

*Predictive Validity of Examinations
at the Secondary Education Certificate (SEC) level*

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Abstract:

This paper presents the predictive validity of results obtained by 16-year-old Maltese students in the May 2004 Secondary Education Certificate (SEC) examinations in Biology, Chemistry, Physics, Mathematics, Computing, English and Maltese for the Advanced level examinations in these subjects taken by the same students two years later. The study checks whether the SEC level is a good foundation for the higher level, the likelihood of obtaining a high grade at A-level from particular SEC results, possible gender differentials and differentials between students who obtained grades 4 and 5 from optional SEC papers. The results show moderately high predictive validity values ranging from 0.76 to 0.52 and no fixed pattern in the likelihood of obtaining a high A-level grade. No significant gender differences and no fixed pattern of differences in the Advanced level results of students who had obtained SEC grades 4 and 5 from Paper 2A or 2B were noted.

Introduction

One of the main questions to be answered during the design of any assessment system is: To what extent will the results of the assessment serve the particular uses for which they are intended? (Linn and Gronlund, 2000). This question points towards issues of validity, which is perhaps the most important aspect of assessment as it reflects upon the meaningfulness of results. In the context of examinations, validity of the results is specific to a particular use (e.g. selection, grading) and may range from high through moderate to low validity depending on the quality of the examination. High quality examinations address the various facets of validity including *criterion validity*, that is the extent to which the results provide evidence of achievements/performance in other related areas. One aspect of *criterion validity* is the *predictive validity* of the results, that is, the extent to which the result provides evidence of future achievements or performance in other related subjects (Athanasou and Lamprianou, 2002; Institute of Educational Assessors, 2006).

The determination of the predictive validity of an examination serves various purposes. It provides important data about validity because it has greater fidelity to the real situation in which the results will be used and helps in reaching conclusions about the usefulness of the test or examination. An example of such use is the longitudinal study carried out in the UK which compared the use of the national end of Key Stage 2 (KS2) tests and the Cognitive Abilities Test (CAT), taken at age 11, to predict performance in the national end of Key Stage 3 (KS3) tests taken at age 14 and the General Certificate of Secondary Education (GCSE) and other public examinations taken at age 16. The study showed that the CAT had significantly higher correlations with subsequent KS3 and GCSE outcomes than did the KS2 test scores. However, multiple regression analyses indicated that a combination of CAT and KS2 test scores gave the best predictions of future KS3 and GCSE outcomes (Strand, 2006). Predictive validity measures over a number of years could also show whether standards are maintained. One such study carried out by the Curriculum Evaluation and Management Centre at Durham University (Coe, 1999) investigated the most likely A-level grades achieved by a typical student with GCSE Grade B in the subject. The results showed that for some subjects, a student with Grade B at GCSE level is likely to obtain Grade C at A-level but for other subjects including Mathematics, Computing, Chemistry, Physics and Biology, the student is likely to obtain Grade D. Similarly, the A-level grade plotted against the average GCSE grade demonstrated differences between subjects. The researchers concluded that these results seem to indicate that some subjects are harder than others. However, the researchers still considered the students' achievement at GCSE to be the best single objective predictor of a student's A-level performance.

Measures of predictive validity of the results obtained in examinations at a particular level can also be used with benefit for making decisions about which subjects to study or which courses to take at a higher level. For example, in the Maltese context, knowledge of the predictive validity of the results obtained in examinations at Secondary Education Certificate (SEC) level can help students make the right choice of which subjects to study at Advanced Matriculation level. It can also provide them with an indication of the probability of obtaining a good grade at this level.

Some preliminary studies have already been carried out in this respect. Measures of the predictive validity of SEC examinations in the sciences (Biology, Chemistry, Physics) taken in 1998 were determined in an attempt to answer the following questions: 'Should a student who only managed to obtain Grade 4 in a science examination at SEC level be advised to study that subject at Advanced level?', and 'Would it make a difference if the student obtained Grade 4 from the more demanding Paper IIA or the alternative Paper IIB?'. The study showed that the chance of a Grade 4 candidate obtaining Grade A to C at Advanced level in a science subject is small (17% to 24%) but the probability of obtaining a pass (Grade A to E) is moderate to high, ranging from 58% in Chemistry to 81% in Biology. Additionally, candidates with Grade 4 from Paper IIA and Paper IIB obtain similar results at Advanced level. However, only very tentative answers could be provided to the research questions because the study was based on the results of a small number of candidates (Ventura, 2001). In 2004, Farrugia carried out a comprehensive analysis of all subjects at SEC level taken in May 2001 and determined their predictive validity at Advanced and Intermediate Matriculation levels taken in May 2003. She concluded that in most subjects, the results appear to have a high predictive validity and in general, SEC examinations in all subjects provide a good foundation for study at Advanced and Intermediate level. However, candidates with a Grade 4 at SEC level are unlikely to achieve high grades at Advanced level, especially in Chemistry and Pure Mathematics. Furthermore, a Grade 5 obtained at SEC level seems to provide insufficient foundation for successful study at the higher level. Indeed, only a very small number of students who obtain a Grade 5 in a subject proceed to study the subject at Advanced level and when they do so they obtain poor grades or fail (Farrugia, 2004). A subsequent study analysed the predictive validity of the mathematics and sciences SEC results for success in Advanced and Intermediate Matriculation examinations in the same subjects. Previous conclusions were confirmed but differences between subjects were highlighted further. For example, students who had obtained a Grade 3 in SEC Biology, Computing and Physics were twice as likely to achieve a high grade at Advanced level than students with the same SEC grade in Chemistry and Pure Mathematics (Farrugia and Ventura, 2005). Focusing solely on one subject, Pace and Bonello (2006) investigated the correlations between the SEC Physics results, the results of four informal assessments and the formal test held at the end of the first year at the Junior College and the students' performance in the Advanced Matriculation (AM) Physics examination. Their data consisted of the results of 159 students who finished their two-year course in 2000 and another group of 153 students who finished the course in 2002. For this small and homogenous group they found correlations of $r = 0.488$ and $r = 0.442$ between SEC and AM results. The correlations between the end-of-year test results and the AM results were $r = 0.708$ and $r = 0.550$ for the 2000 and the 2002 cohort respectively, and for the informal assessments and the AM results the correlations ranged between $r = 0.318$ and 0.630 . They noted no gender differences in the students' performance in the SEC and AM examinations. They also found that students who had sat for Paper IIB at SEC level and had obtained Grade 4 still stood a fair chance of obtaining a good grade in the AM Physics examination.

The present paper addresses the following main research questions with special reference to science subjects, mathematics, computing and the two core languages Maltese and English:

1. Is the SEC level in a subject a good foundation for the study of the subject at Advanced level?
2. Do male and female students who obtain the same grades at SEC level achieve comparable results at Advanced level two years later?
3. With results showing a particular grade at SEC level, should one advise students to take up the subject at Advanced level considering the estimated likelihood of obtaining a good grade at the higher level?
4. Do students who obtain a Grade 4 from Paper IIA obtain better Advanced level results than students who obtained the same SEC grade from Paper IIB?

The Educational Context

In Malta, education is compulsory from age five to age sixteen. At the end of compulsory education, pupils sit for the Secondary Education Certificate (SEC) examinations offered by the Matriculation and Secondary Education Certificate Examinations Board (MATSEC) of the University of Malta. Entry to post-secondary institutions is based on a minimum of six passes at SEC level including Maltese, English Language, mathematics and a science subject. Sixth-form colleges offer a two-year course leading to the Matriculation Certificate examination. This certificate is an entrance requirement to university. Students choose two subjects to study at Advanced level, three subjects at Intermediate level and Systems of Knowledge. A subject at Intermediate level is considered to be equivalent to one third of a subject at Advanced level. Systems of Knowledge offers students a multidisciplinary perspective with an emphasis on the values fostered by different areas of knowledge. At the end of the two-year course, students sit for the Matriculation Certificate examinations offered by the MATSEC Board. Each year almost 8,000 candidates register for the SEC examinations (MATSEC, 2006). A good number are awarded certificates for passes in these examinations and proceed to study a choice of subjects at Intermediate or Advanced level, which to a large extent depends on which course they aim to join at university. In recent years, about 2500 students took the Matriculation Certificate examination each year (MATSEC, 2007).

At SEC level, students are awarded grades between 1 and 7. In all SEC examinations all students sit for Paper I, which may include an oral component or an element of school-based assessment, and a choice of either Paper IIA or IIB. Students who opt for Paper IIA may qualify for grades 1 to 5, Grade 1 being the highest. The Paper IIB option offers students the opportunity to obtain grades 4 to 7. Grade U denotes an unclassified performance in both options of Paper II. Grades 1 to 5 are accepted by most post-secondary institutions as passes that enable students to pursue post-secondary education with profit. At Advanced level and Intermediate level, students are awarded grades A to F, with F denoting failure. Students who wish to follow an undergraduate course in a particular subject are usually required by the university departments to obtain at least a Grade C at Advanced level in the subject.

Method

In order to attempt to answer the research questions, the individual results of candidates sitting for the Advanced level examinations in May 2006 were taken and compared with the results for the corresponding SEC examination of each individual candidate from the 2004 session. The number of candidates sitting for each examination is much larger than the sample under consideration but the candidates involved in this study were limited to those who sat for the examinations in these two years. The candidates in this study were therefore sub-sets of the two groups of candidates sitting for the examinations. This provided a group of students who were homogenous in that they sat for their Advanced level examinations two years after their SEC examinations, in most cases after following a regular full-time course at a post-secondary institution. In this study each SEC grade was taken one by one and the number of students scoring a particular grade at Advanced level two years later was counted and displayed in a table showing the frequency and distribution of grades. Thus, for example, the first row of the table shows how many of students who obtained Grade 1 at SEC level went on to achieve a Grade A, B, C and so on at the higher level. The second row shows the same information for students who started with a Grade 2, and so on for the other grades. Table 1 is given as an example to illustrate frequency and distribution of 386 matched results in SEC Biology and Advanced level Biology. Given that the data were in the form of categories, the analysis used the Spearman Rank Correlation Coefficient to calculate the predictive validity of the SEC results. This required the results to be converted into ranks such that SEC grades 1 to 7 were ranked 1 to 7 respectively. Grade U was converted to rank 8. Candidates who had been awarded Grades 6, 7 or U in May 2006 but were able to improve their grade in September 2006 were included in the sample by taking their highest grade. The Advanced level grades A to F were ranked 1 to 6 respectively. A correlation between two results does not indicate that the achievement of one leads to the achievement of the other but is simply an indication of how one result may be related to another. In the case of Advanced level Biology the correlation was 0.760 which is the measure of the predictive validity of SEC results for this subject. It also summarises the data in Table 1. Similar tables were drawn up and the predictive validity measures were determined for each subject at Advanced level.

The results of the analysis carried out were also expressed in terms of an expectancy table in which the frequencies are converted into percentages, which show more clearly the likelihood of obtaining a particular grade at Advanced level having obtained a certain grade at SEC level. Table 2 illustrates how the data of Table 1 are transformed into an expectancy table for Advanced level Biology. The results in this table show that all the students with Grade 1 in Biology at SEC level obtained Grades A to C in Advanced level Biology. Students with Grade 2 at SEC level had a 92.9% chance while students with Grade 3 at SEC level had 83.5% chance of obtaining Grades A to C in Advanced level Biology. Students with Grade 4 had 44.9% chance of obtaining Grades A to C. The data also show that students with Grade 5 only had a 14% chance of obtaining Grades A to C in Advanced level Biology while students with a lower SEC grade were not likely to obtain a good grade. The same method was used to obtain frequency tables, expectancy tables and Spearman Rank Correlation Coefficients for all Advanced level subjects with a matched sample of not less than 20 results. However, in this paper, the focus of the analysis is on mathematics, the science subjects, computing, English and Maltese. The two languages are included

because of the concern that has been expressed in recent years about the students' achievements in these subjects. In these cases, the analysis would primarily provide an indication of the predictive validity of the SEC examinations in these subjects. English and Maltese are core subjects and in this paper were also included as a comparison with the sciences, which are assumed to be marked more objectively.

Table 1. Distribution of matched grades in Biology for the May 2004 SEC and May 2006 A-level examination sessions

Biology A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	34	9	2	0	0	0	45
2	20	48	11	5	1	0	85
3	6	26	49	10	5	1	97
4	0	12	32	25	23	6	98
5	0	1	6	4	24	15	50
6	0	0	0	0	1	0	1
7	0	0	0	0	1	0	1
U	0	0	0	3	3	3	9
Total Number	60	96	100	47	58	25	386

Spearman Rank Correlation = 0.760

Table 2. Expectancy Table (%) for A-level Biology

Biology: A-level Grade							
	A	B	C	D	E	F	Total
SEC Grade							
1	75.6	20.0	4.4	0.0	0.0	0.0	100
2	23.5	56.5	12.9	5.9	1.2	0.0	100
3	6.2	26.8	50.5	10.3	5.2	1.0	100
4	0.0	12.2	32.7	25.5	23.5	6.1	100
5	0.0	2.0	12.0	8.0	48.0	30.0	100
6	0.0	0.0	0.0	0.00	100.0	0.0	100
7	0.0	0.0	0.0	0.0	100.0	0.00	100
U	0.0	0.0	0.0	33.3	33.3	33.3	100

Analysis of Results

Predictive Validity: General Results

The presentation of the frequency tables for all the subjects is not practical in the context of this paper, it has therefore been decided to present the predictive validity measure for each Advanced level subject in graphical form. A high predictive validity measure would mean that there is a strong relationship between the grade obtained at SEC level and the grade achieved at the higher level. In other words high values of predictive validity show that students with high SEC grades in a subject would tend to obtain high grades at the higher level in that subject and correspondingly, students with low SEC grades would tend to obtain low grades at the higher level. When the

predictive validity is low, the relationship between SEC grades and grades at higher levels is less strong and it becomes more risky to predict the likely performance in the subject at the higher level from the grade achieved at SEC level.

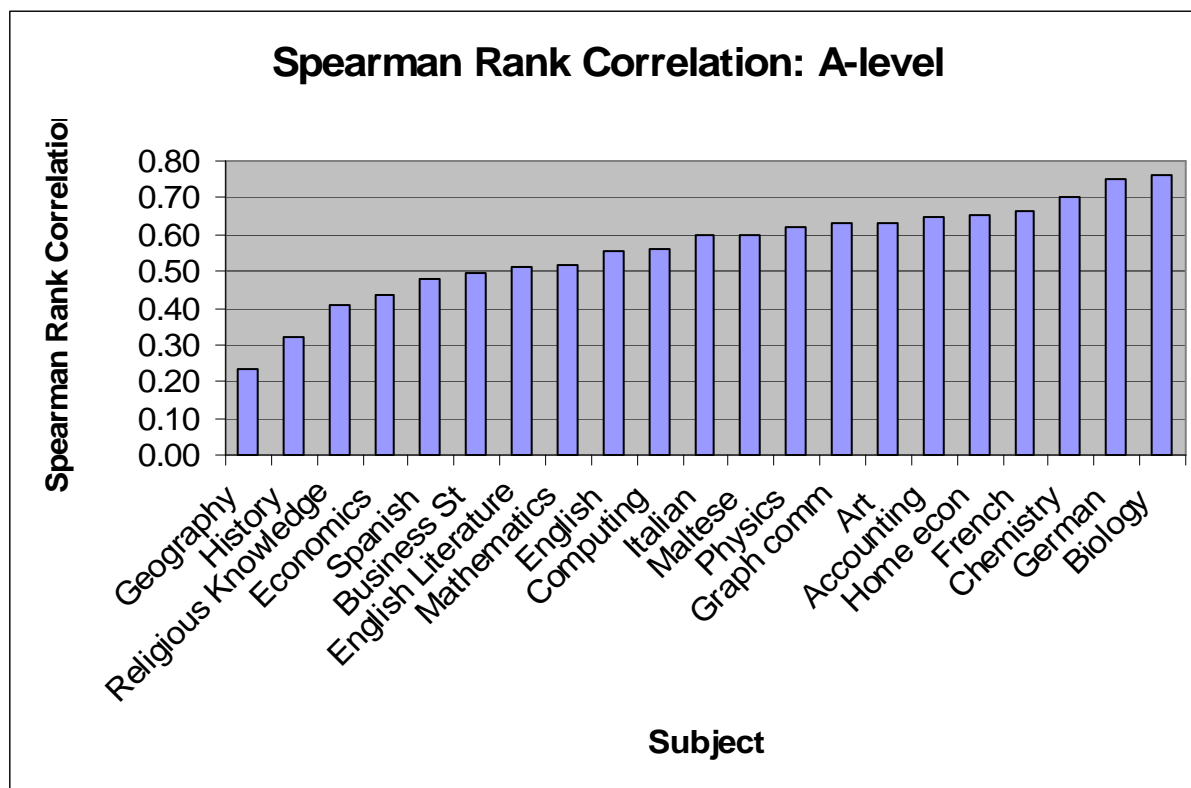


Figure 1: Graph of Predictive Validity results for all A-level subjects

Figure 1 shows that the predictive validity measures of SEC results for Advanced level subjects range from a high $r = 0.76$ for Biology to a low $r = 0.23$ for Geography. The subjects could be divided into four groups with the SEC results in Biology, German and Chemistry showing high levels of predictive validity ranging between 0.70 and 0.76. A second group of subjects, which includes French, Home Economics, Accounting, Art, Graphical Communication, Physics, Maltese and Italian shows predictive validity measures in the range 0.60 to 0.66. A third group, consisting of Computing, English, Mathematics, English Literature, Business Studies, and Spanish, has predictive validity in the range of 0.48 and 0.56, while Economics, Religious Knowledge, History and Geography have predictive validity measures in the range 0.23 to 0.43. The results for History ($r = 0.38$) and Geography ($r = 0.23$) may be spurious because of the small number of students involved and when analysed by gender, significant differences are found in the predictive validity of results obtained by male and female students. In History, the results of the 16 female students showed a correlation of 0.13 while those of the male students had a correlation of 0.43. In Geography, only the results of 23 students could be matched and the gap in the correlations by gender was very wide. Two cases of particular interest concern English and Accounting. The predictive validity of SEC English Language results for Advanced level English is 0.56 while that of English Literature is slightly lower at 0.51. This is a rather unexpected result considering that two thirds of the Advanced level English examination concerns literature. In Accounting, the predictive validity

of both SEC Accounting results and SEC Business Studies results for Advanced level Accounting were calculated. Not surprisingly, the predictive validity of SEC Accounting was found to be a moderately high 0.65 while that of SEC Business Studies was lower, but it was still a significant 0.50.

Considering the ranges of predictive validity scores reported in the literature, these results fall within the normally expected ranges. Thus, for example, Strand (2006) reported correlation coefficients in the range 0.51 to 0.76 between CAT scores and GCSE results and in the range 0.52 to 0.71 between KS2 points scores and GCSE outcomes five years later. In the USA, a study of the correlations between high school grade point averages, scores on SAT I and SAT II achievement tests taken before admission to the University of California and the first year university grade point average showed that in the period 1996-1999 the correlation coefficients ranged between 0.39 and 0.47 (Geiser and Studley, 2001). McDonald (2004) found a correlation of 0.47 between the Cambridge GCE alternative ordinary mathematics results of 177 students from Trinidad and Tobago and the results of the same students in the GCE advanced level mathematics examination of the same examination board.

Predictive Validity: Advanced level Science, Mathematics and Computing

A recurrent criticism of the SEC examinations is that the level reached by the students in various subjects does not provide them with sufficient foundation to follow studies at Advanced level with profit in these subjects. This section attempts to check whether this criticism holds true for the sciences, mathematics and computing. This objective can be achieved by inspection of the full data that have been collected and therefore tables similar to Table 1, which gives the Biology results, are presented for Chemistry, Physics, Pure Mathematics and Computing. The values of the predictive validity of the SEC results and some comments are given after each table.

Table 3 shows the analysis of the Chemistry results.

Table 3. Distribution of matched grades in Chemistry for the May 2004 SEC and May 2006 A-level examination sessions

Chemistry A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	18	10	8	0	0	2	38
2	6	17	44	5	1	4	77
3	4	5	28	16	15	22	90
4	0	1	5	7	10	28	51
5	0	1	1	0	6	22	30
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	1	0	0	1	2
Total Number	28	34	87	28	32	79	288

Spearman Rank Correlation = 0.70

Note that a very high proportion of students with Grades 1 and 2 at SEC level obtained Grades A to C in the Advanced level exam and so did about 41% of students with Grade 3. A few students with grades 4 and 5 also obtained good grades. These observations and the high value of the correlation coefficient indicate that these students could follow A-level studies with profit.

On the other hand, six students with grades 1 and 2 failed the A-level examination. This observation cannot be explained easily and it goes to show why predictions are risky. Indeed, only 49% of the variance in the examination can be explained. The percentage of failures and Grade E results then increases dramatically in the case of students who start off with a SEC Grade 3 result or lower.

The analysis of the Physics results is shown in Table 4.

Table 4. Distribution of matched grades in Physics for the May 2004 SEC and May 2006 A-level examination sessions

Physics A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	22	29	14	3	4	1	73
2	6	24	39	20	11	10	110
3	1	8	23	33	12	13	90
4	0	3	12	10	19	38	82
5	0	0	0	2	5	10	17
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0
Total Number	29	64	88	68	51	72	372

Spearman Rank Correlation = 0.62

Most of the students with Grades 1 and 2 in Physics at SEC level were able to acquire Grades A to C at Advanced level. Quite a good number of candidates with Grade 3 at SEC level (68%) were able to obtain Grades A to C at Advanced level but a very sharp drop in performance is observed in the case of students with Grade 4 at SEC level. In fact only 33.6% of these students obtained Grades A to C at Advanced level. Students with Grade 5 or lower at SEC level were unlikely to sit for the examination in Advanced level Physics or failed to obtain the higher grades if they did sit for the examination.

The analysis of the Mathematics results is shown in Table 5.

Table 5. Distribution of matched grades in Mathematics for the May 2004 SEC and May 2006 A-level examination sessions

Pure Mathematics A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	55	33	30	9	8	10	145
2	14	32	41	19	17	30	153
3	0	15	36	14	23	42	130
4	1	6	9	7	10	37	70
5	0	0	1	0	1	16	18
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0
Total Number	70	86	117	49	59	135	516

Spearman Rank Correlation = 0.52

In the case of Mathematics, 81.4% of the students with Grade 1 at SEC level obtained Grades A to C in Advanced level Pure Mathematics, but only a surprisingly low number of about 57% of the students with Grade 2 at SEC level managed to obtain Grades A to C at Advanced level. The percentage of students obtaining Grades A to C becomes progressively lower for students starting with Grade 3 (39.2%) and Grade 4 (22.9%) at SEC level. In this subject, we again observe that students with Grade 5 or lower at SEC level were unlikely to sit for the examination in Advanced level Pure Mathematics or fail to obtain the higher grades if they did sit for the examination. The low predictive validity indicated by the relatively low value of the correlation coefficient and by the results especially those obtained by students with the higher SEC grades make it difficult to predict performance even for students with a high SEC level grade.

The analysis of the Computing results is shown in Table 6.

Table 6. Distribution of matched grades in Computing for the May 2004 SEC and May 2006 A-level examination sessions

Computing A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	7	9	10	3	0	0	29
2	6	14	19	12	1	2	54
3	0	9	12	13	7	3	44
4	0	3	5	6	9	14	37
5	0	0	1	0	1	1	3
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0
Total Number	13	35	47	34	18	20	167

Spearman Rank Correlation = 0.56

A relatively high proportion of students with Grade 1 and Grade 2 in Computing at SEC level managed to obtain Grades A to C at Advanced level. However, only 47.7% of students with Grade 3 managed to obtain the higher Advanced level grades. Less than half this number managed to obtain Grades A to C having started with Grade 4 at SEC level. The number of candidates sitting for Advanced level Computing who had Grade 5 at SEC level was only three but one of these candidates managed to obtain a Grade C at Advanced level. The data seem to show that students with lower grades at SEC level were unlikely to sit for the examination or obtain Grades A to C in Advanced level Computing. These observations may explain why the value for the correlation obtained was only 0.56.

Predictive Validity: Advanced level English and Maltese

Two other Advanced level subjects, English and Maltese, are included in the analysis and discussion presented in this paper as they are entry requirements to a number of university courses. They are also Advanced level subjects with a relatively high candidature and may be used as a comparison with the sciences, which presumably are marked more objectively.

Considering Advanced level English first, we compare students' performance in Advanced level English with their performance in SEC level English Language and SEC level English Literature since at SEC level these two subjects are offered separately. The predictive validity of SEC level English Language for Advanced level English was as shown in Table 7.

Table 7. Distribution of matched grades in English Language for the May 2004 SEC and May 2006 A-level examination sessions

English A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	3	7	19	8	2	1	40
2	1	7	63	44	27	17	159
3	0	3	26	43	36	41	149
4	0	0	5	10	18	40	73
5	0	0	1	1	3	26	31
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	0	0	0	3	3
Total Number	4	17	114	106	86	128	455

Spearman Rank Correlation = 0.56

The results show a rather low correlation between student performance at the two levels. Students tend to obtain low grades at Advanced level irrespective of the grades obtained at SEC level with the exception of Grade 1, where 72.5% of the students with that grade at SEC level obtained Grades A to C at Advanced level. Around 45% of the students with Grade 2 managed to obtain Grades A to C most of whom actually obtained Grade C. Students with lower SEC level grades performed

even less well, with only 19.5% of the candidates with Grade 3, 6.3% of the candidates with Grade 4 and 3.2% of the candidates with Grade 5 obtaining Grades A to C at Advanced level. These observations clearly indicate that while it is difficult to predict results and advise students with the higher SEC level grades, it is much easier to advise students with lower SEC level grades in English language about whether they are likely to be able to follow the course with profit. There were no candidates with Grades 6 or 7 sitting for Advanced level English and only three candidates with Grade U at SEC level sitting for Advanced level English who, not surprisingly, failed at Advanced level.

On the other hand the predictive validity of the results of SEC level English Literature for Advanced level English was as shown in Table 8.

Table 8. Distribution of matched grades in English Literature for the May 2004 SEC and May 2006 A-level examination sessions

SEC Grade	English A-level Grade						Total Number
	A	B	C	D	E	F	
1	2	1	9	1	1	0	14
2	1	6	20	11	2	3	43
3	0	7	51	24	25	13	120
4	1	1	20	42	21	27	112
5	0	0	10	18	22	32	82
6	0	0	1	0	2	15	18
7	0	1	0	1	1	7	10
U	0	0	1	4	5	11	21
Total Number	4	16	112	101	79	108	420

Spearman Rank Correlation = 0.51

Unexpectedly, the correlation between the grades obtained in English Literature at SEC level and Advanced level English is lower than the correlation between English Language at SEC level and Advanced level English. This may be surprising since Advanced level English has a high component of English Literature and one would expect that skills attained in SEC level English Literature would be useful at Advanced level. This observation may indicate that the prediction of performance at Advanced level is more a function of the students' command of the written language than on knowledge of literature. Close inspection of the results shows, however, that the low value of the correlation coefficient is not a result of a high performance at SEC level being followed by a low performance at Advanced level. In fact candidates with Grades 1, 2 and 3 in SEC level English Literature were able to obtain better grades at Advanced level than students with similar grades in SEC level English Language. The lower correlation (compared to SEC English Language) is a result of the relatively good performance at Advanced level observed for some candidates with low SEC level English Literature grades. In fact even some students with Grades 5, 6, 7 and U in SEC English Literature managed to obtain Grades A to C at Advanced level.

In the case of Maltese, there is only one subject offered at SEC level which contains both a language component and a literature component. The predictive validity of the results in Maltese at SEC level for Advanced level Maltese was as follows.

Table 9. Distribution of matched grades in Maltese for the May 2004 SEC and May 2006 A-level examination sessions

Maltese A-level Grade							
	A	B	C	D	E	F	Total Number
SEC Grade							
1	2	9	0	0	0	0	11
2	5	19	17	0	0	0	41
3	3	18	17	3	3	0	44
4	0	12	38	19	8	1	78
5	0	1	23	10	15	6	55
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0
Total Number	10	59	95	32	26	7	229

Spearman Rank Correlation = 0.60

The students with Grades 1 and 2 in Maltese at SEC level were all able to obtain Grades A to C when sitting for Advanced level Maltese. Most of the students with Grade 3 and 4 at SEC level obtained Grades A to C in Advanced level Maltese (86.4% of the Grade 3 students and 64.1% of the Grade 4 students). Candidates with Grade 5 were also able to perform well; in fact 43.6% obtained Grades A to C, while the students with Grade 6 or lower at SEC level did not sit for Advanced level Maltese. In the case of Maltese it is not difficult to predict and advise students about whether they are likely to perform well at Advanced level when starting with a good SEC level grade.

Gender

Another research question addressed in this study asked whether male and female students who obtain the same grades at SEC level achieved comparable results at Advanced level. One way of looking at this is by considering the Spearman Rank Correlation Coefficient for the different subjects by considering the results of male and female students separately. This would give an indication whether males and females were obtaining Advanced level results comparable to their SEC results. The results for the Biology, Chemistry, Computing, English, Maltese, Mathematics and Physics are given in Table 10.

Table 10. Spearman Rank Order Correlation Coefficient relating the SEC level results with Advanced level results for the whole group, female and male students

Subject	Total no of students	Spearman Correlation all students	Number of Female students	Spearman Correlation Females	Number of Male Students	Spearman Correlation Males
Biology	386	0.76	271	0.78	115	0.71
Chemistry	288	0.70	190	0.68	98	0.75
Computing	167	0.56	66	0.55	101	0.57
Mathematics	516	0.52	212	0.57	304	0.49
Physics	372	0.62	132	0.68	240	0.60
English	455	0.56	354	0.53	101	0.64
Maltese	229	0.60	169	0.56	60	0.71

As observed with reference to the correlation for the different subjects taking all students together, there is considerable difference in the Spearman Rank Order Correlation obtained between the different subjects but one can also note marked differences between the correlation obtained for female students and that obtained for male students. In Biology, Mathematics and Physics the correlation between results obtained at SEC level and those obtained at Advanced level for female candidates was higher than that for male candidates. In the remaining four subjects (Chemistry, Computing, English and Maltese), the correlations for male candidates were higher than that for female candidates, with a surprisingly marked difference observed in the case of English and Maltese.

These results especially the much lower correlations in the case of female students raise a number of questions, for example, in what way are the A-level results of female students not correlating with their SEC results? Is it the females with higher SEC level grades who are not performing well at Advanced level or is it the females who had lower SEC level grades who are now performing very well at Advanced level and giving rise to these low correlation coefficients? In order to attempt to answer these questions, the distributions of matched grades for the different subjects for the May 2004 SEC and May 2006 A-level results of male and female students were considered separately. Table 11 gives the percentage probability of obtaining Grades A to C at Advanced level having started with a particular grade at SEC level, taking the results of male and female students separately.

The results indicate that, in general, there was no fixed different pattern of performance between male and female students but there were some differences in specific subjects. Generally, males obtained slightly better grades in Advanced level Biology compared to female students starting with the same grade at SEC level except for students starting with Grade 3 at SEC level where female students showed a better chance of obtaining Grades A to C (a difference of 15.8%). In Chemistry there was no clear trend although there was a marked difference between the results of students starting with Grade 3 at SEC level. Male students were 2.2 times more likely to obtain Grades A to C compared to female students. On the other hand female students starting with Grade 4 were 4.2 times more likely to obtain Grades A to C at Advanced level compared to male students. No clear pattern in gender difference

emerged. In Computing, male students obtained higher grades than female students with the same grade at SEC level at times with a wide difference in results. For example when starting with Grade 3 male students were 1.7 times more likely to obtain Grades A to C at Advanced level than female students. In Mathematics, male students tended to get better grades in Advanced level Pure Mathematics when starting with any grade at SEC level except Grade 1. For example when starting with Grade 3 at SEC level, male students were 1.5 times more likely to obtain Grades A to C compared to female students. In Physics, female candidates generally obtained better grades than male candidates starting with the same grade at SEC level but the differences were not too large except for the case of students starting with Grade 4 where female students were 1.6 times more likely to obtain Grades A to C compared to male students. In the case of the two language subjects the Spearman Rank Order Correlation Coefficients for the results of male and female students were observed to be rather different. When the students' results were analysed it was clear that in English male students with any grade even a high grade in SEC level English Language, were less likely to obtain Grades A to C in Advanced level English. For example when considering students with Grade 1 in SEC level English Language, male students had only 50% chance of obtaining Grades A to C compared to the results obtained by female students with a 76.5% likelihood of obtaining Grades A to C at Advanced level. In Maltese, female students with the lower grades (3, 4 and 5) were doing a lot better at Advanced level and had a much better chance of obtaining Grades A to C in Advanced level Maltese compared to male students who had the same grade at SEC level. Chi square tests were carried out for each subject to check whether the differences observed were statistically significant. Tests were carried out between the numbers of males and females starting with the same SEC grade who eventually obtain Grades A to C at Advanced level. The tests show only one statistically significant difference which concerned students starting with Grade 3 in SEC Chemistry. In this case, males performed significantly better than females in the Advanced level ($\chi^2 = 10.527$, $df = 1$, $p < 0.01$). The tests confirm that there is no significant pattern in the differences in the percentage values between males and females.

Table 11. The percentage probability of obtaining Grades A-C at Advanced level having started with a particular grade at SEC level for male and female students

Subject	Grade at SEC Level									
	1		2		3		4		5	
	M	F	M	F	M	F	M	F	M	F
Biology	10 0	10 0	96. 7	90. 9	72. 4	88. 2	48. 3	43. 5	14. 3	14. 0
Chemistry	93. 3	95. 7	90. 0	86. 0	65. 5	29. 5	4.3 9	17. 2	18. 0	0 0
Computing	92. 3	87. 5	75. 0	68. 2	57. 7	33. 3	21. 4	22. 2	50. 0	0 0
English	50 0	76. 5	48. 8	43. 2	14. 3	20. 7	0 0	8.6 0	0 0	4.8 0
Maltese	10 0	10 0	100 0	100 0	75 0	88. 9	52. 9	67. 2	33. 3	48. 6
Maths	79. 1	84. 7	58. 5	54. 9	44. 9	30. 8	24. 4	20. 0	7.7 0	0 0
Physics	87. 2	92. 3	61. 6	64. 9	36. 5	33. 3	15. 1	24. 1	0 0	0 0

Note: Grades 6, 7 and U were ignored since all values were 0% except for the result of one female student who obtained a high grade (Grade A-C) in Advanced level Chemistry out of two females starting their A-level with Grade U in the subject at SEC level.

Grade 4 obtained from Paper IIA or Paper IIB

Another research question investigated in this study concerned students who obtained Grade 4 at SEC level. According to the current system, a candidate may be awarded Grade 4 by sitting for Paper 2A since the grades available for that paper are Grades 1 to 5. On the other hand, Grade 4 is the highest grade that may be awarded to candidates sitting for the less demanding Paper 2B. Therefore, the issue investigated was whether students who obtain a Grade 4 from Paper IIA obtain better Advanced level results than students who obtained the same SEC grade from Paper 2B.

The percentages of students obtaining Grades A to C at A-level when starting with Grade 4 obtained by sitting for Paper 2A or Paper 2B are given in Table 12 together with the numbers of candidates on which these percentages are based.

Table 12. Percentage of candidates obtaining Grades A-C at A-level when starting with Grade 4 obtained by sitting for Paper 2A or Paper 2B

Subject	Paper from which Grade 4 was obtained together with number of candidates			
	Paper 2A/%	N	Paper 2B/%	N
Accounting	40.8	49	45.5	11
Art	0.0	6	0.0	5
Biology	46.1	89	40.0	10
Business Studies	46.7	15	47.1	17
Chemistry	11.1	45	16.7	6
Computing	8.0	25	50.0	12
Economics	100.0	17	90.9	11
English Language	6.0	50	8.7	23
English Literature	18.8	96	25.0	16
French	33.3	6	0.0	6
Geography	50.0	2	0.0	0
German	0.0	2	0.0	0
Graphical Communication	100.0	1	0.0	0
History	100.0	1	100.0	1
Home Economics	16.7	6	60.0	5
Italian	0.0	6	45.5	11
Maltese	70.9	55	47.8	23
Mathematics	20.8	48	27.3	22
Physics	14.8	61	28.6	21
Religious Knowledge	85.7	7	100.0	7
Spanish	40.0	5	0.0	0

Disregarding the subjects where the number of students sitting for the Advanced level subject having started with Grade 4 is very small and presenting the results graphically as shown in Figure 2, an interesting observation emerges. In most subjects (Accounting, Chemistry, Computing, English Language, English Literature, Mathematics and Physics) the performance at Advanced level of candidates starting with Grade 4 at SEC level was better if the grade was obtained by sitting for Paper 2B than by sitting for Paper 2A. The difference observed ranged from a mere 2.7% in English language to a difference of 42% in Computing. One way of explaining these differences is by the fact that the candidates sitting for Paper 2B had been awarded the highest grade available for that paper which is Grade 4. They were likely to obtain a higher grade had they opted for Paper 2A. This observation underlines one of the disadvantages of the differentiated paper system, that is, the possibility of candidates failing to make the right choice of paper according to their abilities. The results for Mathematics and Computing seem more surprising since in these two subjects, students studying for Paper 2B have a different syllabus content going to less depth than the syllabus for Paper 2A. It is possible, however, that students study the syllabus for Paper 2A but sit for Paper 2B.

On the other hand in two other subjects (Biology and Maltese), students who obtained Grade 4 by sitting for Paper 2A did better at Advanced level and were more likely to

obtain Grades A to C than students who obtained Grade 4 by sitting for Paper 2B. In Biology the difference was only of 6.1% but in Maltese a marked difference was obtained equivalent to 23.1%.

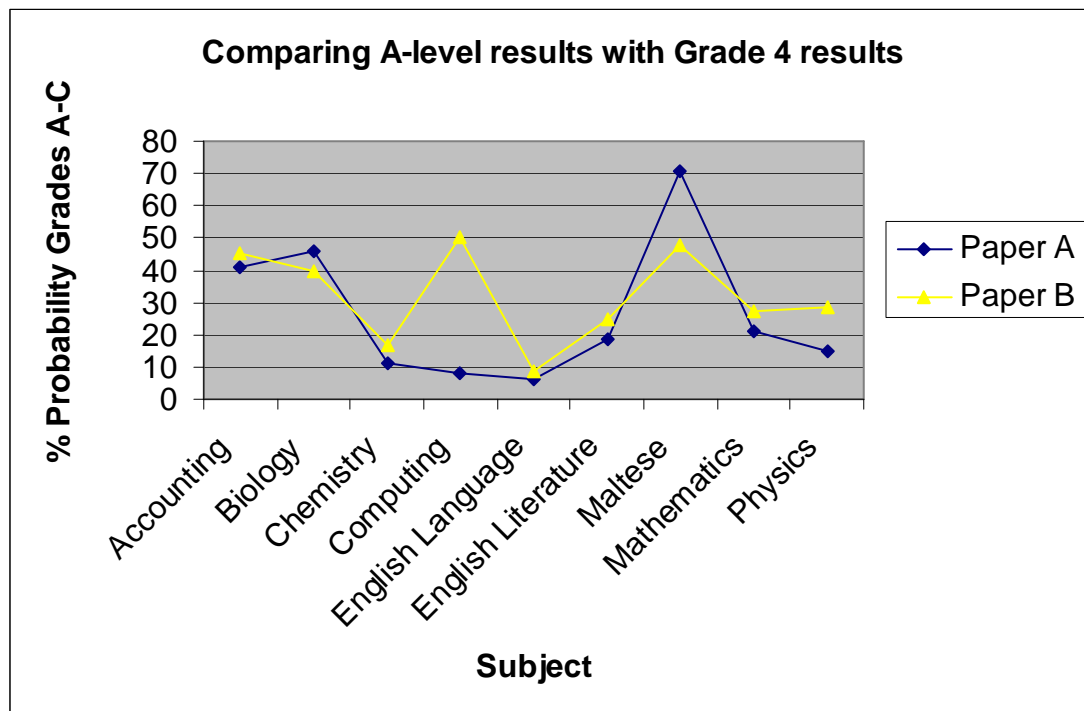


Figure 2: Percentage chance of obtaining Grades A-C at A-level when starting with Grade 4 obtained by sitting for Paper 2A or Paper 2B

When a similar comparison was made with respect to students starting their Advanced level studies with a Grade 5 obtained by sitting for the two different papers, only five subjects could be included in the analysis since very few candidates with Grade 5 at SEC level opt to study the subject at Advanced level. Figure 3 shows the performance of the two groups of students, that is those who acquire Grade 5 by sitting for Paper 2A and those who acquire Grade 5 by sitting for Paper 2B. Generally candidates who obtained their Grade 5 by sitting for Paper 2A did better at Advanced level than those who obtained their grade by sitting for Paper 2B at SEC level. The only exception was Chemistry, where the students who had sat for Paper 2B did better than those who had sat for Paper 2A.

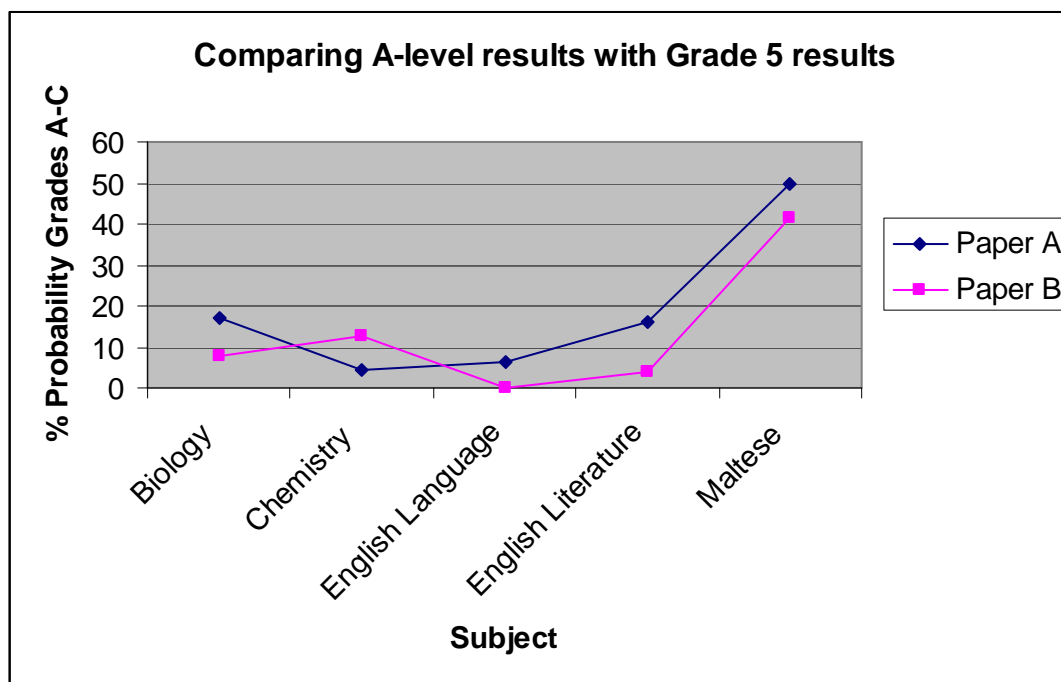


Figure 3: Percentage chance of obtaining Grades A-C at A-level when starting with Grade 5 obtained by sitting for Paper 2A or Paper 2B

Conclusions and Implications

This paper addressed a number of research questions with special reference to science subjects, mathematics, computing and the two core languages Maltese and English. It attempted to determine whether obtaining a certificate at SEC level in a subject was a good foundation for the study of the subject at Advanced level. The analysis showed that at Advanced level, for most subjects, students with Grades 1 to 2 and in most cases also Grade 3 are very likely to obtain Grades A to C at Advanced level. Students who start their Advanced level studies with lower grades generally find it more difficult to obtain the higher grades at Advanced level. Exceptions are observed in Pure Mathematics and English where it is rather difficult to obtain Grades A to C at Advanced level even when starting with Grade 2 at SEC level. Another exception is Advanced level Maltese, where quite a number of students with Grade 4 at SEC level managed to obtain grades A to C at Advanced level.

These results raise a number of questions. For example with results showing a particular grade at SEC level, should one advise students to take up the subject at Advanced level considering the estimated likelihood of obtaining a good grade at the higher level? On the other hand, should students with particular grades at SEC level be discouraged from studying a subject at a higher level. The results also showed that in some subjects, students with lower grades at SEC level were still likely to obtain good grades at higher levels while in other subjects, students with higher grades at SEC level were not achieving very high grades at Advanced level. This seems to support popular beliefs that certain subjects are harder than others. In order to attempt to answer this question further analysis was carried out. This involved comparing the likelihood of obtaining Grades A to C at Advanced level when starting with Grade 3

in a particular subject. Grade 3 was selected as it is a grade that many Advanced level students possess at the start of their course.

Figure 4 gives the probability of obtaining Grades A to C at Advanced level when students start with Grade 3 in a particular subject. The subjects with less than 20 students starting the higher level subject with Grade 3 were not included in the plots. The results obtained show a rather wide difference in the probability of obtaining a high grade at Advanced level having started with the same grade at SEC level. For example, in Accounting, Religious Knowledge, Biology and Maltese, starting with Grade 3 was very likely to lead to Grades A to C, in fact between 73.8% and 86.4% of the candidates obtained Grades A to C at Advanced level. On the other hand in Spanish and Business Studies the students starting with Grade 3 at SEC level were less likely to obtain Grades A to C at Advanced level; in fact the percentage probability in these subjects was around 60%. In the case of Physics, Mathematics, Chemistry, Art, Italian, Computing and English Literature students starting with Grade 3 were even less likely to obtain Grades A to C, in fact between 36% in Physics and 48% in English Literature. The lowest Advanced level grades were obtained by students starting with Grade 3 in English Language and French respectively. Only 19.5% of the students of English and about 22% of the students of French starting with Grade 3 at SEC level were able to obtain Grades A to C at Advanced level.

These differences give rise to a number of questions since an Advanced level subject should ideally involve a comparable level of difficulty and require a comparable level of commitment from students studying different subjects.

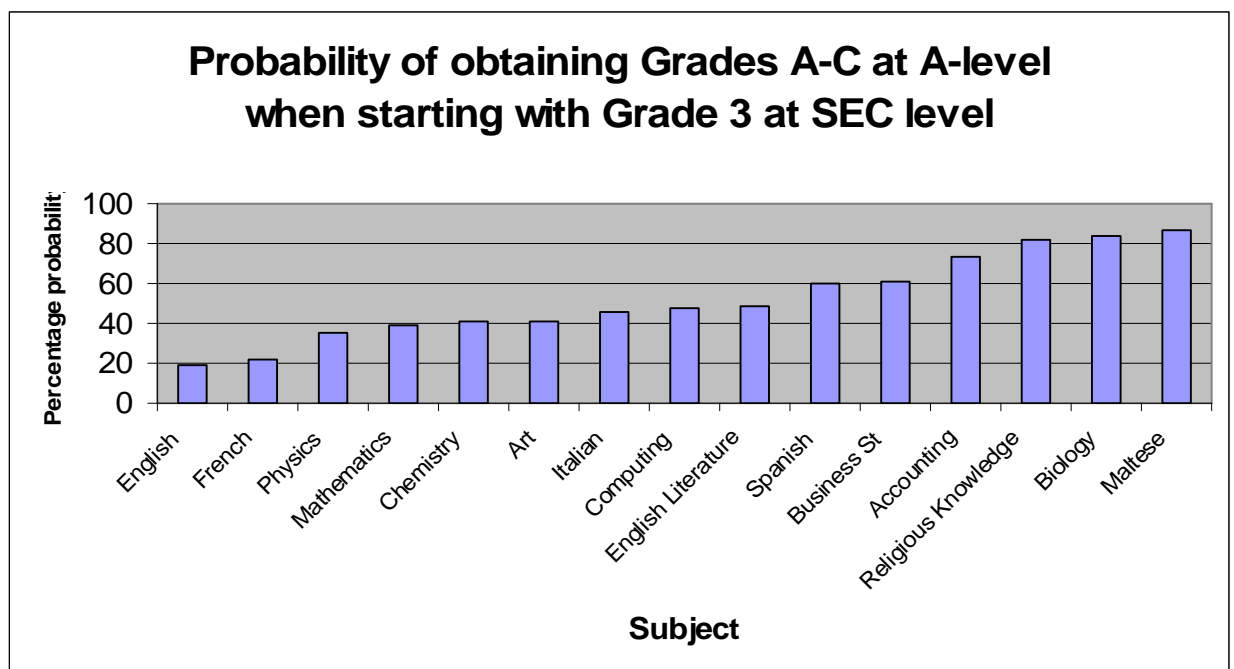


Figure 4: Probability of obtaining Grades A to C at A-level when starting with Grade 3 at SEC level

A similar analysis carried out in the UK by the Curriculum Evaluation and Management Centre at Durham University (2003), investigated the most likely A-

level grades achieved by a typical student with GCSE Grade B in the subject. The results are illustrated in Figure 5.

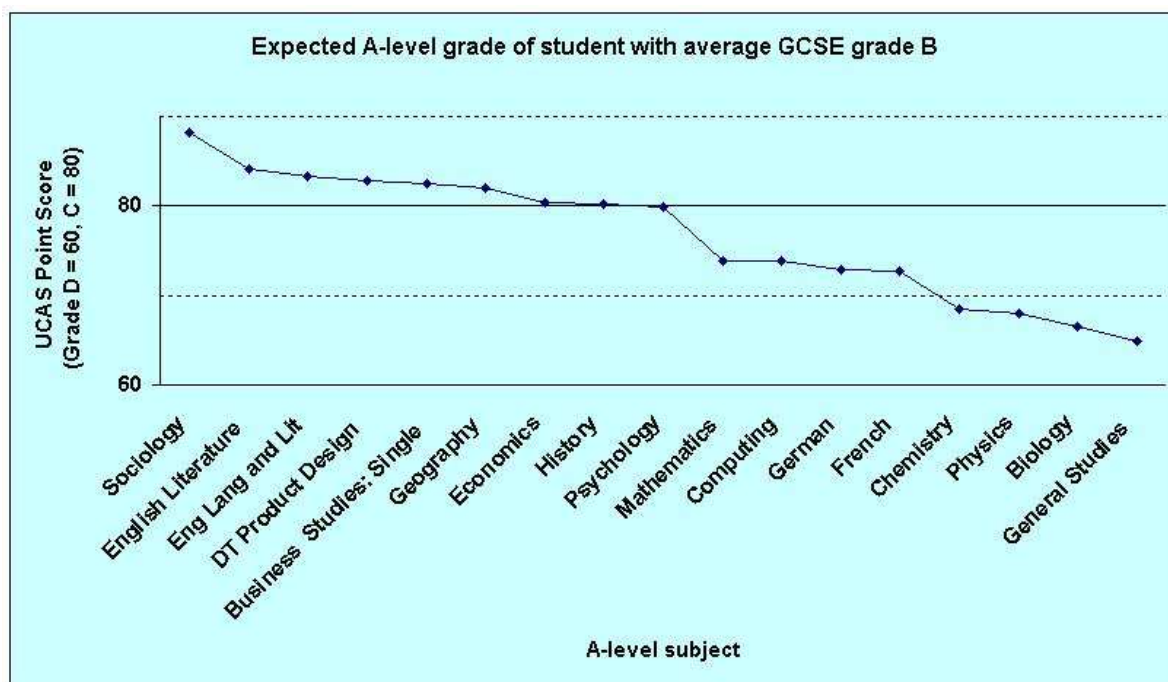


Figure 5: Expected A-level grade of student with average GCSE Grade B

For some subjects, a student with Grade B at GCSE level was found to be likely to obtain Grade C at A-level but for other subjects including Mathematics, Computing, Chemistry, Physics and Biology, the student is likely to obtain Grade D. The researchers claimed that this seems to indicate that some subjects are harder than others. In the U.K., General Studies, Biology, Physics and Chemistry were found to be the hardest subjects while Sociology and English were classified as the easiest. In the local study, on the other hand, English and French were found to be the hardest followed by Physics, Mathematics, Chemistry and Art while the easiest were found to be Maltese, Biology, Religious Knowledge and Accounting in that order. While there are some similarities between the classification made in the U.K. and that made in Malta, such as the classification of Physics and Chemistry as hard subjects in both instances, there are however some wide differences in placement such as that of Biology and English.

The study reported in this paper also attempted to determine whether there were any differences in the performance at higher levels of male and female students who obtain the same grades at SEC level. The results showed that in general there was no fixed different pattern of performance between male and female students at Advanced level but there were some differences in specific subjects. For example, generally male students obtained slightly better grades in Advanced level Biology compared to female students starting with the same grade at SEC level. Similarly in Computing, male students obtained higher grades than female students with the same grade at SEC level at times with a wide difference in results. Again in Advanced level Pure Mathematics, male students tended to get better grades when starting with most grades at SEC level compared to female students starting with the same grade. On the other hand, in Physics, female candidates generally obtained better grades than male

candidates starting with the same grade but the differences were generally not very large. Similarly in Advanced level English male candidates with any grade including high grades at SEC level were less likely to obtain Grades A to C compared to female students with the same SEC level grades. In Maltese, female students with the lower grades (Grades 3, 4 and 5) were doing a lot better at Advanced level and had a better chance of obtaining Grades A to C at Advanced level compared to male students who had the same SEC level grade. However, the difference was not statistically significant.

Another issue investigated was whether students who obtain a Grade 4 from Paper IIA obtain better Advanced level results than students who obtained the same SEC grade from Paper IIB. The analysis showed that in most subjects the performance at Advanced level of candidates starting with Grade 4 at SEC level was better if the grade was obtained by sitting for Paper 2B than by sitting for Paper 2A. This can be explained by the fact that the candidates sitting for Paper 2B had been awarded the highest grade available for that paper which is Grade 4. The observation also identifies a number of candidates who could have obtained a higher grade had they opted for Paper 2A at SEC level. However in two subjects (Biology and Maltese) this general pattern was reversed since students who obtained Grade 4 by sitting for Paper 2A did better at Advanced level and were more likely to obtain Grades A to C than students who obtained Grade 4 by sitting for Paper 2B. When a similar analysis was attempted with respect to students starting their Advanced level studies with a Grade 5 obtained by sitting for the two different papers, few subjects could be included since very few candidates with Grade 5 at SEC level tend to opt to study that subject at Advanced level. In this case, generally, candidates who obtained their Grade 5 by sitting for Paper 2A did better at Advanced level than those who obtained their grade by sitting for Paper 2B at SEC level.

The results provided detailed information about specific subjects. The data show that in general SEC examinations seem to provide a good foundation for study at Advanced level. The results show that candidates with the best grades at SEC level are likely to obtain the best grades at Advanced level while students with low grades at SEC level are unlikely to obtain very good grades in the higher level examination. Another general observation is that most candidates who obtain Grade 5 or lower in a subject at SEC level avoid taking that subject at Advanced level and those who opt for it obtain low grades at the higher levels. These grades can be useful for admission to courses and occupations that do not necessarily involve the study of those particular subjects at a higher level.

The results show that for the subjects presented, there is a moderate to strong correlation between the results at SEC level and the results at the higher level. However, one must be cautious in making this claim since the results depend on the reliability of the data obtained from examination results for which we have not measured reliability. The Spearman Rank Correlation Coefficients were used as an indication of the degree of relationship between two sets of results but not that one causes the other. In fact, if we consider A-level Biology with Rank Correlation Coefficient 0.76 we note that the examinations share 57.8% of the variation in common. It leaves a considerable part of the remaining variance that must be accounted for by other factors. Correlation depends on a number of factors including the spread of scores and the time span between measures. As observed earlier, few

students with low SEC grades take a subject at higher levels and this may result in the predictive validity appearing to be weaker than it really is. Since in these examinations candidates are awarded grades rather than scores, grades were used in this study. Each grade represents a range of scores and this may have influenced the results obtained.

It seems reasonable to use the SEC results as an indication of possible achievement at the higher level in most subjects. The study provides some of the answers required but it also points out issues where further research is necessary. For example, the answer to the first research question appears to be that the SEC level is a good foundation for study at Advanced level. There are however significant differences between subjects. For example, students obtaining Grade 3 in Biology and Maltese are twice as likely to obtain a good result at Advanced level as students with the same SEC grade in Chemistry and Pure Mathematics. There may be several reasons for this observation and it is clear that further research is required in order to obtain a better understanding of the progression of students from studying a subject at SEC level to studying it at Advanced level.

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