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MALTA

Participation in the activities
of Member States in science and
technology education

The teaching of biology

by Clive G. Carre

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THE TEACHING OF BIOLOGY

by Clive G. Carre

Report prepared for the Government of Malta by the United Nations Educational, Scientific and Cultural Organization (Unesco)

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INTRODUCTION

1. At the request of the Government of Malta, the Director-General of Unesco arranged, under the Organization's Regular and Participation Programmes for 1979-1980, for a consultant to visit Malta from 9 April 1960 to 5 May 1980 with the following terms of reference:

(a) to study and report on existing school curricula and methods of teaching with a view to raising standards and introducing innovations with special reference to G.C.E. (Ordinary and Advanced Levels);

(b) to examine the biology content in integrated science programmes and pre-nursing programmes and to advise on equipment for teacher-training courses.

2. During his visit the overwhelming message which the consultant gleaned from teachers was that they were poorly paid and were working strictly in accordance with regulations laid down for them. Many teachers were disillusioned and found their classes disinterested and pupils difficult to control. Retaliation to this state of affairs was to adopt a style of teaching which demanded an absolute minimum amount of time in preparation, almost no practical work, a very high percentage of teacher talk and pupils copying from blackboard or book. It is no small wonder that the pupils are bored and find "no point" in attending classes.

3. Reference has been made to the private school, as a contrast, where a traditional pattern of teacher and pupil commitment to work still exists. The relatively few teachers met in such schools were highly motivated and treated teaching as more than an ordinary job of work. Many professional people, send their children to such schools and pupil numbers are of significance (see paragraph 16).

4. In making recommendations for future action in science education the consultant has in mind the great and urgent need to make the science teachers of Malta feel that they are part of decision-making procedures in curriculum development. He has suggested ways by which science teachers can become involved and responsible for what and how they teach, and with guidance through the Science Education Officer, Mr. Xerri, consider their own professional development, simultaneously to that of selecting appropriate content.

5. It is hoped that such a procedure, the practical details of which have already been discussed in some detail with Mr. Xerri and for which guidelines have been included in this report, will have the effect of raising morale and self-esteem, and at the same time improve classroom interaction and pupil learning.

6. A summary of recommendations appears on page 19. The consultant wishes to record that his discussions with the Director and with Mr. Xerri, Education Officer in Science, have always been conducted in a frank and friendly manner, and he has received the utmost co-operation from them during his stay in Malta.

GENERAL OUTLINE OF EDUCATION IN MALTA

7. Schooling in Malta is compulsory for all children between 6 and 16 years; the years 5 to 11 are spent in primary schools. Education is free for Maltese children in government schools (i.e. tuition, textbooks, writing materials, transport).

8. Although primary schools are mixed, secondary schools are of single sex, a number of primary schools acting as feeder schools for each secondary school.

9. The secondary-school course is of 5 years, divided into two cycles. The first two years aim to provide a wide-based general education, the common core consisting of:

English	Religion	Art
Maltese	Physical Education	Music
Arabic	History	Craft(boys)
Mathematics	Geography	Needlework and
Integrated Science	Social Studies	Home Economics(girls)

and one foreign language from French, German and Italian. It should be noted that the heavy bias towards languages results in subjects such as art and music having as half a period per week allocated to them.

10. At the end of Form II pupils are helped (by guidance service) to opt for a form of technical education and go to trade schools, or remain in the secondary school.

11. Trade schools, with a heavy vocational bias, currently account for 15 per cent of the Form II population; the demand is heavy and necessitates selection. Trade schools provide courses for boys and girls not wishing to continue their secondary education studies. Trades offered include bench fitting, sheet metal work, welding, wood trades, building trades (for boys) and a variety of handicraft trades for girls. Courses last from 2 to 3 years, and include some academic subjects taken in secondary schools alternating with their trade work. These students too may enter an apprentice-student scheme or work alternately 6 months in trade school, 6 months' apprenticeship (as pupil workers) after their third or fourth year.

12. Those pupils remaining in secondary school opt for one of two broad streams, known as Group I and Group II. The Group I curriculum is intended for motivated pupils and those intending to take G.C.E. at O level, leading to A level work. This academic stream currently consists of approximately 50 per cent of the Form III population.

13. Subjects for Group I

Compulsory Subjects	III	IV	V
Maltese	4	4	2
English	5	5	5
Arabic	4	4	4
Maths	5	5	5
Physics	4	4	4
Religious Education	2	2	2
Physical Education	1	1	1
Civics	1	1	1
	26	26	26

In addition, each student selects two other subjects, e.g. another language, biology or chemistry for a further 4 periods each week. It should be noted that the nursing option is now no longer available for pupils.

14. The Group II curriculum is intended for those students who are less able and/or less motivated. Their course work is less academic and is not intended to lead to an O level. They have the following compulsory subjects:

Maltese	Maths	Physical Education
English	Integrated Science	Social Studies
Arabic	Religion	Craft or Needlework/Home Economics

There are school-based half-yearly and nationally based annual examinations both written in English.

Advanced level studies

15. Students with the following qualifications may enter the Lyceum, the Upper Secondary School, to study for A level. Six G.C.E. O level passes are required for entry, to include: English Language: Maltese: Mathematics (and from 1982) Physics and Arabic. The students will be accepted only as "pupil workers". Under this scheme their three-year period of study is divided into three and a half months of study and five and a half months of work annually. They are provided with employment (e.g. hotel work) with a stipulated salary.

Private schools

16. These schools, generally associated with religious orders, provide a significant service in facilities and offer a general curriculum of at least comparable standard to government schools. At secondary level for example (Forms I-V) there are 38 government schools and 21 private schools having 14,113 and 6,988 pupils respectively. At VIth form level the government schools have 771 pupils and the private schools have 580 (figures taken at December 1979).

The University system

17. The University of Malta has as its Chancellor the President of the Republic and is administered by its own Council, Senate and Faculty Boards. The executive head is the Rector, Dr. Welwyn James.

18. 1980 saw the creation of a new University of Malta, the Old University ceasing to perform its duties and functions. Some personnel have been moved to the New University, others remain at the Old University to continue running existing courses in Arts and Science, which are being phased out. Some staff have resigned, others have found employment in other countries.

19. The University currently grants the following degrees:

Doctor of Laws, Doctor of Medicine, Bachelor of Mechanical Engineering, Electrical Engineering, Engineering and Architecture, Dental Surgery, Pharmacy, Bachelor of Arts in Accountancy, Administration, Business Management and Education.

20. The University is to run on worker-student lines whereby worker-students nominated by employers, according to their needs, and having the necessary entry requirements, are selected by a Students' Selection Board to pursue such studies on a six-month work - six-month study basis. (All University courses

are run on a six-month semester basis.) A salary is provided, not less than that stipulated by the Minister of Education. While the employer is required to give to worker-students a salary, the worker-students may be asked to bind themselves by contract to work for their employer for a number of years after graduating.

21. The law also provides entry into the University by non-worker students if there is space for them and in these cases a tuition fee is demanded.

Administration

22. The Minister of Education, Dr. Philip Muscat, is an elected Member of Parliament and a member of the Cabinet of Government. He is in charge of the Education Department, at the head of which is Dr. Francis Chetcuti, assisted by assistant directors of education (one specifically for secondary education, Mr. L. Farrugia). There are a number of education officers in charge of curriculum subjects, two for science, Mr. Charles Xerri and Mr. Vincent Ciancia, and others for child guidance and for education statistics and records (Mr. Joe Zammit Mangion). At present there is no science education officer with professional qualifications in Biology.

23. There is a clear statement of objectives from the Director of Education (Circular No. 26/77) which lists in a comprehensive way many of the ideals which other countries are striving for. It is concerned, amongst other things, to encourage writing, reading and oral skills, introduce affective dimensions into teaching and to integrate aspects of community science across the curriculum. It is unfortunate that these concerns, currently endorsed by many educational programmes in other countries are as yet only given lip-service in Maltese science lessons.

COMMENTS ON THE GENERAL OUTLINE OF EDUCATION IN MALTA

24. Even a casual glance at the curriculum indicates that it is not a balanced one, with a strong language commitment for all pupils. With approximately 26 periods per week accounted for in Group I curriculum there is very little time left for general cultural subjects. It is hardly fair or desirable that the latter should on occasion be squeezed into the midday break period.

25. Attention must be directed to the inclusion of compulsory Arabic for all students and compulsory Arabic and Physics for all Group I pupils. Whatever the objectives for the inclusion of these subjects, reality reflects the extreme difficulty that this policy is having on pupils' performances in school. Half-year examination results in some schools (1979-1980) illustrate all too vividly that even bright pupils are finding it extremely difficult to cope with the load, in particular, science pupils finding Arabic a problem and arts pupils finding Physics a problem (e.g. it is not uncommon to find that in non-science option classes in year III all pupils have failed Physics).

26. Part of the problem in the understanding of Physics is that it is taught as a mass of facts to be memorised, and this point is emphasised in the examination. The subject would be more palatable if a move was made towards more applied aspects of Physics, more class practical participation by the pupils and a greater emphasis on the processes of science being taught.

27. If a single compulsory science subject (i.e. not integrated science) is thought to be desirable in providing pupils with "science for life", arguments could be made to see a place for biology, including both human and social aspects, to be more suitable and more motivational for non-science candidates.

28. It could be seen that the insistence of compulsory Physics might have an adverse effect on the future recruitment of females for the teaching profession. Currently there are only about 25 female teachers of science from a total of approximately 130, and this ratio could get worse.

29. The 1978-1980 Education (Amendment) Bills creating the worker-pupil and worker-student scheme carried with it a series of reforms which has totally altered the pattern of post-secondary and higher education in Malta. The government's policy is clearly stated as one where judicious planning would enable the University to maintain a balance between professional personnel needed by the community and the graduates coming out of the University. The arguments put forward for such utilitarian reforms include the notion that a student through his work-phase could contribute to society by using his academic qualifications and this would bring the professional classes closer to the working community. He would also be financially independent.

30. It is now advantageous to be a worker, putting oneself in a position to be nominated for a University place by one's employer, for preference is given to worker-students. However, it must be stated that a system of linking human resources to the needs of industry and commerce not only restricts a student's personal freedom of choice (in subject and duration of study) but relies on the ability of businessmen and industrialists to make sensible and educationally sound judgements. One can only hope that the government's trust in the ability of employers and in their continued interest, will in the last resort benefit the community and be fair to individual students.

31. These concerns are heightened when one realises that employers sit on the New University Council and on Faculty Boards, and influence University policy. However it is noted that the government retains a major share in University control.

32. The system poses serious problems for teacher training. The B.A. (Educ.) degree course now extends to five years on worker-student lines. The number of students seeking training as teachers (56 in 1978, 43 in 1979) is dropping, due predominantly to the raising of entry qualifications into the University.

33. The Education Department is itself an employer and sponsors those worker-students having specialist subjects needed in schools. Although one appreciates the problems of a small island community to absorb its output of graduate teachers, the system can dictate against an individual's personal wish.

34. However, it can be seen that of all the student-worker schemes the one associated with the Department of Educational Studies can be seen as professionally justified, beneficial to the Ministry and to the student teacher. The teacher-training programme can be enhanced with more teaching practice and more general educational awareness without shortening of academic University-based studies. If first-year students are given clerical administrative work with the Ministry of Education, this could be of benefit in making them aware of that aspect of education which teachers all too often take for granted.

35. As an employer, the Department of Education employs pupil-workers during their work phase, whilst at Upper Secondary School, and student workers whilst at University, in office/clerical work in the Department of Education or teaching work in school. However, pupil-workers quite often find themselves in hotel work, in shops or in factories. It seems that a golden opportunity has here been missed.

36. One of the most effective teaching strategies reported by Dr. Rex Meyer in a recent (1980) world survey or methodologies for teaching and learning about community biology is that of experiential learning. In this report he emphasizes the value of job-related experiences and direct work experience. In a biology (or science) programme where objectives are associated with relevance and the development of skills of the community, work experience ought to be exploited to the full. The situations available are endless, but could in Biology education, for example, include work in agriculture, pharmacy, veterinary practice, health departments, horticulture, food preservation and hospitals. In this way, work in a biology-related industry would provide real life employment experiences and give access to applied biological principles in a way that classroom activity could seldom provide. The employer must obviously see himself in the light of an educator and not an employer of cheap labour to make the work phase particularly relevant to the studies of pupil-workers.

SCIENCE AND BIOLOGY EDUCATION IN SECONDARY SCHOOLS

37. The education system is a centralized one and syllabi (both in content and suggested approach) are set by the Department of Education. Schools are invited to modify their syllabus in the light of their particular needs, but modifications, when they do occur, point to the negative effects of neglect rather than innovation.

38. Part of the core curriculum for Forms I and II is integrated science and currently pupils follow the Scottish Integrated Science Courses. In the near future it is intended to replace this course with a locally originated course presented as a series of modules.

39. As already indicated, pupils entering Group I take Physics as a compulsory subject and select two other subjects from a list which includes Biology. Currently about 150 pupils in each of Forms III, IV and V are studying for their O levels in Biology.

40. The number of pupils opting for Biology (and Chemistry too) is relatively small and to economize on staff and resources in these subjects, schools have been selected to become "science centres". There are seven such schools where there would be at least one Biology teacher specialist (i.e. qualified in having at least an A level at G.C.E.). The schools so selected are:

Corridino	(boys)	Naxxar	(boys)
Hamrun	(boys)	Gozo	(boys)
Hamrun	(girls)	Gozo	(girls)
Mriehel	(girls)		

41. The less able and low-motivated pupils entering Group II follow an Integrated Science Course. It is intended to present the course as a series of modules, each lasting between 15-20 hours. Pupils will cover three compulsory modules:

A. Introduction to Physical Science

B. Introduction to Life Science

C. Energy and Machines

and in addition, two other optional modules. These modules are at the moment in first draft form and will be modified in the light of feedback from teachers in trial schools.

42. A revised Biology syllabus for O level candidates has been prepared for Forms III, IV and V. The scheme of work suggests by implication, rather than explicit statement, the order in which topics might be taught and no clear guidance is given as to how topics interrelate, how they might be presented, appropriate time allocation or emphasis.

43. The textbook currently in use is Mackean's "Introduction to Biology" and also available are class sets of the accompanying text "Experimental Work in Biology".

44. Biology laboratories are generally well equipped and generally adequate storage facilities exist. Keeping of living organisms is not the norm, either in the laboratories or outside. Some fish tanks are kept and in only one instance, at Hamrun Girls' School, was an enthusiastic Biology teacher keeping a well cared for garden plot and greenhouse; he was also on the point of constructing a school pond. In this instance the pupils were actually involved with the work of keeping and using living organisms through a well organized Science Club. With the exception of Victoria Girls' School, all laboratories observed had fixed benches which were of the traditional type in rows.

45. The almost exclusive use of a didactic authoritarian approach to teaching Biology has meant that teachers see their role as informers, explainers and tellers of examination "knowledge". In some instances the "lesson notes" of a teacher have been Mackean's text, which is followed page by page with teacher explaining or pupils reading around the class. The idea of involving pupils in their work, and organizing materials with which they can become actively engaged is a foreign idea to the majority of Biology teachers. Small group work is not practised and in whole class teaching, invitation to talk is minimal.

46. Practical work, I am told, is done on occasion but I have not seen any evidence of this during my stay. There are very few technicians, and this is seen as a major excuse for not attempting practical work (e.g. at Corridino Boys' Secondary there is only one technician for 8 laboratories and he is also used by the Schools' Administration).

47. A Field Studies Centre, with a resident warden, (Mr. Joe Sultana) and an assistant (Miss Angie Cameron) exists at Villa Psaigon. Twenty-nine pupils can use this centre and it is also used for in-service teacher training. The work at this centre can only be described as excellent, due to the enthusiasm of Mr. Joe Sultana. His worksheets and local keys are well prepared and he decorates the walls with pupils' work. He has created an environment which is not only aesthetically pleasing and informative but provides an atmosphere in which work is expected to take place.

48. Groups of pupils spend two and a half days at a time at the centre, and although Biology pupils are given priority, a number of Integrated Science pupils are also given the chance to attend.

49. Sixth form field work studies which I observed at a valley near Mosta, organized by the staff from the Lyceum (Upper Secondary School) was extremely well conducted. The students were working in small groups under the leadership of members of staff and their individual projects would have made a comprehensive survey of the area. Their methodology was sound and the staff's enthusiasm infectious.

50. One particular aspect of VIth form Biology teaching which could be improved is the selection of suitable project work for individuals to "research" during the year. Teachers need guidance in what constitutes a "reasonable project" and what help needs to be given to pupils.

51. Teachers are advised that the language of classroom instruction be English, but in practice this does not happen. It is usual for a mixture of English and Maltese to be used during lessons, especially when explanation or expansion of an idea to a pupil is required. In some rural areas (e.g. Gozo) the pupils find it extremely difficult to converse in English. In some classes English could now be regarded as a foreign and not a second language. This inability to use English has serious consequences in science teaching, where the textbooks and all homework and examinations are in English.

52. Qualifications of Science Staff in Secondary Schools

M.Sc.	1		
B.Sc.	11		
B. Pharm.	7		
3 A levels	7	) -	A levels would be in a science subject and
2 A levels	18	)	these teachers would have taken a special science
1 A level	43	)	subject at Teacher Training College
No A level	50	-	possibly some science at Teacher Training College; all have at least one O level in a science

At VIth form level all science staff are qualified at least to first degree level.

RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE DEVELOPMENT

53. It is not profitable to make recommendations only in terms of Biology, when so much of the education system of Malta at teaching staff and curriculum level is so intertwined with common issues concerning Biology, Physics and Chemistry and Integrated Science. Also, the total number of Biology teacher specialists is very low - only seven.

A. Provision for in-service experiences

54. There is a need, expressed by many teachers, to acquire more understanding of biological and scientific concepts. This is quite understandable when one sees the limited nature of their qualifications. It is my experience working with teacher groups that if they are not confident with their subject content they do not feel free to use their creative potential to develop captivating pupil activity.

55. Therefore I suggest an updating programme in science content, through an Open University science foundation course, S100 (alternatively S101). The necessary tutors for fortnightly tutorials and marking for such a course might come from the science staff at the University of Malta or graduate teachers from the Lyceum, and they may be willing to conduct a two-week practical at the end of the course. Teachers would study at home and not have to miss school. The School Broadcasting TV Unit could broadcast the course programmes between 17.00 and 18.00 hours.

56. I see it as most important that this in-service programme be conducted in a non-lecture fashion, so that teachers can experience the acquisition of knowledge through a well-structured course based on active participation of the student. It is hoped that this experience might then be transferred to the classroom where similar skills and techniques could be employed. The course could be taken by any of the 130 science teachers in Malta and Gozo, and there would be no necessity for the course to lead to examination. Because of initial cost it is envisaged that a group of 20-25 teachers might participate in the first year.

57. Although there are many advantages to a centralized system of education one glaring disadvantage is that teachers do not necessarily see themselves in the role of innovator, seeing the creative input for curriculum change in the hands of the Department of Education.

58. I would give top priority to a system of school-based in-service curriculum development in science; the task would be to adapt the present integrated science curriculum with pupil activity in mind (not confined to practical work but including material to develop thinking skills).

59. This in-service programme could be characterized by the following:

(a) A central core of approximately 20 teachers (10 teachers of Group I pupils and 10 teachers of Group II pupils) who would meet each Wednesday afternoon during term time at one or more centres.

(b) The organization of this group would be under the direction of an education officer in science. His role would be two-fold: initially to come to agreement on concepts to be covered and also to arrange for a definite plan on methodology to be adopted which would allow for flexibility and variety of format and cater for different teaching conditions (see outline in Appendix I).

(c) The task of this teacher group would be to plan suitable pupil activities with certain content and objectives in mind, i.e. the teachers would form, under guidance, the planning and development of their own curriculum.

(d) In addition to this group, the education officer would circulate to a much wider circle of teachers some form of newsletter, the function of which would be to inform on progress, invite contribution of ideas, request help to try out newly developed material and provide feedback.

(e) The system provides for maximum interaction amongst teachers and between them and the Department of Education. The help of teacher educators can be enlisted at any stage. It is also a resilient and dynamic system for it can be easily reorganized to meet changing needs and staff. Potentially every science teacher can be involved and a central core remains to maintain its development and reappraisal.

(f) It would be highly desirable to have the use of a resource centre for duplicating and photocopying work. A portable bench/trolley with gas and small sink would be adequate for demonstrations and trying out experimental ideas. Two types of reference material should be: one concerning details of tasks and time schedules for different groups, the other a bank of relevant textbooks and recent curriculum developments. It would be most helpful if one or more biological/science publications could be subscribed to, so that recent findings and latest developments could be assessed and also Maltese teachers make contributions (e.g. Journal of Biological Education or ASE Journal). A necessary preliminary to creating new ideas in a short time is to know what others have already done! Also a changing display of children's work would indicate the potential outcomes of new classroom activities.

(g) The help of a graphic artist would assist production and also give an appearance of professionalism to classroom materials produced for dissemination to teachers.

(h) Dissemination of material from the group could be in the form of "Notes for Teacher Guidance" - i.e. advice on classroom strategy, on forms of assessment or ideas on sequencing of material or "pupil material" (e.g. worksheets, pictures, casts of fossils, photocopies of newspaper cuttings, facsimile reproductions, etc.). One would guard against overproduction of the dreaded worksheet!

60. The consultant proposes a pattern of work similar to that devised by the science project of the Resources for Learning Development Unit at Avon, England, which aimed at improving learning for 11-14 years old. This teacher co-operative produced materials which were placed in schools on trial, and feedback of effectiveness led to renewal and revision.

61. It would be useful if the School Broadcasting TV Unit had an important role in this curriculum development for it could create films to comply with one major objective from the Department of Education, to "understand the contribution of occupations to society".

62. A parallel programme of professional development of teachers would seem to be necessary and desirable; introducing them to communication skills, ideas about the role of language in science, questioning techniques, assessment procedures, lesson planning with objectives in mind, teacher-pupil interaction, etc. The production of pupil materials alone in a curriculum project is of limited value without the means of making their use a reality in the classroom. Hopefully, one outcome of such a course of professional development would be the change in attitude to teaching and a willingness to consider more pupil-centred strategies.

B. Closer links between pre-service training and in-service work

63. It would seem highly desirable to maintain the closest possible links between University lecturers and personnel in the Department of Education. Co-operation is suggested as follows:

(i) In the placing of student-teachers for teaching practice, even though in practice the considerable problem has to be resolved of weighing the interests of the student with the needs of the department.

(ii) In the adoption of a common agreed form of assessment of teaching practice used by University staff and education officers. In designing a suitable form I feel it desirable to provide adequate categories which are seen to be "assisting professional development" alongside those, perhaps more mundane categories, associated with "assessment". Whatever form is eventually produced, it would seem highly desirable for student teachers to be shown the comments that all their visiting tutors have made and the rationale for such comments. If advice is given or comment made based on some theoretical premise, it is that much easier to accept than when a grade/comment is given purely on a subjective basis.

(iii) In using the science methodology lecturer (Mr. Frank Ventura) at the University to assist with the in-service programme of professional development of teachers. Both University and school based in-service programmes are likely to make use of S.T.E.P. (the Science Teacher Education Project) and the recent (1980) publications from T.E.P. (Teacher Education Project).

(iv) A teacher-tutor scheme could exist and is suggested to provide a structured way of giving professional advice to student-teachers rather than in any way assessing them. Immediate feedback of progress ensures that the student can progress in a very effective way. Lecturers' visits are of necessity infrequent and relatively long periods exist between each one. Teacher-tutors can be guided to make and emphasize positive aspects of each lesson viewed. It would be necessary at the beginning of each term for teacher-tutors to meet University lecturers and education officers to review method work covered and to consider their role. Subsequent meetings would be for exchange of views and discussions on performance of particular students.

C. Day projects and science fairs

64. It is suggested that one-day "science events", asking teams of pupils from different schools to compete in some science project might motivate and capture interest. Children could be asked for example to "Design a machine which has to carry one litre of water over a given distance in the quickest time" and have a month to design and make the machine. This aspect of applied science involves skills not often practised in the classroom. Details of the organization of such events, together with examples of competitive project work, have been left with the science education officer, Mr. Charles Xerri.

65. Science fairs are common throughout the world and do generate considerable enthusiasm and moreover involve parents and the community. Special care needs to be given to defining what type of "project" for the fair is acceptable, for from experience they fall into two categories. Of most value is the project which has asked a question, and the pupils' research is geared to answering that question. Other projects come under the category of "exhibits" where a display can be commended for the hours of patience and skill involved in presenting material, but is not science. Clear-cut rules must be circulated beforehand to indicate precisely what is acceptable (and what is not!) so that acute disappointment is avoided.

D. Field study centres

66. Villa Psaigon is such an obvious success, and is in demand, that I would strongly recommend creating a second residential centre at Fort St. Lucien, Marsaxlokk for marine biology work. The marine environment demands different techniques for its study and amongst other activities would be most appropriate for developing individual project work for VIth form studies. Certain facilities do already exist at this centre and a minimum of expenditure would be required to add school ecology to its existing function as a research laboratory. Dr. Jaccarini might be willing to assist with the development of this side of things as well as supervising research projects. It is almost unnecessary to mention the value of field study centres in achieving aims in the affective domain, associated with co-operation, conservation, respect for life and the social aspects of science which are so difficult to attain in the classroom.

E. The role of education officers

67. It is suggested that the role of the education officer be extended beyond that which is already clearly defined in terms of administrative responsibilities checking, evaluating and assessing. It is quite possible that because of these duties the education officer is viewed by teachers with suspicion, and it is to the credit of an individual's personality that he can also achieve, by persuasion, changes in teacher behaviour. It would seem desirable that the latter role, as curriculum developer, could be seen at least as important as the "policeman" image and it does entail working alongside teachers and relying on their good will. It is so much more profitable to persuade and encourage rather than direct.

68. The suggestions on in-service programmes made in this report demand a commitment and a heavy one at that; this includes organizing and collating activities with teachers, working with them as a member of a curriculum development team, assisting a graphic artist and responding to feedback from trial material. I am also suggesting (see below) that they guide heads of sections to use structured observation schedules so that student teachers and young members of staff are being assisted in an objective way and not by anecdotal experiences. Should these ideas come to fruition, it will be necessary to gain some form of extra assistance so that the education officers between them can share the various tasks.

69. It might be possible to get from Voluntary Service Overseas one or two graduates, with some teacher training and teaching experience who would be willing to come for a two-year period to assist the education officers: (a) in organizing and carrying out curriculum development; (b) having a part-time teaching commitment in school; (c) assisting the development and running of the proposed field study centre at Fort St. Lucien.

70. Alternatively a third education officer might be appointed.

F. The role of heads of section

71. The head of a department in science has a timetable reduced to only 14 teaching periods per week and has Friday afternoon to attend a meeting each week with the education officer. It could be seen that besides their administrative responsibilities, they could take a vital role in pre-service and in-service work. They could act as teacher-tutors, their experience enabling them to make helpful suggestions and aid the professional development of the young student-teacher. Help in structured guidance, as used for example in the Teacher Education Project on mixed ability teaching, may be of considerable value in training the teacher-tutor to make objective statements about lessons.

72. The common practice amongst heads of section, to offer the most difficult classes to young student-teachers whilst they keep the more manageable ones for themselves, can only be deplored and criticized most severely.

73. They could also provide a valuable link in the chain of in-service curriculum development, assisting teaching to develop units of work and co-ordinating, within their school, evaluation of trial materials.

74. As a first move in this direction, it is suggested that a Head of Section follow a class through a whole (or part of) a day and study various children systematically. The results might be both gratifying and horrifying, but in terms of "time on task", i.e. what are children actually doing in class, it would much food for science staff discussion. It might well be thought profitable to organize an exchange, say, for a term, of a head of department from a school in England with a head of section here in Malta.

G. Examinations

75. There does not appear to be a definite statement on the objectives of assessment in science, the purpose seen only in terms of grading. It seems, therefore, pertinent to make some positive recommendations about the function and purpose of examination and the structure and format of examination papers. It is suggested that consideration be given to the following:

(i) The purpose of examinations should be defined for different levels.

(ii) The setting of examination papers should be in the hands of people who have been given some guidance in designing an examination paper. The writers of items for the question bank should for example:

- be given examples of instructional objectives, and terms (or words) used for stating specific learning outcomes.
- be shown examples of test items in science related to Bloom's taxonomy and questions testing processes of science as well as content. (The work of "The Assessment of Performance Units in Science" would help in this respect).
- be given guidelines for improving test items once written. (The appropriate section in the Science Teacher Education Project would help there).

It would seem appropriate that creating test items to a question bank for national (i.e. not school) examination papers should warrant remuneration, especially if the controller of the question bank was the Science Education Officer who directed item construction according to need (i.e. the balance of type of questions and content covered).

(iii) The end of Year II examination is of such importance that it would seem highly desirable to maintain the paper printed in English. To give pupils practice in sitting for examinations in English it could be argued that previous examinations in Year I should also be in English. However, if one is trying to assess the ability of pupils in Science, then in Year III, IV and V pupils in Group II could well take their science papers printed and answered in Maltese. Many pupils in Group II find reading English difficult and of even greater importance find it difficult to express themselves and their ideas in a language other than Maltese. The majority of teachers in practice are using Maltese for instruction in science classes.

For these children English is a foreign, not a second, language and they are being heavily penalised sitting science papers written in other than Maltese.

(iv) The papers for Group II pupils in Forms III, IV and V could be set and marked by individual schools. If this were the case the papers could be graded in difficulty.

76. These suggestions are made bearing in mind the important proviso that Group II pupils are unlikely to transfer to the Group I stream.

H. The biology content of the integrated science scheme

77. The basic premise upon which recommendations about changes in content of the syllabus is made is that if concepts are to be applied in a pupil's private life, things done at school will have to be seen by the learner to link with everyday life. The types of biological concepts (pre-"O"-level age range) which would be regarded as socially important, (i.e. a science for life), where opinion and action may be enlightened because of these concepts, are given below:

Reproduction and sex
Menstrual cycle
Fertilization
Embryo
Growth
Microbes
Pasteurization
Ecosystem
Habitat
Succession
Interdependence
Community
Pollution
Instinct
Social Behaviour

Nutrition
Diet
Water Balance
Fluoridation
Dental decay
Photosynthesis
Blood Groups
Variation
Immunization
Immunity
Inheritance
Environment
Adaptation
Selection
Antibiotics
Genes
Evolution

78. Each concept could be treated in class by making use of out-of-school experiences of the pupils and the teacher guiding the class to see the usefulness, relevance and application links with later life in the community. Here is one example:

CONCEPT	Out of School Experience of Pupils	Links with Life of Community
Microbes	Food "gone off"	Food hygiene and preservation
	Upset stomachs on holidays	Personal hygiene
	Food poisoning in news-paper reports	Health hazards
	Flu epidemics	Immunization of children. Disease.

SUMMARY OF RECOMMENDATIONS

It is suggested that:

I. The pupil-worker scheme might enhance the training of VIth formers if the work phase was seen to be a community work experience associated with their A level studies.

II. Provision be made for in-service experiences for all science teachers through a tutorial system and using Open University Texts S100 (or S101), to update their scientific knowledge and at the same time widen their experiences in methods of learning.

III. The present curriculum in integrated science be adapted by producing materials which involve pupil activity, developing thinking skills and practical work. This development would be school-based and initially involve a corps of 20 teachers.

IV. The School Broadcasting TV Unit could contribute to the curriculum development by producing suitable film on science at work in the community.

V. Associated with the curriculum development, the team of teachers would undergo a simultaneous professional development in modern aspects of methodology.

VI. For these developments in curriculum and teacher behaviour to take place it is thought most necessary that extra assistance is given to the science education officers.

VII. Closer links be made between the University's pre-service training and the Department of Education's in-service work.

VIII. Project work be encouraged and given recognition through science "fairs", to stimulate interest in science.

IX. A marine field study and residential centre be developed at Marsaxlokk and run on similar lines to the centre already in existence at Villa Psaigon.

X. The role of education officers be reconsidered.

XI. The role of heads of sections be reconsidered.

XII. The structure and function of examinations in science be reappraised and the procedure for setting papers be re-examined.

XIII. The biology content in the integrated science curriculum be modified to take into consideration concepts which link school knowledge with "community science".

ACKNOWLEDGEMENTS

The consultant wishes to extend his thanks to Dr. Philip Muscat, Minister of Education who initiated the request to Unesco for this mission, for providing every facility to complete his task in such a friendly and co-operative environment.

Also his thanks to Dr. Francis Chetcuti, Director of Education, for making this mission in Malta such a pleasant one. Not only did he provide an office and secretarial assistance, ensured adequate transport for visiting schools and other institutions, but he personally arranged accommodation.

To the two Science Education Officers, Vincent Ciancio and Charles Xerri, he is particularly indebted for arranging visits and also for the many hours of discussions on Maltese Education. He is grateful too to Mr. Joe Zammit Mangion for his care in explaining some of the intricacies of the educational system to a newcomer.

He would wish to thank Heads of Schools and science teachers in Malta and Gozo for their welcome to their schools and classrooms and for their discussions of educational problems.

Finally he is most grateful for the hospitality received from Mr. and Mrs. Xerri, Mr. and Mrs. Ciancio, Mr. and Mrs. Zammit Mangion and Dr. and Mrs. Chetcuti and Mr. and Mrs. Cox.

APPENDIX I

Programme of the consultant

9. 4.80	Arrival in Malta. Met by Mr. Xerri.
10.4.80	Briefing meeting with Dr. Chetcuti, Director of Education, Mr. Xerri, Education Officer in Science, Mr. L.A. Farrugia, Assistant Director of Secondary Education.
11.4.80	Visit to Lyceum (Upper Secondary School) Drive to Mosta to visit teachers with VIth form students engaged in a one day field study trip.
14.4.80	Visit to Hamrun Girls' Secondary School Headmistress Miss M. Borg Grech. Biologist: Mr. Alfred Micallef, IV and V Year Biology Class observed. (I had an opportunity to take part of the lesson with Form V).
	Visit to British High Commission - discussion with Mr. Roger Sykes.
15.4.80	Visit to Hamrun Boys' Secondary School. Headmaster: Mr. R. Abdilla, Biologist: Mr. Joe Camilleri IIID Biology Class observed.
16.4.80	Visit to Biology Teachers' In-service Day on Marine Ecology at Fort St. Lucien Marine Station, Marsaxlokk Bay.
	Dr. Jaccarini was director of the course.
17.4.80.	Visit to a private secondary school - St. Aloysious College Headmaster: Father Cilia, Biologist: Mr. Thake. Talked with V's form and viewed 1st Year project work.
18.4.80	Visit to Mriehel Girls' School. Headmistress: Miss Agnes Azzopardi, Biologist: Mr. Dennis Borg. Vth Year lesson seen. Heads of Science Department meeting - discussions on mixed ability classes.
19.4.80	Attendance at Opening of 2nd Malta International Book Fair by the Minister of Education. Attendance at Reception given by the Minister of Education at the Mediterranean Conference Centre, Valletta.
20.4.80	Boat trip to the Island of Gozo.
21.4.80	Visit to Department of Education, Gozo. Visit to Victoria Boys' School. Headmaster: Mons. Father Gauci, Biologist: Miss Mizzi Vth Form Biology Class observed. Visit to Zaghra Trade School for Girls. Headmistress: Miss Sultana.

22.4.80	Visit to Victoria Girls' School. Headmistress: Miss Vella, Biologist: Miss Attard taking 2A and Mr. Peter Vella taking 3C. (I had an opportunity to take part of 3C's lesson) Visit to Qala School, Biologist: Mr. Bajada taking II year integrated science class.
23.4.80	Visit to Corradino Boys' Secondary School. Headmaster: George White, Biologist: Mr. B. Farrugia Head of Section: Charles Chetcuti. Saw a lesson with 5C on pollution.
24.4.80	Visit to University of Malta Discussion with Professor C. Farrugia - Department of Education, Associate Professor Falzon, Psychologist, Mr. Frank Ventura, Methodology lecturer, Mr. Victor Axiaq, Biology lecturer.
25.4.80	Work in Department of Education
26.4.80	Visit to Mriehel Girls' School to examine class sets of books Visit to Field Study Centre, Villa Psaigon Warden Mr. Joe Sultana and his assistant Miss A. Cameron
28.4.80	Meeting with the Minister of Education, Dr. P. Muscat, Dr. F. Chetcuti, Director of Education, Mr. Victor Axiaq, University Biologist, Dr. Jaccarini, University Biologist, Mr. Charles Xerri, Science Education Officer. Discussion on my observations to date and future in-service suggestions.
29.4.80	Writing first draft of report.
30.4.80	Meeting with Dr. Chetcuti, the Director of Education, Mr. Farrugia, Assistant Director, Science Education Officers, Mr. Charles Xerri and Mr. Vincent. Discussion and planning for future in-service work.
1.5.80	Public Holiday.
2.5.80	Visit to British High Commission. Preparations for discussions with Mr. Roger Sykes whole day workshop.
3.5.80	Lectured to 30 science teachers and arranged a full day workshop on "Teaching Style". San Blas Centre, Siggiewi.
5.5.80	All day discussions with Science Education Officers. Discussion with Mr. Cox, Director of Drama.
6.5.80	Departure for London.

APPENDIX II

Check list of strategy methods

It is suggested that the strategy to be adopted to cope with the creative development of a variety of materials for pupil participation by teachers is for the science education officer to keep a check list of strategy methods suggested for each topic/concept to be taught or learned. (No single approach is deemed to be "correct" but a profile could be constructed for each topic.

Topic/Concept	Strategy on Method to Stimulate Active Thinking												
	a	b	c	d	e	f	g	h	i	j	k	e	...
Microbes		x		x	x	x			x			x	

Examples for the strategy and methods which could be considered:

STRATEGY	METHOD	STRATEGY	METHOD
Reading	Independent study Reading tasks	Simulation	Role play Educational games
	Analysis of Care Studies	Lab Work/Fld Work	Descriptive
Formed Lecture	Short structured talk Problem setting Demonstration		Experimental Social Aspects Resource production by pupils
	Audio-visual	Small group Work	Talking Tasks Guided discussion
Participating Activity	Question and Answer Session Quiz Lecturette by pupils		Free discussion Problem solving/ planning Pupil demonstration
	React to Media by writing or talking Discussion Analysis of class results Large group Experiment Writing tasks	Experiential Activity Audio Tutorial	Visits Work Experience Remedial "packages"