

Subject Choice and Performance in Chemistry and the Science Subjects in Malta: Patterns According to Gender and School Type

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1. Introduction

In 2005, a new scheme differentiating between standard and special grants for University of Malta students was launched to increase enrollment in science, engineering and information technology (IT) courses. The Government considered: the country's socio-economic development; the Lisbon agenda; and OECD standards. The courses identified were: B.Sc.(Business & Computing); B.Sc.(Hons) (IT, Biology, Chemistry, Mathematics, Physics, Statistics & Operations Research, Computer Science, Informatics); B.Eng.(Hons); and B.Ed.(Hons)/PGCE (Biology, Chemistry, Physics, Mathematics, Computer Science).

At age 12/13, students make subject choices that eventually provide them with the Secondary Education Certificate (SEC) qualifications for Sixth Form and, later, University. The least popular Science is Chemistry.

2. The Secondary Education Certificate and Entrance to Sixth Form

In Malta, at the end of compulsory education (age 16) pupils sit for SEC exams by the Matriculation and Secondary Education Certificate (MATSEC) Examinations Board of the University of Malta. Grades awarded are 1 to 7 or unclassified (U), with grade 5 the lowest accepted for access into Sixth Form, leading to University. Sixth Form entry entails six SEC passes including Mathematics, English Language, Maltese and one of the three Sciences.

3. The Matriculation Certificate and University Entrance

Sixth Forms courses lead to the MATSEC Board's Matriculation Certificate (MC), which is an entrance requirement to the University of Malta. It includes two Advanced Matriculation (AM) and three Intermediate Matriculation (IM) subjects and IM Systems of Knowledge. An IM subject is equivalent to one third of an AM subject. At AM and IM, candidates are awarded grades A to F (F denoting failure). Points associated with each grade are: 30, 24, 18, 12 and 6 points for grades A to E at AM, and 10, 8, 6, 4 and 2 points for IM respectively.

There are four groups of subjects: the Languages in Group 1, the Humanistic and the Commercial subjects and the Science subjects in groups 2 and 3, while group 4 includes other subjects (as Art, Engineering Drawing, etc.). The MC includes one subject from each of groups 1, 2, and 3, any other two subjects, and the compulsory Systems of Knowledge. The MC is awarded if it includes: passes in a subject from groups 1 to 3 at AM or IM level and Systems of Knowledge; and a minimum of 44 points. Prospective students must also satisfy the special University course requirements.

Regarding courses included in the 2005 scheme, AM Chemistry at C or better is a requirement for the B.Sc.(Hons) and B.Ed.(Hons)/PGCE with Chemistry as specialisation. It can be offered, amongst others, alongside Pure Mathematics, for B.Sc.(Hons) in IT. Other University courses require an AM pass in Chemistry, as Medicine (M.D.), Pharmacy, and a number of Health Sciences courses. Entry to M.D. is very competitive and requires two AM passes at grade B in Biology and Chemistry and in one IM subject (excluding Systems of Knowledge), all in the same session.

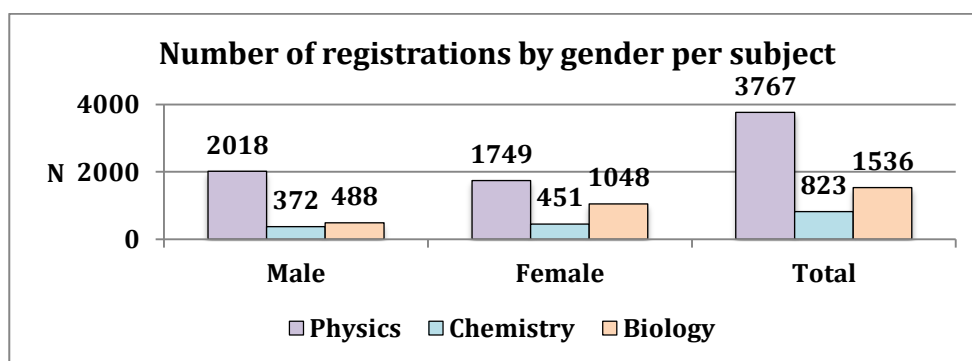
4. May 2013 SEC Registrations for Physics, Chemistry and Biology

Table 1 and Figure 1 report the registrations for the three sciences at SEC level for the May 2013 session. It is clear that only 823 candidates (13.4%) registered for SEC Chemistry as compared to 3767 (61.5%) for Physics and 1536 (25.1%) for Biology.

Table 1. SEC Registrations for Physics, Chemistry and Biology – May 2013

							% per total number, by gender			
	Males (M)		Females (F)		Total		per subject		science registrations	
	N	%	N	%	N	%	M	F	M	F
Physics	2018	70.1	1749	53.9	3767	61.5	53.6	46.4	47.0	40.8
Chemistry	372	12.9	451	13.9	823	13.4	45.2	54.8	8.7	10.5
Biology	488	17.0	1048	32.3	1536	25.1	31.8	68.2	11.4	24.4
Total	2878	100.0	3248	100.0	6126	100.0				

Figure 1



5. SEC Chemistry: A & B Option Choice – May 2013

The SEC examination has two papers: a common Paper I and Paper IIA for the higher achievers (getting grades 1 to 5 or U) or Paper IIB for the lower achievers (grades 4 to 7 or U). Table 2 and Figures 2 and 3 show the A/B choice for SEC Chemistry according to school type (CS = Church schools; IS = Independent schools; SS = State schools; PSS = Post-secondary schools; PC = private candidates) and gender. Choosing option A (may) indicate higher levels of expectation and aspiration as well as confidence and self-efficacy.

Although the majority of students attend a State school, more than half the candidates for SEC Chemistry are from Church schools. This 'problem' is more pronounced with male with respect to female candidates.

Table 2. Candidates for SEC Chemistry per school type per gender

	Option A			Option B			Options A & B		
	M	F	M&F	M	F	M&F	Tot M	Tot F	M&F
CS	211	184	395 (48.0%)	19	26	45 (5.5%)	230 (61.8%)	210 (46.6%)	440 (53.5%)
IS	56	53	109 (13.2%)	8	12	20 (2.4%)	64 (17.2%)	65 (14.4%)	129 (15.7%)
SS	39	117	156 (19.0%)	16	22	38 (4.6%)	55 (14.8%)	139 (30.8%)	194 (23.6%)
PSS	10	19	29 (3.5%)	4	4	8 (1.0%)	14 (3.8%)	23 (5.1%)	37 (4.5%)
PC	4	11	15 (1.8%)	5	3	8 (1.0%)	9 (2.4%)	14 (3.1%)	23 (2.8%)
Total	320	384	704 (85.5%)	52	67	119 (14.5%)	372 (100.0%)	451 (100.0%)	823 (100.0%)

Figure 2

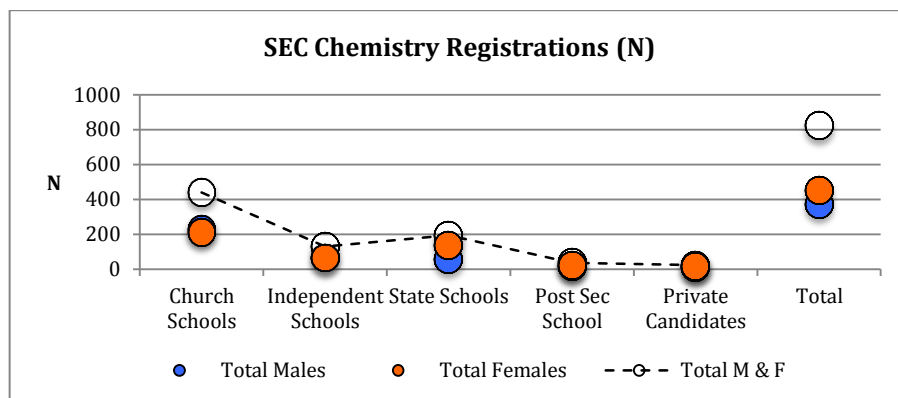
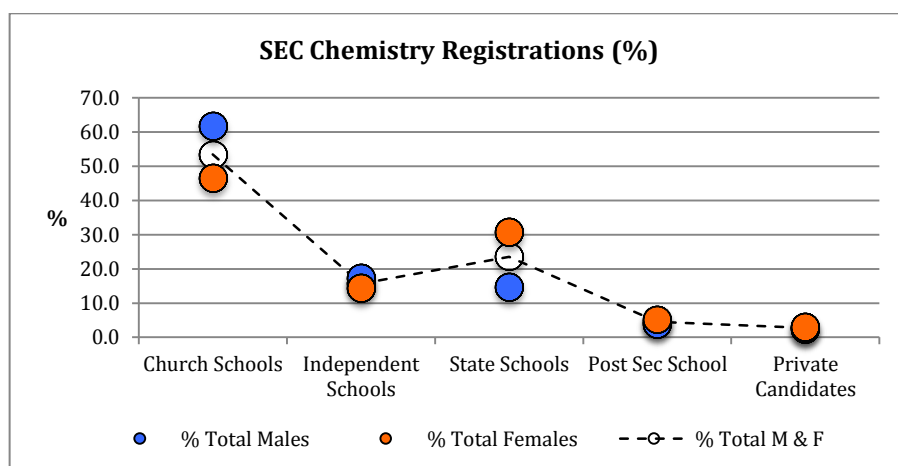


Figure 3



6. SEC Chemistry: Distribution of Grades by Gender and School Type

Tables 3 to 5 and Figure 4 depict the distribution of grades (%) per gender and school type. The best performance, although by a slight margin, is for Independent school pupils in both genders. The performance of Church school candidates is close to that of the Independent school pupils. One notes that no State school male candidate obtained a grade 1.

Table 3. Percentage performance by grade for male candidates per school type

M	Grade									Total out of total M
	1	2	3	4	5	6	7	U	abs	
CS	11.7	20.9	17.8	19.6	10.9	0.4	0.9	17.4	0.4	61.8
IS	14.1	23.4	17.2	9.4	17.2	1.6	0.0	17.2	0.0	17.2
SS	0.0	3.6	12.7	18.2	18.2	1.8	5.5	40.0	0.0	14.8
PSS	0.0	0.0	7.1	7.1	0.0	0.0	7.1	71.4	7.1	3.8
PC	0.0	0.0	0.0	33.3	11.1	22.2	11.1	0.0	22.2	2.4
Total	9.7	17.5	16.1	17.5	12.6	1.3	1.9	22.3	1.1	100.0

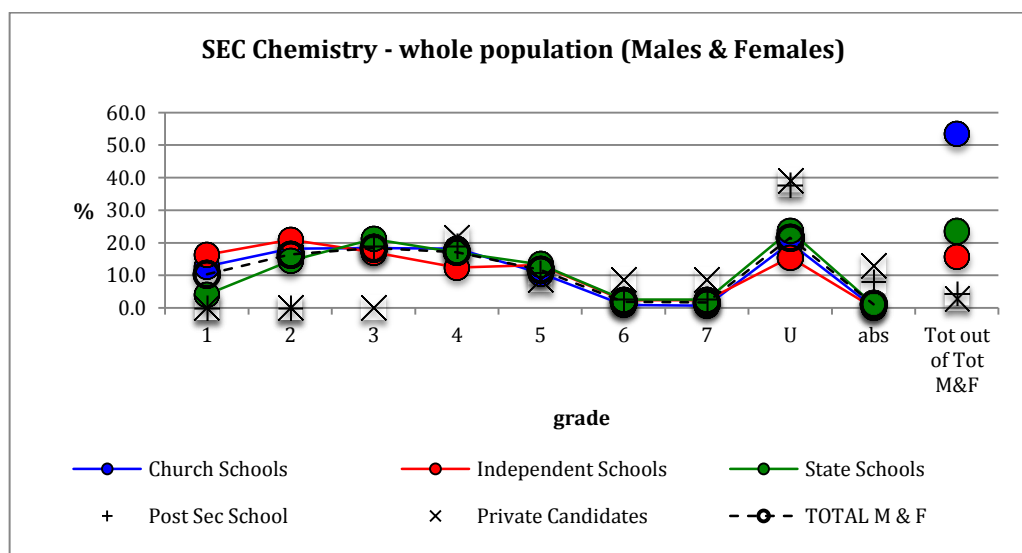
Table 4. Percentage performance by grade for female candidates per school type

F	Grade									Total out of total F
	1	2	3	4	5	6	7	U	abs	
CS	13.8	15.2	19.0	16.7	10.5	1.4	0.5	22.9	0.0	46.6
IS	18.5	18.5	16.9	15.4	9.2	3.1	4.6	13.8	0.0	14.4
SS	5.8	18.7	24.5	16.5	11.5	2.9	1.4	17.3	1.4	30.8
PSS	0.0	0.0	26.1	26.1	17.4	4.3	0.0	17.4	8.7	5.1
PC	0.0	0.0	0.0	14.3	7.1	0.0	7.1	64.3	7.1	3.1
Total	10.9	15.5	20.2	16.9	10.9	2.2	1.6	20.8	1.1	100.0

Table 5. Percentage performance by grade for all the exam population per school type

M & F	Grade									Total out of total M & F
	1	2	3	4	5	6	7	U	abs	
CS	12.7	18.2	18.4	18.2	10.7	0.9	0.7	20.0	0.2	53.5
IS	16.3	20.9	17.1	12.4	13.2	2.3	2.3	15.5	0.0	15.7
SS	4.1	14.4	21.1	17.0	13.4	2.6	2.6	23.7	1.0	23.6
PSS	0.0	0.0	18.9	18.9	10.8	2.7	2.7	37.8	8.1	4.5
PC	0.0	0.0	0.0	21.7	8.7	8.7	8.7	39.1	13.0	2.8
Total	10.3	16.4	18.3	17.1	11.7	1.8	1.7	21.5	1.1	100.0

Figure 4



7. Choice at Sixth Form: AM Physics, Chemistry and Biology

Considering the May 2013 AM registrations, there were 441, 448 and 630 registrations for Physics, Chemistry and Biology respectively. Taking into account the number of SEC registrations for the same session (although not appropriately equivalent, though it gives a good indication assuming only slight variations from session to session) and calculating the number of AM registrations as a percentage of SEC registrations, one gets 11.7%, 54.4% and 41.0% for Physics, Chemistry and Biology respectively. Thus, although the number of registrations for SEC Chemistry is the lowest, the percentage of students taking it at AM level is the highest.

8. Possible Reasons for Choice of Chemistry at SEC and AM levels according to 'Experts'

Four experts having vast experience in Chemistry education were asked four questions. Two experts have extensive experience in teaching Chemistry at various levels. The other two have coordinating

duties for Chemistry across schools apart from extensive teaching experience. They were also involved in paper setting and marking of national Chemistry exams.

The first question was: **What factors do you think make students chose Chemistry at Form 3?** All four experts indicated two factors: parents' influence and encouragement; and students' previous enjoyable experience of science. Three experts indicated the career aspirations and related entry requirements. One notes that the two experts that have continuous contact with secondary schools also indicated these two factors: a competent teacher who builds a positive image of the subject; and the positive perception and peer influence. Factors that were indicated by one expert are not included.

Question 2: **What factors do you think make students not chose Chemistry at Form three?** All four experts indicated: the belief, or perception, or being told (even by guidance teachers) that chemistry is difficult, suited for the gifted few and needing hard work. Three experts gave: student not interested in a career with Chemistry as requirement; and previous 'bad' experiences of parents/relatives with the subject. Two experts indicated the tendency to go for the 'softer' options where there is wide subject choice.

Questions 3 and 4 consider Sixth Form. Question 3: **What factors do you think make students chose Chemistry at Sixth Form?** All four experts indicated the intended career path. Three experts gave an inspiring teacher at secondary level, while two experts indicated: a wider choice of career options; and family members in related careers and social background.

The final question: **What factors do you think make students not chose Chemistry at Sixth Form?** All experts indicated chemistry perceived as the most difficult Science subject, only for the clever few. Three experts indicated the entry requirements and career choice. Two experts indicated: the perception that many students fail in chemistry; and negative experiences at Secondary school.

9. Conclusion

The data for the May 2013 session shows the relatively low number of pupils opting for SEC Chemistry, in contrast to the high percentage that carry it over to AM at Sixth Form. Differences are detected in subject choice and exam performance per gender and school type. The experts' input may give some initial insight about a number of possible reasons behind the choice of Chemistry in Maltese schools at both SEC and AM levels.

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