

Perception of the Level of Difficulty by Post-Secondary Maltese Students of the Biology Advanced Level Practical Examination Paper

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Abstract

Maltese students sit for the Matriculation and Secondary Education Certificate (MATSEC) Advanced-level biology exam at the end of a two-year 'sixth form' course as a requirement to pursue studies related to science at the University of Malta. The exam consists of four papers, where Paper 1 consists of compulsory structured questions, Paper 2 involves essay-writing, Paper 3 is based on practical work related to theory, and Paper 4 consists of a single experimental design question.

A questionnaire based on a Likert five-point scale was administered to students (N=102) two months before they sat for the MATSEC examination. The aim was to investigate the level of difficulty that students encounter with each of the exam papers as well when answering ten typical questions presented in Paper 4. No significant difference in the difficulty rating evaluation for males and females for Paper 1, 2 and 3 was found; however females found Paper 4 significantly more difficult than males.

When presented with a test at school modelled on Paper 4, males felt more confident than females however they felt equally nervous. On the other hand, females felt more panicky than males. There was no significant difference between the level of difficulty encountered in each paper and the grade obtained at 'Ordinary' level biology (the examination taken at the end of secondary school). Students that were repeating their 'sixth form' second year encountered the same level of difficulty in each paper as those who were not.

The same questionnaire was administered to tutors (N=13) in order to investigate whether student and tutor perceptions differ. Students and tutors rated the level of difficulty of each paper differently. None of the tutors perceived Papers 2, 3 and 4 as 'easy' whereas students did. Another difference in perception was noted in Paper 1: students rated Paper 1 as 'difficult' while tutors did not. Students and tutors also differed in the rating of level of difficulty in Paper 4 questions. Students found the question about devising an experiment as presenting the highest level of difficulty while for tutors the most difficult was that concerned was stating the sources of error. Writing a null hypothesis presented the least difficulty for students whereas drawing graphs was rated as least difficult by tutors.

These differences in perception imply that tutors may be dedicating more time preparing students for papers and questions they (the tutors) perceive as difficult and thus may not be meeting the real needs of the students.

1. Introduction

The Matriculation and Secondary Education Certificate (MATSEC) Advanced-level biology exam was introduced in Malta in 1997. Students sit for this examination at the end of a two-year 'sixth form' course to serve as a gate-way to pursue studies related to science at the University of Malta.

Over the years, a number of changes in the structure of the paper were made. The most recent major change was in 2008 and concerned questions in Paper 4. This is the practical hands-on part, involving experimental work and observations in the laboratory. The paper-format is "one question, involving an experiment to test the ability to follow laboratory instructions, to design experiments, to make accurate observations, to record observations in an appropriate manner and to interpret and analyze experimental data" [1: p4]. In Paper 4, students are required to answer ten questions about an experiment which they device and follow the same format every session. Writing a null hypothesis, describing in detail the experimental procedure to be followed and listing the precautions and the sources of error are a few examples. Table 1 shows information regarding duration of each paper, maximum mark, and nature of questions asked. The practical exam carries 40/300 i.e. accounts for 13.33% of the total. Institutions preparing students for MATSEC dedicate a two-hour session per week throughout the two-year course to laboratory work. During such laboratory sessions, students perform experiments modelled on questions from Paper 4. The number of such sessions varies amongst institutions. The lab-work carried over the two-year course carries a maximum mark of 10 in the MATSEC exam (Table 1).

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Table 1. Duration, maximum mark allotted and type of question dealt with in each paper.
[Source: modified from MATSEC syllabus, 2016, p. 4].

PAPER	TIME /hours	MAXIMUM % MARK	Type of question
I	3	100	Compulsory structured questions
II	3	100	Comprehension and essay-writing
III	1.5	50	Written practical-based exam
IV	1.5	(Experiment exam (40) + Practical workbook (10))	Hands-on practical

According to the annual MATSEC statistical report [2], Biology was the second most popular subject at Advanced level with 672 candidates registering for the 2015 session. Considering the large number of students taking biology at Advanced level in Malta and feedback obtained through direct contact with students, motivated us to investigate quantitatively the students' perceptions of level of difficulty of examination papers. Literature investigating the relative difficulty in examinations between different subjects goes back three decades [3], however no research on difficulty between papers in Biology at Advanced level was found. While some research has been conducted locally involving biology students, this focused on attitudes to science [4] and the perception of the level of difficulty of Biology examination papers by post-secondary students has not been investigated.

2. Purpose of Research

This study was conducted to examine the perception of difficulty of post-secondary Maltese students' at two-levels:

- 1) to the four MATSEC Advanced-level biology exam papers;
- 2) when answering questions modelled on Paper 4.

The study focuses on the following questions:

- 1) What is the level of difficulty that students encounter with each of the four biology Advanced-level examination paper?
- 2) Is there any difference between the perceived level of difficulty encountered in the four biology Advanced-level examination papers with respect to gender, number of years learning biology, institution attended and grade obtained in the 'Ordinary' level exam?
- 3) Is there any difference between the perceived level of difficulty when answering ten typical questions presented in Paper 4 when taking the whole cohort?
- 4) Is there any difference between tutor and student perceived level of difficulty encountered in:
 - a) the four biology Advanced-level examination papers;
 - b) when answering ten typical questions presented in Paper 4?
- 5) Does gender play a role in the level of confidence when answering questions modelled on Paper 4?
- 6) What implications for biology education can be derived from the results of this study?

3. Method

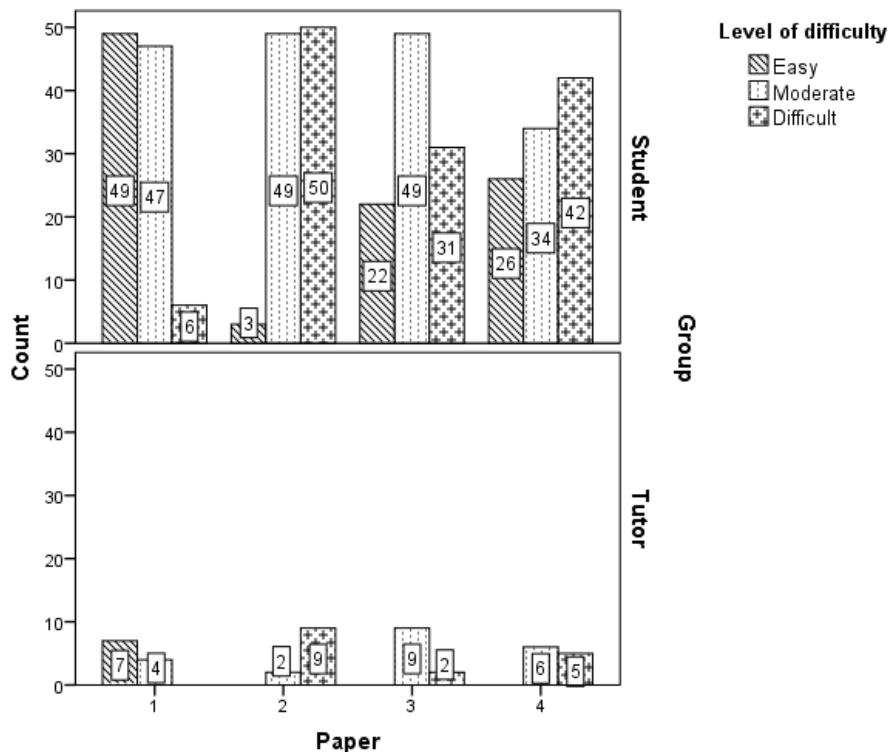
The test subjects were post-secondary students (17-19 year olds) attending a private institution after school hours. The sample consisted of 102 students (35 males and 67 females) categorised as attending 'State Schools' (N=86; 26 males and 60 females) or 'Other Institutions' (N=16; 9 males and 7 females). The students were either in their second-year (N=80; 78.43%) or repeating the second year (N=24; 21.57%). Data were collected over five days, in January 2016, i.e. two months before they sat for the MATSEC examination. A questionnaire divided into three sections was prepared. In Section A, information regarding gender, institution attended, grade obtained at Ordinary level, career-preference and whether biology was their favourite subject were asked. Section B involved a 10-item questionnaire addressing the difficulty the student encounters when answering each type of question in Paper 4. In Section C, students were asked to rate the level of difficulty they encounter in each paper and level of confidence when taking an exam at their school, modelled on Paper 4. The questionnaire was based on a Likert five-point scale. A questionnaire with the same questions as in Sections B and C, was distributed to 13 State School tutors asking them to rate the level of difficulty they think that students encounter. Using SPSS (version 23), the Chi-square test was used to assess the association between student gender, type of institution attended and number of years learning biology with the level of difficulty of each paper. A p-value less than the 0.05 level of significance indicated a significant association between the two categorical variables. The five-point rating scale for level of difficulty was converted to a three-point scale by combining 'very easy' with 'easy' and 'difficult' with 'very difficult'. Thus the new categories for level of difficulty are 'easy', 'moderate' and 'difficult'.



4. Results

The perception of the level of difficulty of each paper by students and tutors differed (Fig. 1). None of the tutors perceived Papers 2, 3 and 4 as 'easy'. The majority of students (N=49; 48%) rated Paper 1 'easy' (Table 2); Paper 2 was rated 'moderate' (N=49; 48%) to 'difficult' (N=50; 49%), Paper 3 as 'moderate' (N=49; 48%) and Paper 4 as 'difficult' (N=42; 41%).

Fig. 1. The perceived difficulty rating of the four examination papers at Advanced-level biology by students and tutors.



When comparing the rank order of the level of difficulty in answering questions in Paper 4 as rated by students and tutors (Tables 2 and 3), only one question, that 'stating objectives', was given the same level of difficulty ('moderate') and occupied the same position for both groups.

Neither the number of years learning biology nor the grade obtained at Ordinary level affected the level of difficulty encountered by the students ($p > 0.05$) in any paper. However, gender has an effect since females found Paper 4 significantly more difficult than males ($p < 0.05$) (Table 3).

A significant difference ($\chi^2(18) = 97.728, p < 0.001$) was found between the rating by students for the ten set questions in Paper 4. Students found the question about devising an experiment as presenting the highest level of difficulty while writing a null hypothesis presented the least (Figure 2).

Tutors perceived the question on stating the sources of error as presenting the highest level of difficulty while carrying out the investigation as the least difficult (Figure 3). The difference was significant ($\chi^2(18) = 62.95, p < 0.001$). When presented with a test at school modelled on Paper 4, males (42.9%) felt more confident than females (16.4%); however, they felt equally nervous (males = 74.3%; females = 74.6%). On the other hand, females felt more panicky (53.7%) than males (17.1%).



Table 2. The effect of gender on perceived difficulty encountered by students when answering the four papers at Advanced-level biology.

Paper	Gender		Difficulty Rating			P-value
			Easy	Moderate	Difficult	
1	Male	Count	18	15	2	0.883
		Percentage	51.4%	42.9%	5.7%	
	Female	Count	31	32	4	
		Percentage	46.3%	47.8%	6.0%	
2	Male	Count	1	20	14	0.406
		Percentage	2.9%	57.1%	40.0%	
	Female	Count	2	29	36	
		Percentage	3.0%	43.3%	53.7%	
3	Male	Count	10	15	10	0.457
		Percentage	28.6%	42.9%	28.6%	
	Female	Count	12	34	21	
		Percentage	17.9%	50.7%	31.3%	
4	Male	Count	16	13	6	0.000
		Percentage	45.7%	37.1%	17.1%	
	Female	Count	10	21	36	
		Percentage	14.9%	31.3%	53.7%	

Fig. 2. The perceived mean difficulty rating and standard error of the ten questions set in Paper 4 at Advanced-level biology by students. Level of difficulty '1'- 'very easy'; '2'- 'easy'; '3' - 'moderate'; '4' - 'difficult'; 5 - 'very difficult'.

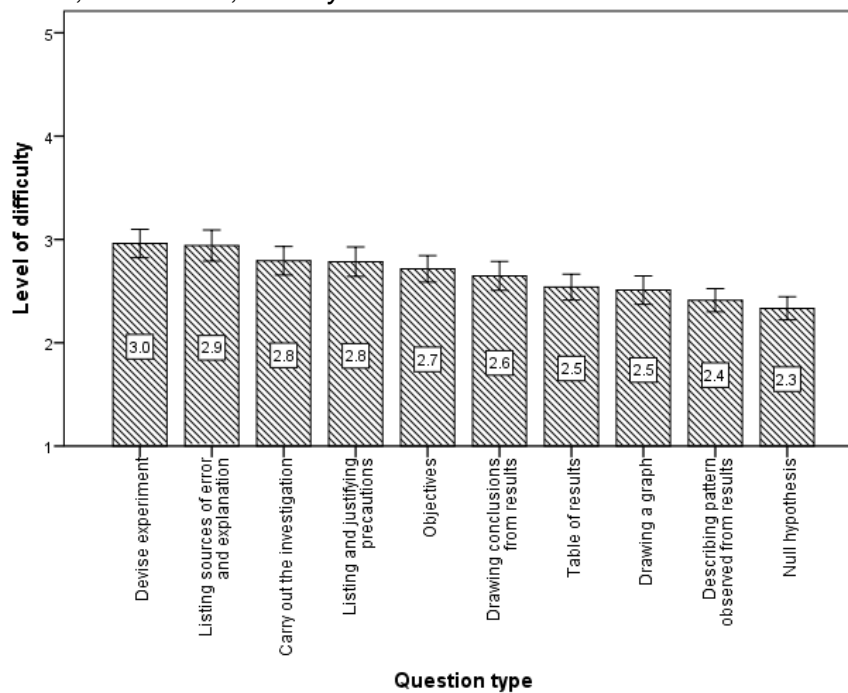
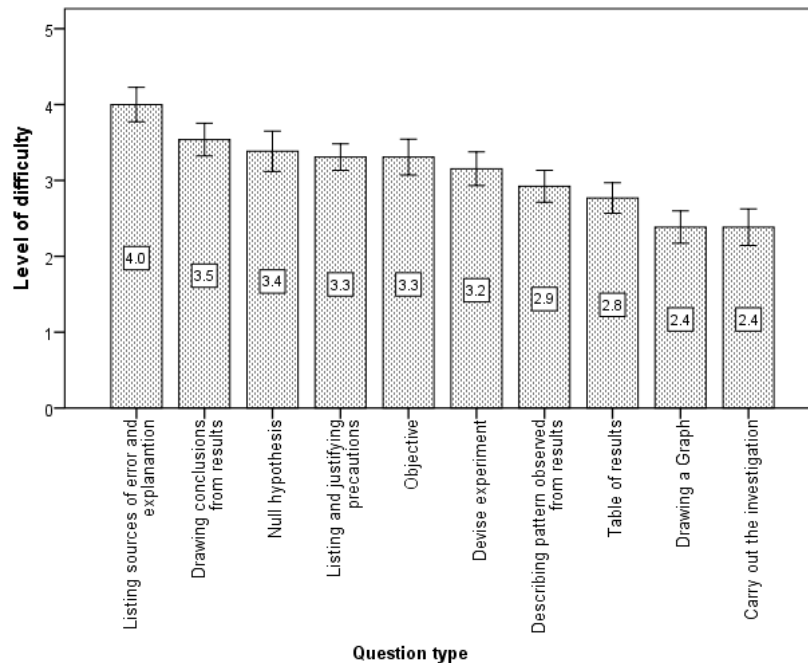


Fig. 3. The perceived mean difficulty rating and standard error of the ten questions set in Paper 4 at Advanced-level biology by tutors. Level of difficulty '1'- 'very easy'; '2'- 'easy'; '3' - 'moderate'; '4' - 'difficult'; 5 - 'very difficult'.



5. Discussion and Conclusions

Although all students participating in the study declared that they wanted to proceed with studies in the medical field, just 61% stated that biology was their favourite subject. This result accords with those carried out on Maltese undergraduate science students [5], where students enjoyed science the most at primary level but this degree of enjoyment decreased as students move from Primary, to Secondary, to Sixth Form. Gender has an effect on perception of difficulty since females find Paper 4 significantly more difficult than males. Gender differences in science, in favour of males, have been attributed by many authors to factors such as females' lack of exposure to science-related activities outside the classroom [6]. Males are seen as more competitive, more confident, and more willing to have a go at something as opposed to low esteem and passive dependent behaviour among females [7]. The gender difference is reflected in the level of confidence students declared when answering questions modelled on Paper 4: 42.9% of males said that they are confident against 16.4% females; similarly [8] found that when required to "think like scientists", girls underperform considerably compared to boys. On average across OECD countries males outperform females – by 15 score points – in the ability to apply their knowledge of science to a given situation, to describe or interpret phenomena scientifically, and to predict changes. The OECD 2015 report [8] states that "*this gender difference in the ability to think like a scientist may be related to students' self-confidence*". Thus the results of the present study, where 53.7% females reported that they feel panicky against 17.1% males, is in perfect harmony with international findings. On the other hand, gender has no role in feeling nervous (males = 74.3%; females = 74.6%). The final conclusion which bears important educational implications is that since differences in perception between tutors and students exist, tutors may be dedicating more time preparing students for papers and questions they perceive as difficult and thus may not be meeting the real needs of the students.

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