

Girls Studying Physics at Post-Secondary Level in Malta¹

Suzanne Gatt^a & Joan Borg Marks^b

^a Faculty of Education, University of Malta, Msida, Malta

suzanne.gatt@um.edu.mt

^b Physics Department, Junior College, University of Malta, Msida, Malta

joan.borg-marks@um.edu.mt

ABSTRACT

All secondary level students in Malta study, at least, one science subject (Physics, Chemistry and/or Biology) up to school-leaving level. This is due to a pass in one science subject being compulsory for entry into general post-secondary education. On the other hand, Physics, rather than Chemistry or Biology, is compulsory in State Schools. This ensures that a large percentage of girls, in Malta, study Physics. Analysis of Physics exam results at school-leaving level, the Secondary Education Certificate (SEC), shows that there is little difference, if any, in performance between boys and girls in the overall grade. A specific study has shown that the only consistent difference obtained was in coursework, this favouring girls with a moderate effect size of 0.35 and 0.57 for two consecutive years. When one considers the number of students opting to study Physics at Advanced Level in post-secondary education, however, the number of boys is significantly larger than girls, even though more girls than boys follow general post-secondary education. It is argued that the image of careers requiring Physics at advanced level (Engineering and Architecture) are male-oriented and girls tend to opt for other career paths, even within the sciences. Possible influences regarding the choice of science subjects are looked into in order to try to understand better why, even though officially there is the same possible access for girls into Physics courses, this is not taken up. There is, therefore, a need to promote these courses with girls.

Introduction

The development of any country depends on its economy. Malta has no natural resources. Its inhabitants are its only resource. Its development thus relies on how much human potential exists for local industry to be able to provide state of the art manufacturing capabilities. It is only through ensuring that the educational system can provide enough professionally trained technical people that this can be achieved. In view of this, one needs to take into consideration the role of girls in science and scientific careers. With a population of about 400,000, Malta cannot afford to disregard the contribution that girls can give. One therefore needs to look at what is

¹ Paper presented at the workshop 'The Access of Women to Science' Cologne, 5-7th June 2004, organised by the Hands on Science Comenius 3 network.

happening to girls in science at secondary and post-secondary level and to identify if there is a difference in performance between boys and girls. One also needs to see whether there exist times at which, somehow, girls decide, or are forced, to opt out of a scientific career. This is the focus of this paper. Since in Malta, Physics is compulsory for both girls and boys at secondary level, it was the obvious subject to choose in order to carry out the comparison. The paper first looks at the performance of girls and boys in their Physics secondary school leaving examination. Then, any difference in performance is related to the number of boys and girls who eventually decide to study science subjects at post-secondary level. Possible factors that might affect girls choices, for or against science at this level and later on as a career, are explored.

The Educational System in Malta

In order to better understand the setting of this study, the Educational System in Malta will be first described. Students attending state primary schools sit for the 11+ exams in Mathematics, English, Maltese, Religion and Social Studies. Those who pass attend Junior Lyceum schools (grammar type schools), otherwise, they attend Area Secondary schools, which cater for students of lower abilities. The syllabus, however, is the same for both school types. All state secondary schools are single sex.

All students must study one science subject during the last three years of their secondary education as a pass in the Secondary Education Certificate (SEC) in one science subject is an entry requirement into post-secondary education. In state schools, Physics is compulsory and thus, over 4000 students a year sit for the Physics SEC Exam (Gatt, 2002). Students attending state schools have four lessons a week for Physics. They are taken as a whole class for two of the lessons where the theoretical aspect is usually covered. They are then divided into two groups for the other two lessons in order to allow practical work to be done. This ensures that the teacher student ratio is less than 1:16 for laboratory work due to safety measures.

The Physics SEC examination consists of three components. Paper 1 is a written examination that is common to all students sitting for the examination. There are two versions of Paper 2. Paper 2A is the 'difficult' paper and is for the more able students. Paper 2B is the 'easier' version intended for the lower ability students. The third part consists of coursework where students have to present a minimum of 15 laboratory write-ups. Coursework is given 15% of the global mark. Performance is rated from 1 (the highest) to 7 (the lowest). For the 1997/98 examinations, Paper A candidates could obtain grades from 1-4 while Paper B candidates could obtain grades 4-7. In either case, very weak candidates could also obtain a grade U which stands for unclassified. Entry for general post-secondary education requires a pass, at grade 5 or better, in one science subject.

Compulsory secondary education in Malta is provided by State, Church and Independent schools. Church and Independent schools cater for about 35% of children in Malta. They more or less follow the same system as offered at a State school, with the difference that students have the option of studying Chemistry or Biology instead of Physics, for their school leaving certificate.

On completion of compulsory education, students have to choose whether they are going to continue with their post-secondary education or not and whether to follow the general or vocational track. Those students who opt for the general post-secondary track need then to decide the combination of subjects to study. The number of students who do, in fact, take up the option of continuing further studies is on the increase. There is a number of institutions offering post-secondary studies on the island. These are the Private School Sixth Forms, the Higher Secondary School, the Malta College for Arts, Science and Technology (MCAST) and the University Junior College. The latter, with a population of 2945 students in 2003, is the main college in Malta providing general post-secondary education, preparing students for undergraduate studies at the University of Malta (Junior College, 2000).

Theoretical Framework

The performance of girls and boys in school leaving examinations has been an area of research interest for some time, with a number of analyses being carried out to study differences across gender, school type and other factors being carried out. In Malta, we find that Ventura and Murphy (1997) report that in the SEC examinations for 1994, 1995 and 1996, statistical significance in favour of girls was found throughout the three years for Maltese and in 1995 and 1996 for English. It is, however, always in favour of boys for Mathematics. In Physics, the only statistical significance was obtained in 1994 and it was in favour of girls. Abdilla et al. (1998) looked at the SEC Physics 1996 paper and show that both boys and girls in church schools outperform students from Junior Lyceums. However, the difference is somewhat greater in the case of boys.

Table 1: SEC Physics Paper 1 Performance May 1996 Session

| <i>School type</i> | Girls | | Boys | | P-value of t-test |
|--------------------------|-------|-------|------|-------|-------------------|
| | No. | Mean | No. | Mean | |
| Private (Church) Schools | 383 | 55.58 | 649 | 53.68 | <0.001 |
| Junior Lyceum Schools | 628 | 47.31 | 340 | 44.13 | <0.001 |

(Abdilla *et al.* 1998)

Ventura and Murphy (1998) also look at school differences. They note both gender and school differences across subjects, but no interaction. They point out that “private schools” (which in this research consists mainly of church schools), outperform government schools for both boys and girls in six subjects studied (Maltese, English, Mathematics, Physics, Italian and Religious Knowledge). This indicates that there appears to be some creaming off for both boys and girls but does not indicate the extent to which this takes place. If one considers the number of boys and girls in church schools (Table 1) it can be seen that the number of girls is much smaller, indicating that less girls are absorbed by the private schools.

The studies mentioned above look at the performance of students by gender. However, good performance in a subject does not necessarily ensure that it is taken up as choice at post-secondary level. The question that one is therefore prompted to ask is “what are the factors influencing student choices before they start their post-

secondary education?" Two research projects that were conducted in the U.K., with the aim of providing more insight regarding these issues are the ACOST (Advisory Committee on Science and Technology) and the FASSIPES (Factors Affecting Schools Success in Producing Engineers and Scientists) ([Woolnough, 1994](#)). While the ACOST research project studied the processes that create negative attitudes towards school science courses both pre-16 and at 'A' Level, the FASSIPES research focused on the positive factors that encouraged students to become physical scientists or engineers. Although these projects related to all students, irrespective of gender, yet they serve as pointers to some of the reasons behind the fact that only a low percentage of girls take up Physics at post-secondary level ([Lightbody and Durnell, 1996](#)).

In providing reasons for negative attitudes towards school science courses, the ACOST project puts forward the following points: heavy content demands; sciences rated as difficult subjects requiring particular skills; not really interested in science-related activities; dull teaching methodology adopted; and the belief that science was only for the bright students. Students commented on the sterile and impersonal nature of much of the content. This comment was put forward by girls, in particular. In fact, girls were found to react strongly against the 'impersonal and abstract nature of the physical sciences at 'A' Level, wanting their studies to have more relevance to their lives and to environmental issues' (Woolnough, 1994, p368).

The sciences were rated as being difficult, requiring particular skills. In addition, only some students become 'switched on' to science and technology through their early experiences, since only a few play with mechanical toys, for example, and only some grow up with scientific parents. Another aspect was early specialization. When the educational system is such that it forces students to specialize early through subject choice, usually in the first years of secondary education, this attracts only those students with a high commitment to science by age 16, to opt to do science at 'A' Level. A system like this stunts the interest of those would-be science students whose inclination for science takes longer to develop. Students were also found to be put off by the dull and didactic way the subject may be taught. Finally, the belief that "science was only for the very brainy and those who were born that way" (Woolnough, 1994, p369) was in part also responsible for pushing certain groups of students away from the subject.

The FASSIPES research, on the other hand, identifies those positive factors that encourage students to become physical scientists. Among these factors one finds the quality of science teachers and the method of teaching. It appears that enthusiastic teachers, expert in the subject, with enough time on their hands to encourage students, as well as being able to run well-ordered and stimulating science lessons play an important role in making science an interesting subject option to consider. Importance was given to aspects of science teaching such as an enjoyable lesson, which was also accompanied by successful results and well-structured lessons with time for students to do their own planning and thus get a better sense of personal achievement. It also included the need for satisfying practical work and planned visits and talks by scientists as also links between practicing scientists and engineers and the school ([Woolnough, 1994](#))

One can understand that in all the above lie the answers to many important issues. Whereas early experiences promoting the love of science are all essential, yet more important still is what the school and the science teachers can offer as a support towards making science more enjoyable and relevant to everyday situations. This is not to say that factors related to the individual student, like aptitude and ability, can be ignored, as also those factors related to the status and rewards that different countries bestow onto Physics related careers. All this and more has an effect on the students when they come to make their choice, for or against taking up science.

Research in the U.K. has dealt with subject choice and attitudes towards science at schools and towards scientific careers (Dearing, 1996; Dainton, 1968; Harvard, 1996 as quoted in Osborne et al., 1998). This body of research evidence has repeatedly shown that the percentage of students taking science is low, compared to the other subjects. One asks whether this fact shows the existence of some form of 'disillusionment with science education amongst young people?' As Osborne et al. (1998) ask: "Why have we failed to communicate the wonder and excitement of scientific knowledge, the pleasure of doing science, the delight in its achievement and the intellectual thrill that comes with understanding why things are the way they are?"(p30).

Havard (1996) has shown that the major factor that tends to influence negatively the uptake of science was its perceived difficulty. In fact, this was also one of the findings of the ACOST project. Many students perceive science subjects as objective and abstract. Such perceptions of school science "persist much longer than any memories of Newton's Law, the formula for sodium chloride or the characteristics of living things" (Osborne et al., 1998, p.30). An interesting outcome resulting from the survey conducted by the Institute of Electrical Engineers (1994) showed that there is a clear disparity between students' and teacher's perceptions of science. Some form of 'perception gap' appears to exist. In this survey, students have been found to perceive science in terms of technology and associate it with personal computers, TV, video, telecommunication and development in space, that is, the relevant world around the student. Teachers, on the other hand, see science as "a series of milestones represented by the significant discoveries over the last century such as DNA, penicillin and the splitting up of the atom. This disparity between perceptions of science held by students reflecting modern technology and the more theoretical, decontextualised version of evidence dispersed within schools, identifies a major problem which may impede effective communication." (Osborne et al., 1998, p.29). This might then be a factor that induces students to dislike science subjects and to perceive them as being particularly difficult.

Girls, like boys, are affected by all these aspects of science, in some cases opting not to study science further, even if it might have appealed to them at an earlier age(Munro and Elsom, 2000). However, girls experience a further drawback. When girls come to make their job choice, the question of culture comes predominantly into the picture. Does a woman choose a 'traditional' or a 'non-traditional' job? Some jobs are said to convey a 'masculine' image. But can it be that we make a mistake in referring to the masculine image attributed to science and engineering jobs? Many feel that indeed it is the culture and not the image of such work and work places, which is masculine. (Henwood, 1996, p212).

The Study

Method of Research

This study involved two main steps. The first step involved an analysis of performance in Physics for boys and girls. Examination results for 1997 and 1998 were taken into consideration. The results for these years have been used, as the data was easily accessible. Gender differences in the different aspects of the Physics SEC examination were considered. In the second part of the research, the number of boys and girls taking up Physics at Advanced level at the Junior College were gathered and analyzed to see if the number of boys and girls opting for science subjects reflect performance differences observed at SEC level.

The data of SEC results was obtained from the Matriculation Certificate Unit at the University of Malta that is responsible for running national examinations in Malta. Data of subject choice by students at the Junior College was obtained from the administrative department within the College.

Results

The analysis will first treat the students' performance at SEC Physics. The second part will look at the number of students taking up science subjects at post-secondary level.

Gender Differences at SEC Level

Grades obtained by students have been awarded points from 0 to 7, with a zero for U, and then increasing from 1 up to maximum points of 7, as performance improves from grade 7 to the top grade, 1. This method is similar to that adopted by Ventura and Murphy (1998). The actual marks obtained in Paper 1 of the exam are also considered. These marks should give a more accurate picture of differences in performance. Since two versions of SEC exist – Option A for the better students with possible grades 1-4 and U (these students could have obtained a grade 5-7 had they chosen option B) and Option B for weaker students with range 4-7 and U (these candidates cannot obtain a grade 1-3, however well they do in their exam) – differences in grades obtained may be due to the choice of paper type opted for in Physics rather than in performance. Since Paper 1 is common for all students, this possible interference is eliminated.

May 1997 examination

A t-test carried out across gender for grades and Paper 1 showed no difference in the case of grades but a significant difference when considering marks in Paper 1.

Table 2: t-test across Gender for Grades and Paper 1

| | Gender | No. of Candidates | Mean | t-test | p-value | Effect size |
|---------|--------|-------------------|-------|--------|---------|-------------|
| Paper 1 | Male | 1639 | 51.19 | 3.78 | 0.001 | 0.13 |
| | Female | 1743 | 48.71 | | | |
| Grades | Male | 1698 | 2.71 | -0.02 | 0.984 | - |
| | Female | 1793 | 2.72 | | | |

Boys did better in Paper 1. The effect size is 0.13, which is low. This difference is not reflected in the final grade obtained showing that it is being compensated by some other factor. The final grade also includes performance in Paper 2 which may be difficult (Option A) or easy (Option B) together with 15% of the marks allotted for practical work (coursework) done in schools during the course. It may then be either that girls are being more cautious and so more opt for the easy paper, or else they are performing better in their practical work.

Table 3: t-test across gender for separate Option students in Paper 1, points and Practical work

| Data considered | Student group | Mean | | t-test | p-value | Effect size |
|-----------------|----------------|-------|-------|--------|---------|-------------|
| | | Boys | Girls | | | |
| Paper 1 | Paper A option | 61.95 | 59.84 | 2.48 | 0.013 | 0.14 |
| | Paper B option | 44.18 | 42.27 | 2.42 | 0.015 | 0.11 |
| Points | Paper A option | 3.20 | 3.14 | 0.447 | 0.655 | - |
| | Paper B option | 2.41 | 2.48 | -1.362 | 0.173 | - |
| Practical work | Paper A option | 11.98 | 13.19 | -9.207 | 0.001 | 0.33 |
| | Paper B option | 10.04 | 11.65 | -9.56 | 0.001 | 0.35 |

Separate t-tests carried out for Paper 1 of Option A and B candidates still give the same pattern with effect sizes of 0.14 and 0.11 respectively. It could then be that girls catch up in grade from their performance in practical work, especially since t-tests for Papers 2A and 2B are not significant. The t-tests indicate that the practical work reports are making up for the gender difference apparent in Paper 1. Both Option A and Option B girls gain more marks than boys in their practical work. Moreover, the effect size is 0.33, much more than for Paper 1, showing that not only do girls catch up, but have the possibility of surpassing boys.

May 1998 examination

Results for 1997 SEC Physics indicate certain trends in performance with regard to gender differences. The analysis of results for 1998 SEC Physics examination will help to establish the consistency of these trends. As in the case of 1997 SEC, marks obtained for the separate papers were used. Points were assigned to grades in the same way as that used for SEC 1997.

The overall trends across gender are similar to the 1997 results. t-tests for Paper 1, practical and grades as dependent variables across gender as independent, show that

girls' performance this year has improved over that for 1997 (Table 4). The difference, however, is only slight. The boys' advantage over girls in Paper 1 has disappeared while girls have superseded boys in the overall grade, even if the effect size (0.06) is only slight. A significant difference, which appears to be consistent, is girls' better performance in practical work. In fact, the effect size obtained was again 0.3, of the same order as that for 1997.

Table 4: Means and t-test for SEC 1998 Papers and Grades

| Paper | Mean | | t-test | p-value | Effect Size |
|-----------|--------|--------|--------|---------|-------------|
| | Boys | Girls | | | |
| Paper 1 | 49.97 | 49.05 | 1.325 | 0.185 | - |
| Paper 2A | 63.51 | 64.36 | -0.899 | 0.369 | - |
| Paper 2B | 44.78 | 44.26 | 0.640 | 0.522 | - |
| Practical | 12.103 | 12.726 | -9.172 | <0.001 | 0.30 |
| Grades | 2.93 | 3.04 | -1.987 | 0.047 | 0.06 |

In order to look at whether gender differences occur between those students who opt for the different types of paper, t-tests across gender were carried out for the separate groups of students.

As in the case of 1997, the pattern found for the A and B options, when considered separately, was the same as the overall pattern of the examination. In both cases, girls have outperformed boys in practical work. The main difference was in the case of Option A candidates where the effect size is considerable at a value of 0.57 (see table 5). The difference for Option B students was similar to that of the whole sample but with effect size of 0.26. This shows that gender differences are present across the whole range of abilities but more accentuated in the case of the higher ability girls.

Likewise, girls in both categories outperformed boys in the case of grades. The difference however was very small with an effect size of only 0.11.

Table 5: Means and t-test for the A and B paper type candidates in 1998

| Paper | Type | Mean | | t-test | p-value | Effect size |
|-----------|----------|-------|-------|---------|---------|-------------|
| | | Boys | Girls | | | |
| Paper 1 | Option A | 66.5 | 66.42 | 0.161 | 0.872 | - |
| | Option B | 41.20 | 41.34 | -0.202 | 0.840 | - |
| Paper 2A | - | 63.51 | 64.36 | -0.899 | 0.369 | - |
| Paper 2B | - | 44.78 | 44.26 | 0.640 | 0.522 | - |
| Practical | Option A | 12.72 | 13.58 | -10.530 | <0.001 | 0.57 |
| | Option B | 11.76 | 12.35 | -6.550 | <0.001 | 0.26 |
| Grades | Option A | 3.95 | 4.19 | -2.001 | 0.046 | 0.11 |
| | Option B | 2.40 | 2.58 | -0.283 | 0.005 | 0.11 |

It is interesting to note how the large effect size of practical work for Option A students does not appear to have influenced many differences in the final grade. Such results confirm the consistency of the trends identified whereby girls are

outperforming boys in the practical part of the examination, even if this does not appear to have a great influence on the differences in final grade obtained.

Subject Choice within the general post-secondary education (Junior College)

General post-secondary education in Malta is provided mainly through the Junior College that also forms part of the University of Malta. This college has been established since 1996 and follows the Baccalaureate system. The number of students attending the Junior College has increased steadily. Looking at the student intake over the years, one can see that there are more girls than boys doing post-secondary studies at the Junior College.

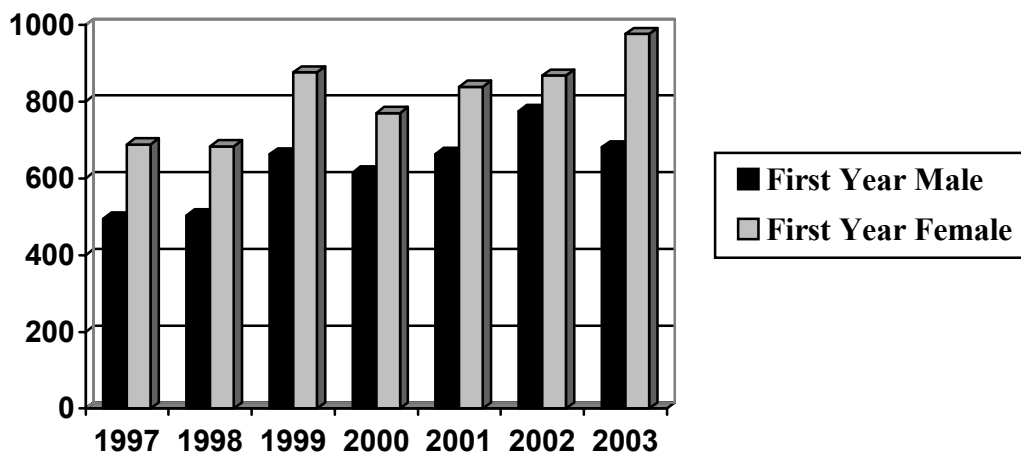


Figure 1: First year student intake by gender

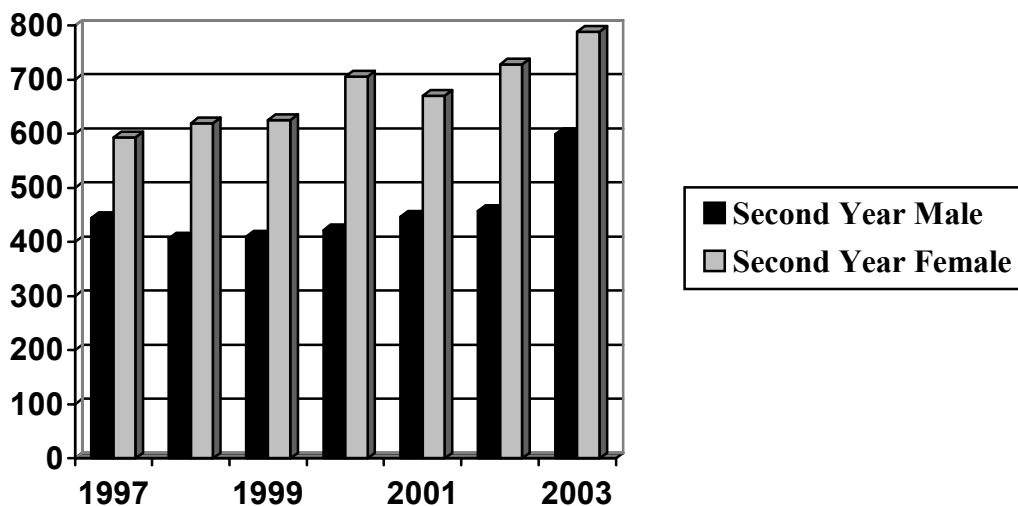


Figure 2: Second year student intake by gender at Junior College

In order to follow a science, technology, engineering or architectural course at the University, a number of 'A' Level passes in science subjects, with a good grade, is required.

The following graphs show that the percentage of students taking Biology, Chemistry and Physics, separately, at 'A' Level is low.

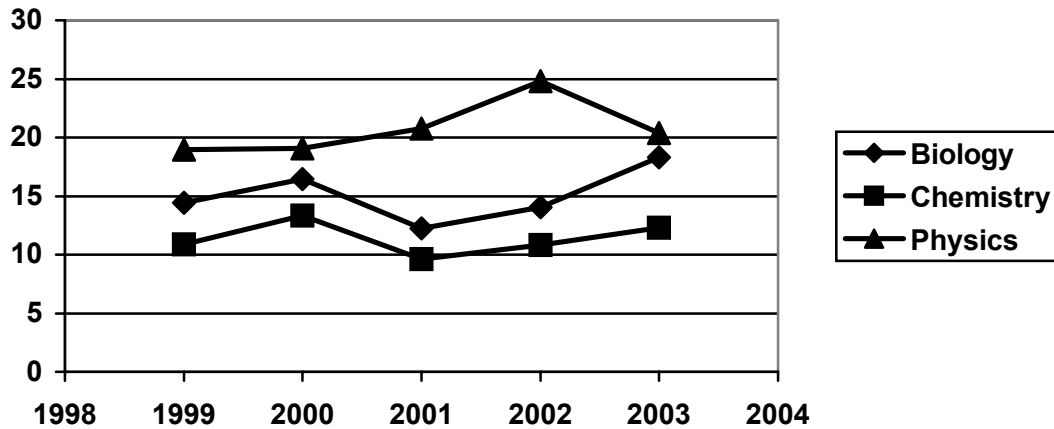


Figure 3: Percentage number of students taking science subjects

From the above graphs it is also clear that, of these three subjects, it is the Physics course that is being attended by most of the students taking science.

On the other hand, Figure 4 shows that the percentage number of girls doing Physics is low.

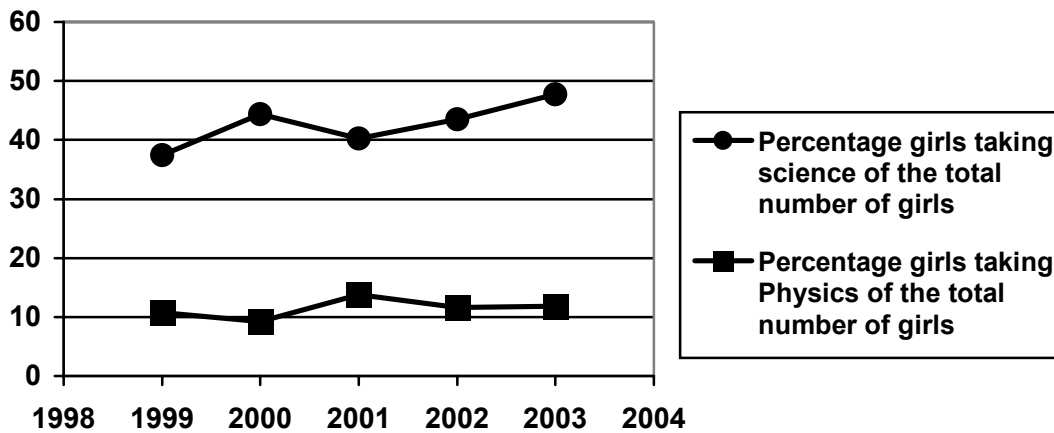


Figure 4: Percentage number of girls taking science subjects and Physics

The following histograms show the number of students, by gender, who have followed A level courses in Physics, Chemistry and Biology, taken separately, over these last two years, that is, in 2002 and 2003.

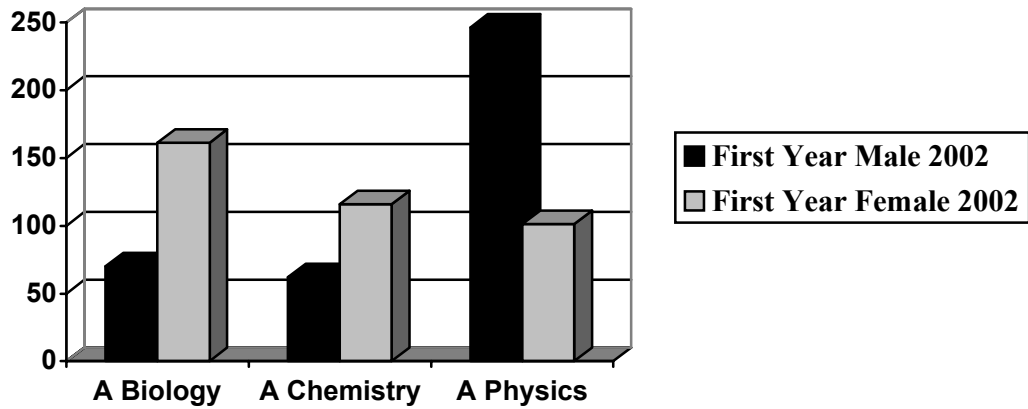


Figure 5: Number of Students taking sciences in 2002

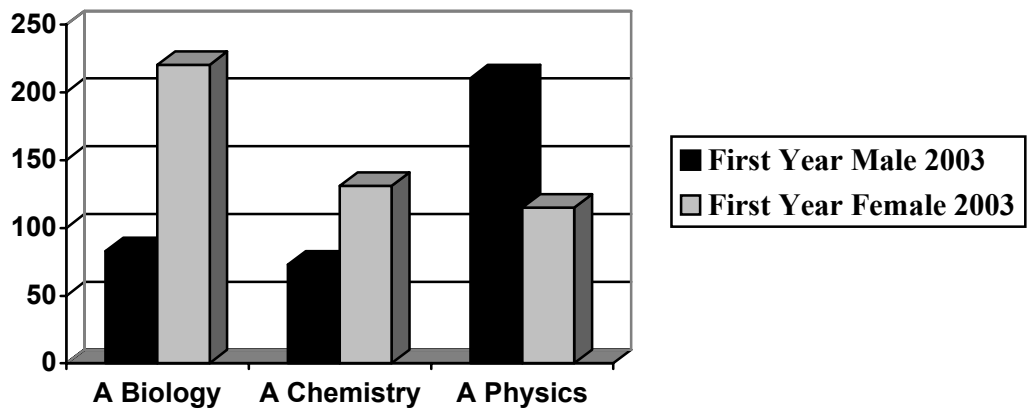


Figure 6: Number of students taking sciences in 2003

These histograms indicate that there were predominantly more males than females taking up the Physics course. Data shows that this trend goes back for quite a number of years. The following graphs are evidence of this.

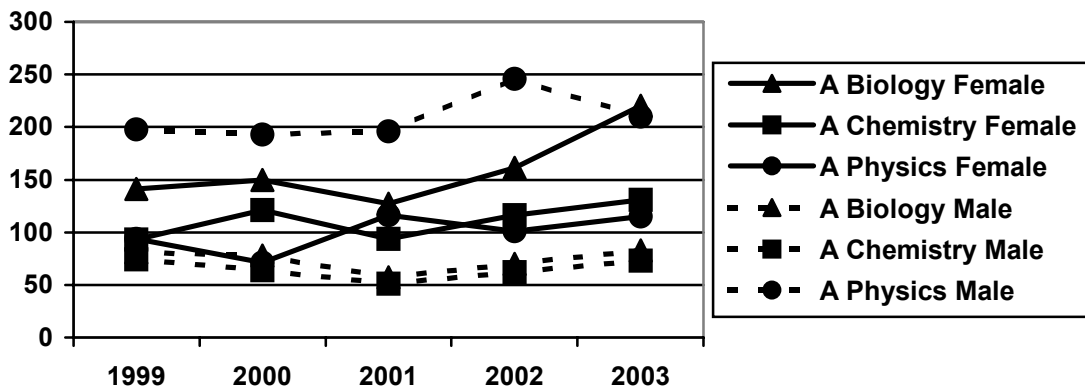


Figure 7: The number of males and females taking science subjects

What is quite worrying is the fact that this trend is not just being evidenced in Malta alone today. In fact, even as far back as 1996, the British Psychological Society showed concern in that, 'despite an overall rise in the proportion of female undergraduates, the physical science and technological courses failed to attract increased numbers of female applicants' (Lightbody and Durndell, 1996, p.231).

Discussion

This research indicates that there are differences between boys and girls. At secondary level, where Physics is compulsory in all state schools and girls are practically forced to study the subject, no gender difference in overall performance was noted. Boys were found to do better under examination conditions, especially in Paper 1, whereas girls were significantly better performers in coursework, in Physics consisting of write-ups of experimental work carried out. The same effect was also registered in the United Kingdom where it was noted that girls' achievement in science and mathematics increased to match that of boys when coursework formed a substantial element of the G.C.S.E assessment (Harding, 1996). In explaining girls' underperformance in written exams, Harding (1996) argues that girls lack the necessary affective readiness. A typical explanation for girls' better performance in coursework is that girls tend to be more diligent and do their work meticulously whereas boys, on the other hand, tend to be careless which results in poorer marks. White (1996), however, argues that these stereotypic assumptions are not supported by evidence. In fact, she reports that in the case of G.C.S.E English, coursework made a slightly larger contribution to the final subject mark for boys than for girls. It may, therefore, be that girls' schools are more equipped to carry out laboratory work (Xuereb, 1996) than boys' schools or that teachers in girls' schools are concerned about this aspect of the course which is then reflected in the better performance obtained.

It has been shown that, despite finding no overall difference in performance at SEC level between boys and girls, few girls opt to study the sciences at post-secondary level, with Physics being the least taken up amongst these. This is a matter of great concern, as it appears as if we are losing the potential of a percentage of students who could be successful in a scientific career. One cause for such a shift may be the negative attitude students tend to have towards the science subjects, particularly Physics. Another factor may be the limited communication between students and teachers. In addition, there is also the cultural bias when it comes to choose a science job that tends to have 'male' brand written all over it. All factors mentioned raise problems within themselves but each problem also sustains and further promotes the other. While some advances have been made on an individual basis, yet, this is not enough. It is not enough for individual educators to take separate initiatives, which are eventually discontinued. One cannot aim to achieve an overhaul in cultural attitudes without a co-coordinated and sustained effort.

Teaching methodology plays an important role in attracting students towards science. Starting with the assumption that the student has the ability and aptitude to do science, then all educators must work hand in hand towards the promotion of an effervescent student relationship with Science, at school level. We must look into the curriculum and changes must be affected with care. The curriculum must be relevant and

stimulating to all students, as much as possible. In the classroom we must be clear about whether students are still being “force-fed the dried fruits of scientific labour” (Claxton, 1996) or whether they are still being presented “the dry, desiccated roll-call of core concepts with which we are all familiar” (Claxton, 1996). This is certainly unacceptable. “Before we ask more people to dine at the restaurant of science should we not ask ourselves whether the menu we offer is both appropriate nourishment and appealing?” (Osborn et al, 1998, p33).

The above emphasizes the importance of a relevant curriculum content, as well as good class teaching. This implies that the importance given to science by the school management, just as the teacher qualities and performance, must be again highlighted when considering attracting more girls towards science. The main focus is for the teacher to be able to “stimulate the students’ imagination, motivation and commitment and then to produce self-confidence” in the science subjects “as they achieve a worthwhile goal” (Woolnough, 1994, p370).

It has been 20 years since the launch of the Women into Science and Engineering (WISE) campaign. This is quite a long time ago and today, theoretically, it is universally accepted that women can be good at doing a job that was previously branded as ‘MALE’. But if this argument were correct, then why is it that we are still reading newspaper articles that bring to attention the under-representation of women. For example, UNESCO’s Secretary General “has called on newsrooms world-wide to hand over editorial responsibility to women on International Women’s Day” (The Malta Independent on Sunday, March, 2004). There is also awareness of the situation that women still tend to be absent from higher levels of management. It is acknowledged that females, even those with credentials, tend to keep themselves back as the ‘old boys network’ is still quite strong (The Malta Independent on Sunday, April 4, 2004). The reality is that women need to be more assertive than men to get anywhere and sometimes this may be perceived as aggression, so they tend to hold back (The Malta Independent on Sunday, April 4, 2004). It is thus felt that there is the need to overcome the barriers to women’s progress in leadership positions, which are partly historical and partly cultural. There is an urgent need to tackle the sexual discrimination and harassment at the workplace, both of which are a hindrance to women’s career development (The Sunday Times, March 7, 2004).

Often the reason why the number of women in science-related jobs is low is attributed to the fact that women do nothing about this. It is women’s fault that they do not take science as a choice for their career. “All the emphasis is put on women – it is they who need to be WISE and take up the opportunities that exist for them in engineering (Henwood, 1996, p 201).

But it is not the lack of qualifications or the lack of information about the specific jobs that usually makes more women choose a traditional ‘female’ career. It is the problems such ‘male’ environments may create for women that reduce the probability of the choice.

Not all women are adventurous and confident enough to fight the tensions, pressures and hostility from men towards women resulting from working in a dominating male environment. Women know that it requires effort to stay at the top and to prove themselves. The following quotes say it all:

- I was struggling at first, felt I was being watched all the time to make my first mistake, that's 4 years ago now and it's gone but I do understand when other women say they've had difficulties. It's kind of sly. I can't explain to you how it's done, it's subtle, to show you how incompetent you are. When you do a job, an equal job beside a man, really you've got to do it twice as good as he has. You haven't only got to prove it to yourself, you've got to prove it to him. (an engineering technician talking at length about her experiences when she first joined her department)
- I don't know, I see it in myself. My husband, they're not afraid to say something and they could well be wrong but I have to be 100 per cent sure of my facts before I say anything. (a lecturer in applied sciences)

This culture is so strong that women may unconsciously be influenced in their careers (Henwood, 1996, p205; Lightbody and Durnell, 1996, p241) opting to choose a traditional job out of science.

Conclusion

On a national level, efforts must go into making the general public appreciate the importance of science for a better future. Scientists and people with science-related careers need to be made more available and visible to the general public and to communicate their delight and enthusiasm for science. This can be achieved by having more organized science and technology weeks and more hands-on science centers where all the family can enjoy a scientific afternoon out together. The media may also be better used to promote the idea of science in a way that appeals to all.

On the other hand, with the culture problem still persisting, women must be more determined and perseverant in trying to reach equality at the workplace. But equality can never be achieved unless the underlying causes of the inequality are tackled directly (Henwood, 1996, p203). So, as we look towards the future with courage, we need to involve ourselves in doing more research to further explore the fine mechanisms that maintain gender inequality at bay and to learn about the ways in which the subjective experiences of some reflect upon the work choices of others.

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