

Language And The Science Curriculum

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Current interest about which language (Maltese or English) is more suitable for teaching certain subjects in the secondary school touches upon important educational issues (1). Language is not simply the medium of exchange of ideas but, once acquired, it becomes the instrument that the learner can then use to bring order into his/her environment (2). In the absence of a prescribed language policy, many teachers opt for the language which in their judgement best helps pupils to understand the subject and to perform well in tests and examinations. In practice this means that they use a mixture of languages depending on the objectives of their lessons. This article focuses on the language used in science teaching and it is based on research carried out in June 1984 as an off-shoot of an evaluation of the science curriculum in the first two years of the Area Secondary schools (3). At that time, excluding pupils attending Junior Lyceums and private schools, the Area Secondary schools catered for 60 percent of all boys and 66.5 percent of all girls at Form 1 and Form 2 level.

The Language of Instruction

During interviews in connection with the evaluation, teachers invariably raised the issue of the language used for explaining science, filling worksheets, writing notes, the text books, and the effect that changing the language of the science examination from English to Maltese could have on the pupils' performance.

Subsequently, a self-administered anonymous postal questionnaire was sent to all Form 1 and Form 2 science teachers in the area secondary schools which, among various aspects of the science curriculum, asked teachers about language.

Seventy percent of the teachers returned the completed questionnaire and according to their responses, the language used for explaining science is as shown in Table 1, while the expected effect of a science examination in Maltese rather than English is as shown in Table 2. The responses are grouped according to the gender and ability of the pupils taught.

From the first table it appears that the vernacular is predominantly used for explaining science, and teachers use more Maltese with the

less able classes than with the more able ones and with boys more than with girls. The preference for Maltese is hardly surprising especially when the teacher, consciously or unconsciously, realizes that learning is a collaborative enterprise involving teacher and class in a process of exchange and negotiation of meaning (4).

Table 1: *The language used by teachers for explaining science in more able and less able classes and in boys' (B) and girls' (G) schools.*

	Percentage response			
	more able	less able	B	G
i. Maltese only	6.4	58.1	40.6	23.3
ii English only	0	0	0	0
iii Mostly Maltese + a little English	51.6	35.5	40.6	46.7
iv Mostly English + a little Maltese	6.4	0	6.3	0
v An equal mix of Maltese and English	35.5	6.4	12.5	30.0

Table 2: *Teachers' opinions about the expected change in performance of pupils sitting for a science examination in Maltese.*

Pupils' results will be:	Percentage response			
	more able	less able	B	G
i better	23.3	39.3	19.4	44.4
ii slightly better	46.7	46.4	58.0	33.3
iii not different	30.0	14.3	22.6	22.2
iv slightly worse	0	0	0	0
v worse	0	0	0	0

The results of the second table show that the majority of teachers in this sample believe that pupils will perform better or slightly better in a science examination in Maltese irrespective of ability, but less able pupils are expected to gain more than the more able ones. Furthermore, the teachers predict that both boys and girls should perform better but the gain by girls is expected to be higher.

The Maltese/English Integrated Science test for Form 1

In view of the teachers' opinion that the language of the examination may be acting as a barrier preventing pupils from showing their full knowledge of science, it was decided to set up an experiment to check the hypothesis. A test consisting of fifty objective type items with four

options each was constructed for Form 1 pupils in a Maltese and an English version (5). Thirty four items were selected after an item analysis of the Form 1 national annual science examination of June 1982. The other sixteen items were written specifically for this test to probe the pupils' understanding more deeply, to introduce some vocabulary and syntax which might influence the pupils' answers, and to balance the number of items per topic. Special attention was given to translation especially in the light of research which showed that just simplifying a single word in multiple choice items (for example by writing "melted" instead of "fused") improved the pupils' performance (6). Great care was also taken to keep the format, length of text, any accompanying diagrams and the printing of both versions as similar as possible.

The test was administered to 284 pupils in thirteen Form 1 classes from three boys' and three girls' area secondary schools in the third week of June 1984 (7).

At that time of the year these classes had covered the science syllabus and were revising it for the national annual examination. The test was presented to them as a mock examination which formed part of their revision. The pupils taking the test had a wide range of abilities as they came from streams ranging from A to F (see Table 3). The table also shows that boys in the sample came from higher ability streams than girls.

Table 3: Distribution of the sample of pupils taking the Maltese/English Science test for Form 1.

	No. of	A	B	C	D-F	Total
Girls	classes	1	2	1	2	6
	pupils	20	56	11	43	130
Boys	classes	3	1	2	1	7
	pupils	65	18	52	19	154
Global	classes	4	3	3	3	13
	pupils	85	74	63	62	284

Each class was randomly divided into two approximately equal groups, one of which took the Maltese version and the other the English version of the test. This ensured that the test was taken by pupils of equivalent abilities, background and preparation. One and a quarter hour was allowed for the test which fitted well in a normal double lesson.

Analysis of Results

The global results of both versions are shown in Table 4. The first observation about these results is that there is a definite difference in the average scores in favour of those who sat for the Maltese version of the test. The difference is statistically very highly significant ($t=7.875$, $p<.001$). Besides this difference, the range of scores of the English version is wider than that of the Maltese version as indicated by the larger standard deviation. An examination of individual scores (not shown here) shows that this happened because while only 22 percent of those taking the Maltese version obtained scores of 40 marks or less, just over 40 percent of those taking the English version fell within this range of marks. There was, however, no such difference between the two versions in the percentages of those obtaining more than 60 marks. The result suggests that as far as the weaker students were concerned, those taking the English version were disadvantaged with respect to their peers taking the English version. On the other hand it appears that in the case of the more able students, those taking the Maltese version did not gain any advantage over those taking the English version. A test of this hypothesis is discussed further on.

Table 4: Global results obtained in the Maltese and English versions of the Science test for Form 1.

	Maltese	English
No of students	150	134
Average score	53.42%	47.98%
Standard deviation	14.66	17.92
Standard error of measurement	6.22	6.14
Reliability (K-R 20)	0.82	0.88

A second general observation about the results is that both versions were practically equally reliable as evidenced by the high reliability coefficients, where the maximum value is 1.0, and almost identical standard errors of measurement. The latter characteristic, which is the standard deviation of the distribution of errors in the observed scores, indicates that the raw scores of both versions can be compared directly since they represent the "true" scores of the pupils with the same degree of accuracy.

Other analyses by question and by topic were carried out but the results are not shown here since they refer to the scientific content which is beyond the scope of this article. It should be pointed out, however, that they reflected the same general trend shown by the global marks; that is

the scores in the Maltese version were higher. But two of these results need to be highlighted since they reflect on important test characteristics of the two versions. First, the analysis by topic showed that the order of difficulty of the topics was the same in both versions. Second, the analysis of the students' response to each question showed that the relative strengths of the distractors for each question were practically the same in both languages. Both of these are sure indicators of the concurrent validity of the two versions.

In order to check whether the difference in performance in the two versions is found across different abilities as measured by the test itself, t-tests were performed on samples of the top and bottom scores. Thus the scores of the top 25 percent (N=38) and of the bottom 25 percent of the students taking the Maltese version of the test were separately compared to the scores of the top 25 percent (N=34) and the bottom 25 percent of those taking the English version. The results which are given in Table 5 show that there was no significant difference between the scores of the top 25 percent of the pupils. In the case of the bottom 25 percent, although the students did not obtain a pass mark in either version, there was a highly significant difference in the average score in favour of those sitting for the Maltese version. It seems therefore that the performance of the more able in science is independent of the language of the test, but the less able students obtain far better results if they take the test in Maltese, although their performance is still very weak. These conclusions corroborate the hypothesis arising from the discussion of the differences between the standard deviations of the scores of the two tests already mentioned above. Furthermore these conclusions suggest that there is a cut-off point in the effect of language on achievement. Pupils who can cope with the language demand of the questions show their true knowledge of science, others who do not have this minimum grasp of the language perform below their ability.

Table 5: Differences between the average scores of the top 25% and the bottom 25% of the students taking the Maltese and English versions of the science test.

		Version		
		Maltese (N=38)	English (N=34)	
Top	Average	72.52	71.94	t=0.332
25%	S.D.	7.36	7.34	n.s.
Bottom	Average	34.00	26.24	t=7.516
25%	S.D.	5.24	4.42	p<.001

Notes: i. S.D. = standard deviation
ii. n.s. = not significant

Since it was known that generally at Form 1 level girls perform better than boys in English, a check was also carried out on whether the effect of language was the same for both sexes. The results confirmed that both boys and girls achieved significantly better results in the Maltese version of the test (see Table 6). Besides, the gain by those sitting for the Maltese version was practically the same for both sexes which means that the effect of language on test performance is independent of gender.

Table 6: Difference between the average scores of boys and girls taking the Maltese and English version of the science test.

		Version		
		Maltese	English	
BOYS	Number	80	74	
	Average	55.58	50.16	t=2.104
	S.D.	14.96	16.80	p<.05
GIRLS	Number	70	60	
	Average	50.94	45.25	t=1.960
	S.D.	13.90	18.88	p<.05

Thus the teachers' general prediction that the students' performance will be better in a Maltese science examination for Form 1 has been corroborated. On the other hand the prediction of most science teachers that girls will gain more than boys and that the overall gain in score will be independent of ability have been rejected by this study. But it should be noted that 30 percent of the teachers correctly predicted that the performance of the more able pupils will not be different if they sat for the test in Maltese rather than English.

Further Work

This article is a brief account of one type of study that can be done first of all to describe what is happening in the schools regarding the language of instruction and secondly to assess its effect on learning and performance in examinations. Other studies covering different subjects and students of different ages and abilities are needed to describe the situation in the various types of schools in Malta and to identify any language difficulties that are encountered in teaching various subjects of the curriculum. Action research by teachers themselves is clearly indicated for empirical studies of the type described above since the locus of control on the language of instruction definitely lies with the teacher. Firstly, however, other research methods are necessary to shed light on whether there should be an official language policy rather than let the individual schools and teachers to

decide which language is most suited for their students as happens at present. Secondly, it is important to attempt to deduce the likely effects of a policy which establishes either Maltese or English as the language of instruction of all or some of the subjects of the curriculum. Thirdly, effective mechanisms need to be found to implement the policy, monitor its outcomes and to take any additional action to achieve the desired results.

Notes and References

1. The Draft Law on the Maltese language has generated a number of contributions to local newspapers on the language question which refer to the role of Maltese in the school curriculum. It has also been reported that among its comments on the Draft Law, the European Bureau for Lesser Used Languages suggested that future-related subjects such as technology, science and environmental studies should be taught in Maltese. All these contributions however are not always clear about which level of education they refer to. An earlier (1968)

suggestion, which has been resuscitated recently and clearly given renewed support, is that "especially at the primary and secondary school level the teaching and learning of basic subjects would be improved immensely if teaching were carried in Maltese rather than English" (Boissevan, J et al. (1990) "Why do Maltese ask so few questions?", *Education*, 3(4), 16-23.

2. Burner, J. (1966) *Toward a Theory of Instruction*, Cambridge, Mass.: The Belknap Press. In chapter 1 Burner makes the point that the nature of language and the functions it serves must be part of any theory of instruction.

3. Ventura, F. (1985) *An evaluation of the science curriculum in the first two years of the Area Secondary School in Malta*. Unpublished M. Phil. thesis, University of Reading, UK.

4. Burner, J. (1986) *Actual minds, possible worlds*, Cambridge, Mass.: Harvard University Press, p. 132

5. The format was identical to that of the national science examination at the end of Form 1.

6. Cassels, J.R.T. and Johnstone, A.H. (1978) "What's in a word?", *New Scientist*, May 18, 1978.

7. In 1984 there were 10 boys' and 18 girls' Area Secondary Schools catering for Form 1 and Form 2 students.