the general finding that intrinsic motivation is tightly linked to performance in mathematics, since sex stereotypes influence boys' and girls' motivation for mathematics independently of achievement. However, there is need for more research in Malta with respect to this area before any concrete conclusions can be drawn.

Studies that examined gender differences in test anxiety based on self-report measures generally report that females score higher than males (e.g. Hembree, 1990; Ho *et al.*, 2000; Zeidner, 1996). This has been attributed to the fact that girls are more willing to report experiencing anxiety (McDonald, 2001). However, this study contradicts this claim and supports the finding reported by Turner *et al.* (1993) that test anxiety is equally prevalent in boys and girls.

Finally, this study also offers empirical evidence that in Maltese mixed ability schools, girls make a greater use of SRL strategies than boys. This finding that girls reported more frequent use of SRL strategies is in fact consistent with two reviewed studies that examined gender differences in the use of SRL strategies among high-achievers (Ablard and Lipschultz, 1998, Zimmerman and Martinez-Pons, 1990).

4. Is the gender difference in mathematics performance moderated by the students' level of involvement in SRL?

This study which is based in Malta has provided empirical evidence that girls perform significantly better than boys in mathematics and that girls make a greater use of SRL strategies than boys. On the basis of these findings, a final attempt will be made to examine whether the gender difference in mathematics performance is still significant after controlling for the differences in the students' use of SRL strategies. To determine this, analysis of covariance (ANCOVA) will be used, with gender as the independent variable, performance in mathematics as the dependent variable, and use of SRL strategies as the covariate. In other words, ANCOVA will determine the effect of gender on performance in mathematics after it partials out the effect of SRL strategy use on students' performance.

Before conducting an ANCOVA, two major requirements must be met (*cf.* Hair *et al.*, 1998). The first requirement is that the covariate must have some relationship with the dependent measure. In fact, Table II shows that SRL strategy use (the covariate) was significantly correlated ($r = 0.691$, $p < 0.01$) to performance (the dependent measure). The second requirement is that the covariate must have homogeneity of regression effect, meaning that the covariate has equal effects on the dependent variable across groups. In the ANCOVA analysis, to examine the assumption of equality of regression slopes, the model was customized to include the interaction term between gender and SRL strategy use (see Table IV). The interaction term was not statistically significant ($F(1,396) = 0.488$, $p = 0.485$), thus confirming the equality of regression slopes assumption.

ANCOVA revealed that when the SRL strategy use was partialed out, the effect of gender on performance was neither statistically significant ($F(1.396) = 1.07$, $p = 0.30$)

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	52,897.596[a]	3	17,632.532	143.334	<0.01
Intercept	13,978.048	1	13,978.048	113.627	<0.01
Gender	131.656	1	131.656	1.070	0.302
SRL	48,843.001	1	48,843.001	397.042	<0.01
Gender × SRL	60.071	1	60.071	0.488	0.485
Error	48,714.823	396	123.017	–	–
Total	1,227,714.935	400	–	–	–
Corrected total	101,612.420	399	–	–	–

Note: [a]$R^2 = 0.521$ (Adjusted $R^2 = 0.517$)

Table IV.
ANCOVA: tests of between-subjects effects

nor practically important (effect size r for $F = 0.05$). The estimated marginal means for performance in means (performance means adjusted to the overall mean for the students' use of SRL strategies) are 52.39 per cent for the boys and 53.73 per cent for the girls. Considering that initially the boys' mean was 49.89 per cent and the girls' mean was 56.22 per cent, it is evident that the students' use of SRL strategies modified the relationship between gender and performance. Based on this empirical evidence, I conclude that the differential performance in mathematics of boys and girls in Maltese secondary schools may be accounted for by the students' use of SRL strategies.

In a previous attempt, Ablard and Lipschultz (1998) focused on high achievers (those who score at or above the 97th percentile on a standardised achievement test) but found that whereas girls has a higher total SRL score, the boys had significantly higher SAT 1 mathematics scores than girls (a small to moderate effect size). However, the finding that boys performed better than girls is not surprising in their study, given that the sample they used was based on students who performed at or above the 97th percentile on an achievement test (SAT). At that time, studies in the USA indicated that boys obtained higher scores than girls in highly selective samples (*cf.* Robinson *et al.*, 1996; Swiatek *et al.*, 2000). Ablard and Lipschultz (1998) concluded that many of these students achieved high levels of performance without necessarily using SRL strategies or else they might not be aware that they use SRL strategies because these strategies had become automated processes for them. Whilst this might be so for talented students, it prompted me to examine the interaction between gender, SRL and performance in a representative sample of Maltese mixed-ability students. The pattern of results obtained in this study supported the predicted hypothesis in the theoretical framework.

Summary of major findings

The scope of this study was to confirm or contradict the existence of a gender gap in mathematics performance in Maltese secondary schools. This study extended the local research by examining gender differences in the mathematics performance of students attending mixed-ability schools. To avoid the sampling limitations highlighted in the introduction, only those schools that guarantee primary and secondary schooling upon entry and where students do not need to take an examination to determine placement were considered. The second aim of this study was to provide an explanation for the existing gender gap that was based on empirical evidence. In fact, the study examined whether students' involvement in SRL accounts for the differential performance of boys and girls in mathematics in Maltese secondary schools. The following is a summary of the findings that emerged from this study.

- In a sample of 400 students attending mixed ability schools in Malta, girls performed significantly better than boys in mathematics. This difference represents a small to moderate sized effect ($r = 0.2$) and is mainly owing to the weaker performance of the low-achieving boys.
- Factor analysis revealed four factors that are directly related to SRL. These are self-efficacy, intrinsic value, test anxiety and SRL strategies (comprising cognitive, metacognitive and resource management strategies). All these components produced a significant main effect on performance, with SRL strategies emerging as the most important determinant of mathematical performance.
- The self-report measures revealed that boys are more self-efficacious and intrinsically motivated than girls, that girls make a greater use of SRL strategies than boys, while boys and girls are equally test-anxious. Given that girls

performed significantly better than boys, this meant that it was not appropriate to include the motivational orientation components together with SRL strategy use to account for the differential performance of boys and girls in mathematics.

- The effect of gender on performance is no longer important after controlling for the students' use of SRL strategies. In other words, the students' use of SRL strategies accounts for the differential performance in mathematics of boys and girls in Maltese secondary schools.

Limitations of the study

There are some major limitations to the findings, however, that must be noted.

- To measure performance, a series of classroom-based mathematics tests which assessed students over a wide range of topics highlighted in the SEC syllabus for mathematics were used. Thus, a limitation of the study is that in examining the students' academic performance, multiple measures of assessment (e.g. practical activities, investigations and other mathematical tasks) were not incorporated. It has been argued that no test or assessment can give a complete picture of classroom performance (*cf.* Hearne, 2001).
- In this study which is based in Malta, it was not necessary to consider variables like race and ethnicity. However, it has been argued elsewhere that studies that do not take into account multiple statuses and roles that students can play as a function of membership in different groups can be misleading and result in simple conclusions being drawn about one characteristic (e.g. gender) when the reality is much more complex (*cf.* Pollard, 1993).
- The measures of students' motivational orientation and SRL were not based on direct observation but on the students' responses to a questionnaire. This means that it was assumed that respondents are capable of an acceptable degree of rating with precision and objectivity. Additionally, it is possible that some students might have presented themselves in what they consider to be a positive manner and this might bias to some extent the results.

Contribution of the study

This study has shown that in Malta gender differences constitute a potentially important source of variation in the students' mathematics performance and in their SRL. A significant contribution of this study is that it produced empirical evidence that accounts for the differential performance in mathematics of boys and girls in Maltese secondary schools. In fact, the gender difference in mathematics performance in Maltese secondary schools could be explained by the students' use of SRL strategies.

This finding also suggests that SRL is a more effective evaluator of mathematics performance than gender. Hence, it would be more profitable if researchers and policy makers in Malta find ways of making boys and girls understand that mathematics performance is more highly related to the way students manage their achievement efforts, rather than focusing on gender differences.

Recommendations

From this study, the issue of increasing the students' level of involvement in SRL emerges as a possible strategy aimed at combating gender differences in mathematics performance as well as the underachievement of students, particularly that of the low-achieving boys within Maltese secondary schools. SRL is desirable due to its positive effects on educational and behavioural outcomes. In fact, in recent years, researchers have made numerous attempts aimed at increasing students' SRL, particularly via SRL programmes (e.g. Azevedo and Cromley, 2004; Fuchs *et al.*, 2003; Naglieri and Johnson, 2000; Pape, 2005). The ultimate pedagogical question is whether students, especially low achievers, can be taught to be more self-regulated learners in order to enhance their mathematical learning and performance. Results of experimental studies in mathematics highlight the potential success of interventions (e.g. programmes, courses, instructions and projects) in SRL for primary, secondary and university students (*cf.* De Corte *et al.*, 2000). There is a need for local programmes or projects that investigate the true impacts of these kinds of initiative. By providing teachers with the necessary tools for remedial action in the classroom, students might "benefit from available educational opportunities and become successful independent learners" (Carr, 2002, p. 161). However, simply teaching students strategies does not guarantee that they will continue to use them. At the most basic level, research initiatives need to monitor the students' use of SRL strategies and continue to explore the relation between gender, SRL and performance in mathematics over time. This should determine whether gender differences in performance are influenced by such interventions, designed to improve the students' level of involvement in SRL.

A concluding note

To say that SRL alone is sufficient to combat gender differences in mathematics performance is probably overstating its importance. This study acknowledges that social and cultural factors (e.g. attitudes, expectations, experience of persistent prejudice, conceptions about the nature of the discipline, pedagogy, assessment) contribute to gender differences in mathematics achievement. In fact, this study shows that in Malta, although girls perform significantly better than boys in mathematics, girls still reported lower levels of mathematics self-efficacy and intrinsic value than boys. In Malta, despite progress, women remain highly under-represented in mathematics-related careers (e.g. mathematicians, operations research analysts, computer programmers, engineers, etc.) and there seems to be a very slow upward trend in the number of females opting for courses leading to such careers at the University of Malta and at the Malta College of Arts, Science and Technology (ETC, 2005).

Recently, following the study by Hyde and Mertz (2009), it has been documented that "the root of gender disparity in math can be pegged to changeable socio-cultural factors" and "such factors either discourage or encourage girls and young women in the pursuit of the skills required to master the mathematical sciences" (University of Wisconsin-Madison, 2009, p. 2). There is a clear need for more local research into the nature of these differences and such research should generate more detailed information than is currently available. Following from the Hyde and Mertz (2009) study, the same conclusion is relevant to the Maltese case where, if Maltese society succeeds in identifying and nurturing mathematically talented youth, regardless of gender, that would help boost our economy.

Note

1. More details on the Maltese Educational System can be found on the web site of the Ministry of Education, Malta (available at: www.education.gov.mt/edu/edu_01.htm).

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