

## The 'Currency' of Coursework in National Examinations: SEC Physics as a Case Study

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### 1. Coursework as an Assessment Tool

Assessment is a process that measures achievement ensuring “objectively standards achieved by students ...”[1] It can be done through range of tools including written exams, coursework, practical and oral tests, etc. “Examinations ... which consist only of timed written papers cannot ... assess ability to undertake practical and investigational work ...”[2] School-based assessment (SBA) can be used to measure processes and skills acquired through a programme of work and cannot ‘fit’ in a written paper. SBA was included in exams to enhance the validity of the assessment process.[3][4][5]

### 2. The Maltese System and Coursework in SEC Examinations

The Matriculation and Secondary Education Certificate (MATSEC) Examinations Board of the University of Malta was instituted in the early nineties to substitute of the British ‘O’ and ‘A’ levels.[6] Secondary Education Certificate (SEC) examinations consist of two papers: “*a common Paper I ... and ... Paper IIA or Paper IIB, with Paper IIA intended for candidates of higher ability ...*”[7] Paper A candidates score grades 1 to 5, grade 1 being highest, whilst paper B students score grades 4 to 7. The major change was the introduction of SBA “*to increase the validity of certain examinations.*”[8]

A study by Briffa, Farrugia and Musumeci[9] found that practically the same marks were being scored by low- and high-achievers alike.[10] The problem seems to be inflation of marks, as highlighted in various Examiners’ Reports across subjects.[11]

### 3. The Methodology and General Categories

The sample reflected the secondary school types in Malta (Independent, Church and State Junior Lyceums and Area Secondary Schools) and the proportions by gender: 14 schools, 112 boys and 111 girls.

A wide variety of activities in the SBA mark for SEC Physics were identified, sorted into categories and into six questions. These categories traced those in a UK study by the Assessment of Performance Unit.[12] The five categories are: (i) symbolic representations, use of scientific representations; (ii) use of apparatus and instruments; (iii) observations; (iv) interpretation and application of data, and results; and (v) investigation design.

### 4. The Questions

#### 4.1 Question 1

To measure a straight line drawn on a paper using a ruler. All students used the same ruler. Marks awarded: dimensions of the line (1 mark); its unit (1).

Only 32% of the students scored full marks in this exercise, with 65% scoring one mark and 3% no marks or no attempt. In all school sectors, other than Area Secondary Schools, the number of girls that scored full marks was always higher than boys and Church school students performed better.

#### 4.2 Question 2

A metal block and other apparatus, to find the block’s material. A table of densities of certain materials was given.

This question had three parts: (i) to indicate the property to investigate to find the cube’s material (1); (ii) the method (2); and (iii) to state the cube’s material (1). The percentage of pupils who attempted this

question was 79%, with 16% scoring no marks. Girls and boys, and different school sectors, performed at roughly the same level.

### 4.3 Question 3

Handling of apparatus, reading from a scale, and familiarity with scientific terms.

In part (i), the spring had to be loaded with a weight labelled X (weight indicated). Another weight, for later use, was provided. After loading the spring, students had to read and record the extension (1). In part (ii), students had to state the tension in the spring (with X) after it stops oscillating (1). In the last part, students had to add another weight and read the extension (1).

In general, students assembled the apparatus correctly, although only four students (1.8%) scored full marks. Just below half the students obtained 2 marks, with an overall mean slightly above 1; the mean mark for girls was 0.1 higher. There difference in mean mark between school types was pronounced.

### 4.4 Question 4

To put potassium permanganate crystals in water, heating it with a weak flame. In part (i), they were asked to note any observations (1) and in part (ii) to interpret the observations and name the process (1). Both genders performed badly in this question, with a slightly higher mean for boys. Both means were below 1 (global mean = 0.8). One notes that 43% scored zero marks, with c. 50% of the students from each sector scoring no marks. There were no significant discrepancies between boys and girls. Less than 25% managed to score full marks, with the highest performance by Church Schools and the lowest by Junior Lyceums.

### 4.5 Question 5

To represent data in graphical form and make inferences from it.

Pupils were presented with values of force (N) and acceleration ( $m/s^2$ ) and had to plot them on a graph. They were left to decide on their own the more appropriate type of plot, and the scale (3). In part (ii), they had to find the mass from the graph (1).

The mean for part (i) was 2.3, indicating that students felt comfortable with graphs, with c. 12% scoring full marks. There were no differences between boys and girls, both scoring the same mean and 26% managed to get all 3 marks. Although there were instructions regarding what to plot on the axes, 61% of students interchanged the axes.

In part (ii), 3% of the students managed to link the mass with the gradient. Moreover, 45% still managed to get a correct answer using  $F = ma$  (given in the initial part of the question). Including the latter, 48% managed a correct answer. More than 25% did not answer this part and c. 28% did not attempt the question.

### 4.6 Question 6

To set up an electrical circuit, from scratch, with two bulbs and a battery; to connect the ammeter and voltmeter for correct readings; to estimate the battery's e.m.f.

Pupils were assessed on how to wire a circuit and handle the apparatus. One mark was assigned for each step: identification of ammeter and voltmeter; value of current, voltage and e.m.f.

The mean was just below the mid-point, at 2.43. Boys performed better than girls in all school sectors. The biggest discrepancy was in Church schools where the boys' average mark was double that for girls. Only 9% obtained full marks, with 11 (out of 20) coming from Independent schools. Most students managed to get at least two marks, for the identification of the meters (which had A and V on them).

## 5. Overall analysis

Tables 1 and 2 show general statistical information and the means by gender and school type. In general, boys performed better than girls. Other than for Independent Schools, this was confirmed for each school category.

Table 1 - Overall statistical information

Mean	Median	Mode	Standard deviation	Minimum mark	Maximum mark
7.59	8.00	8.00	2.68	1.00	13.00

Table 2 – Test mean mark and standard deviation by school sector and gender

School Sector	Boys		Girls		Whole group	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Area Secondary	6.64	2.22	5.18	2.51	5.91	2.46
Church	8.61	2.42	7.46	2.60	8.04	2.56
Independent	8.61	2.53	9.11	2.24	8.85	2.38
Junior Lyceum	7.61	2.78	7.57	2.19	7.59	2.48
<b>Overall</b>	<b>7.87</b>	<b>2.59</b>	<b>7.32</b>	<b>2.75</b>	<b>7.59</b>	<b>2.68</b>

## 6. The Relation between the marks for SBA and the written papers

The relationship between the SEC SBA mark and the marks for the written papers was investigated, for indications whether the SBA mark is a good indicator of the final mark. Tables 3 and 4 give a summary of these components and the SBA mark for option A and B candidates. The standard deviation indicates a measure of the spread of marks.

Table 3 - Statistical results of the SEC Physics Examination

	P I (%)	P II A (%)	P II B (%)	SBA (/ 15)	Global Mark (%)
<b>Mean</b>	68.9	70.2	53.1	13.2	69.6
<b>Mode</b>	82.0	71.0	65.0	14.0	77.0
<b>Standard dev.</b>	20.9	14.1	19.0	2.0	17.1
<b>Minimum mark</b>	13.0	26.0	21.0	0.0	23.0
<b>Maximum mark</b>	97.0	97.0	92.0	15.0	96.0
<b>No. of candidates</b>	216	144	72	216	216

Table 4 - Statistics of raw SBA scores

	Mean	Mode	Standard deviation	Minimum mark	Maximum mark
<b>Paper IIA</b>	13.5	14.0	1.8	1.0	15.0
<b>Paper IIB</b>	11.9	13.0	3.4	0.0	14.0

Figure 1 shows the frequency (%) of the marks for papers I, IIA and IIB and the global mark. The SBA marks tend to be skewed to the high side, and do not map the performance in the other exam components. The study by Farrugia and Musumeci[13] also indicates that SBA marks for various SEC subjects tend to be inflated.

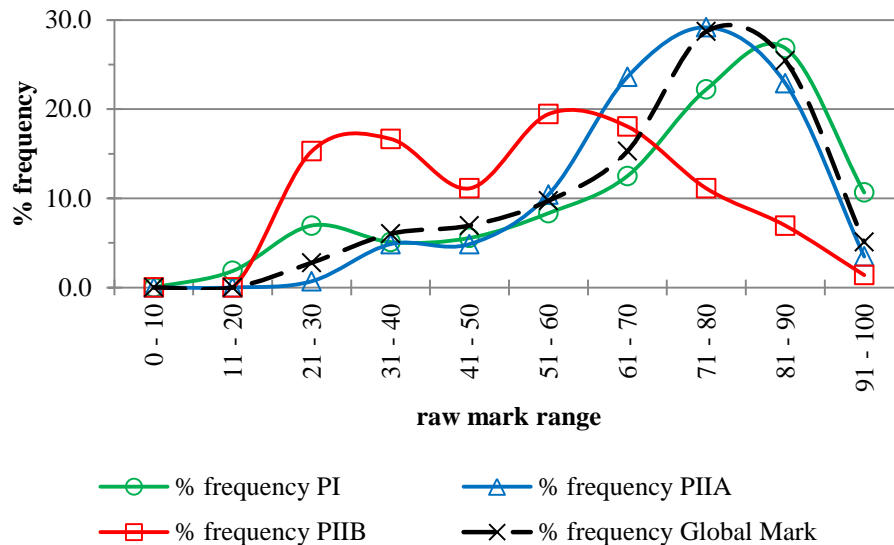


Figure 3 – Percentage frequency of raw marks for PI, PIIA, PIIB and the global mark

### 7. Correlation Analysis

Xuereb[14] stated that nearly half the teachers interviewed believe that students that do well in their SBA work will also perform well in the exam. A cross-correlation study, using Pearson correlation coefficients, with marks from the investigation test, SBA, the Papers and the final SEC total was carried out. The coefficients are reported in the Table 7.

Table 7 - Correlation coefficients for all students

	Test	SBA	P I	P IIA	P IIB	TOTAL
Test mark		0.34	0.71	0.70	0.69	0.73
SBA	0.34		0.40	0.24	0.11	0.30
Paper I	0.71	0.40		0.88	0.93	0.97
Paper IIA	0.70	0.24	0.88		x	0.96
Paper IIB	0.69	0.11	0.93	x		0.96
TOTAL	0.73	0.30	0.97	0.96	0.96	

### 8. Conclusion

An examination "... may be seen ... as objective, fair and consistent – yet can be selective in what it assesses, narrow ..." SBA "... may appear comprehensive in what it assesses, thorough and non-threatening – yet can be subjective, difficult to standardise and open to bias." [15]

It was found that SBA marks tend to be inflated and no discrimination between option A and B candidates is shown. Low correlation was found between the Papers' and the SBA mark (0.30). Conversely, higher correlations with the test mark (0.73) were recorded. These findings indicate that candidates might not be benefitting from the intended SBA learning outcomes, instilling doubts on the validity of this assessment mode. Teachers might not be using assessment criteria uniformly across schools, giving rise to reliability issues.

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