PRIMARY SCIENCE TEACHING IN MALTA: A STUDY

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Introduction

This study analyses the situation of the teaching of Science, and teachers' confidence and attitudes towards the subject in Maltese Primary schools. A total of 257 Primary school teachers answered a questionnaire dealing with various aspects of the teaching of Science at this level. Twelve interviews with Heads of School and professionals in prominent positions in the education sector in Malta and focus groups with all the Science peripatetic teachers were also carried out to enhance the survey findings with qualitative data.

The Importance of Primary Science

The initial years of school Science provide every young citizen with scientific knowledge, skills and attitudes that are useful to impart basic scientific literacy, and contribute to one's holistic development. Primary Science also sets the foundations for an eventual scientific career by providing a taste of what Science is, while benefiting from – according to teachers' feedback – the children's love for Science at this age.[3]

Research shows that interest in and attitudes towards school Science are formed prior to age 14, i.e. during the Primary and early Secondary school years, when students are still forming attitudes and are full of natural curiosity.[4] Research also suggests that quality Science teaching should start as early as possible. Pine and Aschbacher state that the longer non-scientific ideas are kept the harder it will be to change them, and attitudes seem to "*crystallise*" by the end of the Primary grades (p.308).[5]

The Maltese Education Act (Chapter 327, 1988) stresses that pupils are entitled to "*receive education and instruction without any distinction of age, sex, belief or economic means*" (p.3) and, as exposed also in the National Minimum Curriculum[6], there should be quality education for all. As Science is an important compulsory part of the Primary curriculum, children are entitled to a high quality Science education at this level.

Several factors shape the learning process but teachers are identified as "*key players*". The European Council and the European Commission consider the teaching profession to have "*a strong influence on society and plays a vital role in advancing human potential and shaping future generations*" (para.1). The EU Council (5394/10, 2010) identifies quality of teaching and school leadership as the most important within-school factors influencing pupils' performance.[7]

The Maltese System

Maltese students attend State, Independent or Church schools that offer similar educational experiences. The teaching of Science in Primary schools is the responsibility of the generalist class teacher, who also teaches Mathematics, English, Maltese, Social Studies, Religion, Physical Education (PE) and the Expressive Arts. A minority of Church and Independent schools appoint separate Science teachers. In State schools, the class teacher

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[3] Murphy, C. & Beggs, J. (2005). *Primary Science in the UK: a scoping study.* London: Wellcome Trust

[4] Rocard, M., Csermely, P., Jorde, D., Lenzen, D. & Walberg-Henriksson, H. (2007). *Science Education Now: A Renewed Pedagogy for the Future of Europe*. Brussels. Directorate General for Research, Science, Economy and Society; Organisation for Economic Co-operation and Development (OECD). (2006). *Evolution of Student Interest in Science and Technology Studies Policy Report.* Paris, OECD; Osborne, J. & Dillon, J. (2008). *Science Education in Europe: Critical reflections.* A Report to the Nuffield Foundation

[5] Pine, J. & Aschbacher, P. (2006). Students' learning of Inquiry in 'inquiry' curricula. *Phi Delta Kappan*, 88 (4), 308-313

[6] National Minimum Curriculum (1999). *Creating the Future Together.* Ministry of Education, Malta

[7] Council of the European Union, 5394/10, 2010 Joint Progress Report of the Council and the Commission on the implementation of the Education & Training 2010 work programme, "Key competences for a changing world" (January 2010)

is still mainly responsible for the teaching of Science, while peripatetic teachers assist with Science lessons visiting the class at regular intervals.

Research Methodology

Quantitative and qualitative methods were adopted and Cresswell's "*dominant-less dominant*" (p.250) design was used, giving prevalence to quantitative data (from questionnaires) over qualitative data (from interviews and focus group discussions). [8] A questionnaire – adapted from Murphy and Beggs' survey carried out in the UK[9] – was given to a representative sample of teachers from all three types of school, considering: teachers' training and qualifications in Science; the weekly time dedicated to Science; assessment practices; confidence to teach Science and other subjects; confidence in, and frequency of, fostering given skills and developing children's understanding of Science topics; the frequency of use of certain teaching approaches; and teachers' attitudes towards Science teaching.

With a population of 1329 teachers, a degree of confidence at 95% and a 6% margin of error, a sample of 222 was required. A total of 27 schools were involved, with a good response rate of 85%. The actual sample size was actually 257, decreasing the margin of error to 5%. Statistical tools used were: descriptive statistics, the Chi-Square, Friedman and One-way Analysis of Variance (ANOVA) tests and the Pearson correlation.

Focus group discussions with all the (21) peripatetic teachers and 6 semi-structured interviews with Heads of school (two each from State, Church and Independent schools) were conducted to gather qualitative information. Peripatetic teachers were also presented with a short, anonymous questionnaire to gain information which would have otherwise been incorrect to collect within a group setting.

Main Results and Findings

Table 1 reports the number of teachers in Maltese Primary schools, excluding the Science peripatetic teachers.

Table 1: Teachers in Maltese Primary schools in the Year 2008[10]

	State	**Church**	**Independent**	**Total**	**%**
Male	150	16	9	175	13.2
Female	709	265	180	1154	86.8
Total	859	281	189	1329	
% Total	64.6	21.1	14.2	100.0	

Questionnaires were given to a representative sample of teachers, constituting 19% of the total population, and all the peripatetic teachers. The vast majority (72%) of teachers in the sample are in their 20s and 30s, while 64% of the sample underwent the B.Ed.(Hons) course, i.e. the best training available locally for Primary school teachers. The rest have other qualifications, namely: the Post-graduate Certificate in Education (PGCE), the 'old' Teachers' Training College certificate, the Instructors' Pedagogy Course a B.A.(Hons.), a Masters degree, or they are Supply Teachers.

The Peripatetic Teachers: Training and Qualifications

Currently, there are 21 Science and Technology peripatetic teachers (with 20 handing in their responses) in State Primary schools. For the youngest pupils, they will probably be the first individuals with whom they associate Science while developing images and

[8] Cresswell, J.W. (1995). *Research design: Qualitative and quantitative approaches*. Thousand Oaks, CA:Sage
[9] Murphy, C. & Beggs, J. (2005). *Primary Science in the UK: a scoping study.* London: Wellcome Trust
[10] Research and Development, Department of Education, 2008

attitudes about Science and scientists.[11] There are both male and female peripatetic teachers, all relatively young with 16 out of 20 in their 20s and 30s. Figure 1 depicts the type of initial teacher training of the peripatetic teachers.

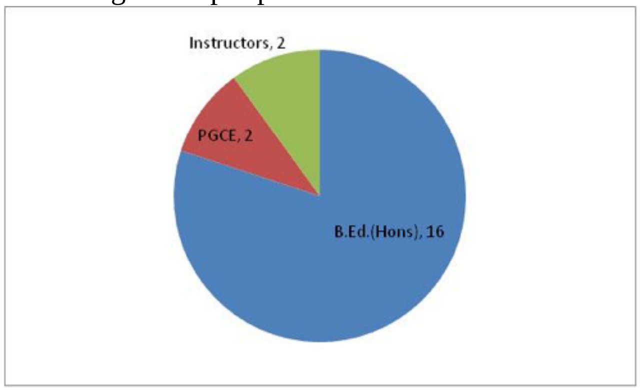

Figure 1: Teacher training of the peripatetic teachers

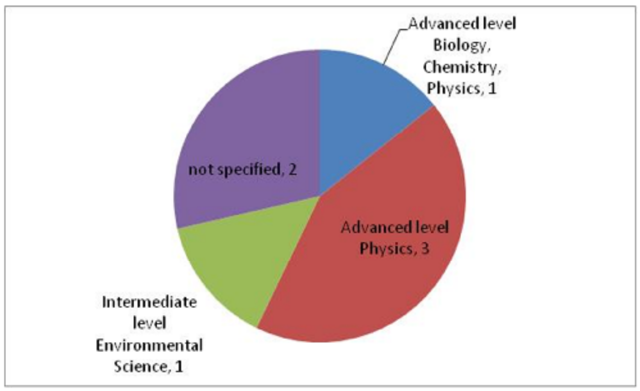

Figure 2a: 18+ qualifications in Science of the peripatetic teachers

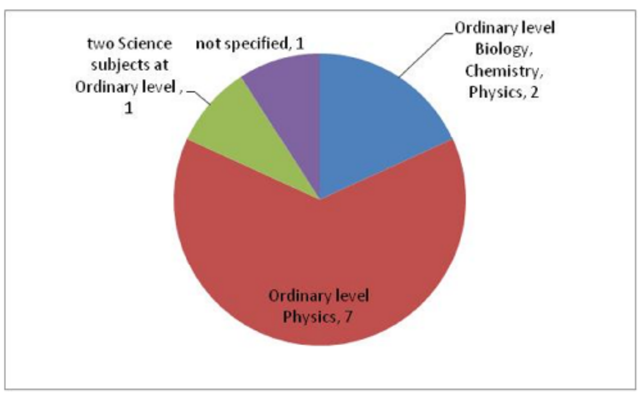

Figure 2b: 16+ qualifications in Science of the peripatetic teachers

Considering those who followed the B.Ed.(Hons) course, four trained as Secondary school teachers specialising in Science, while the others followed the Primary specialisation course with two specifically specialising in Science. Those who trained as Secondary school teachers had more training in terms of content knowledge, while those who followed the Primary specialisation are more aware of the demands of Primary school children and are more experienced with this age group. Two teachers have a Masters degree, but not in Science Education.

[11] Rocard et al. (2007); OECD (2006)

Figures 2a and 2b show respectively the peripatetic teachers' 18+ and 16+ qualifications in Science. The most common qualification is 'O' level Physics, with 7 teachers having it as their highest Science qualification. On the other hand, only 1 teacher has certification in all the 3 Sciences (Physics, Chemistry, Biology) at 'A' level. [12] The peripatetic teachers are not much better qualified than the generalist class teachers, and do not have postgraduate training, as suggested by Jones and Edmunds.[13] Considering experience in teaching Science: 5 teachers have from 9 to 12 years of experience, 8 with 4 to 8 years while the other 7 teachers have less than 3 years of experience as Science peripatetic teachers.
The Education Officer in charge of Primary Science states that they have qualities and skills apt for their role such as initiative, acting skills for presentations held at the Science Centre and the ability to work in a team. These skills are assets but do not compensate for the limitations of a sound grounding in content and pedagogy, which are so needed if they are to be 'catalysts' and promoters of Science teaching in their supportive role in schools.

The Class Teachers: Training and Qualifications
Table 2 shows that most teachers (56%) hold an 'O' level as their highest Science qualification, with 68% of them qualified in Physics, which became a compulsory subject in Secondary schools in 1979.[14] Since the mid 1990s any one of Physics, Chemistry or Biology became compulsory for sixth form entry**.** Those teachers (33%) without any qualification in Science are probably over 40 since before 1979, Science subjects were only offered as an option.
A large proportion of those having 18+ qualifications in Science hold IM level Environmental Science. As per 2008-2010 syllabus, "*the programme seeks to provide basic environmental literacy for candidates ... meant to encourage and provide basic knowledge ... for careers directly related to the environmental field*" (p.2).[15]

Table 2: Teacher pre-university qualifications in Science

Level	Quantity (%)	Highest proportion by subject (%)
'O' level	56%	68% Physics
'A' level	17%	61% IM Environmental Science
None	33%	

In general, Maltese Primary teachers do not have much previous experience of Science. They constitute the generation of Primary teachers who teach Science but lack sufficient Science content knowledge. In line with this, Mulholland and Wallace[16] and Newton and Newton[17] note that few teachers specialise in a particular area during their teacher training. Similarly, Abell and Smith[18] reported that US Primary teachers were not scientifically literate and yet teach Science in elementary schools. Consequently, Primary teachers get stuck when confronted with a classroom situation that requires one's own understanding of

[12] Till the early nineties, he 16+ and 18+ qualifications in Malta were the British 'O' level or GCSE and the 'A' or GCE level exams. Although still available, they have been replaced by the local 16+ Secondary Education Certificate (SEC) and the 18+ Matriculation Certificate (MC) exams. The latter include Advanced Matriculation (AM) and Intermediate Matriculation (IM) level (equivalent to one third of an 'A' level) qualifications.
[13] Jones, M.G. & Edmunds, J. (2006). Models of elementary science instruction: Roles of Science Specialist Teachers. In Appleton K. (Ed.), *Elementary Science Teacher Education*. New Jersey, America: Lawrence Erlbaum
[14] Education Office. (1979), *Letter Circular to Heads of Secondary Schools*, 3rd September
[15] Environmental Science Syllabus 2008-2010 (IM11). Retrieved December 16, 2009, from http://home.um.edu.mt/matsec/syl2008_10/IM%2011.pdf
[16] Mulholland, J. & Wallace, J. (2003). Crossing borders: learning and teaching primary science in pre-service to in-service transition. *International Journal of Science Education,* 25 (7), 879-898
[17] Newton, D.P. & Newton, L.D. (2001). Subject content knowledge and teacher talk in the primary science classroom. European Journal of Teacher Education, 24 (3), 369-379
[18] Abell, S.K. & Smith, D.C. (1994). What is science? Pre-service elementary teachers' conceptions of the nature of science. *International Journal of Science Education,* 16 (4), 475-487

a scientific concept and subsequent simplification to be conveyed to and understood by young children.[19] Murphy et al.[20] showed that even those who studied Science from 11 to 16 years, and even some with post-16 Science qualifications, could not answer correctly some Science questions intended for 11 year old Primary pupils. Insufficient subject knowledge together with lack of experience in Science practical investigation and resources and problems of classroom management – as overcrowding, lack of space and safety measures – contribute to a teacher's lack of confidence.[21]

The Director of the Centre for Environmental Education and Research and Professor in the Department of Mathematics, Science and Technical Education, Faculty of Education at the University of Malta confirms the local teachers' fears regarding Science teaching: *"I think that the majority of Primary school teachers like Science, but are afraid of it ... they know that they don't know Science, but it interests them. ... Teachers fear that: a) children come up with questions which they don't know how to answer, b) their answer is nonsense, c) someone else tells them, "What nonsense have you said?"... apart from the content, they know that there is a particular methodology for teaching Science, which they are afraid of because they didn't receive training in it."*

Qualifications and Confidence

The One-way ANOVA test identified statistical significance for teacher confidence and Science qualifications ($F=7.784$, $df1 = 2$, $df2 = 232$, p-value=0.001) the higher the qualifications in Science, the higher the teacher confidence (Table 3). Teachers holding an 'A' level qualification have a mean score of 3.62 on a scale from 1 to 5, where 1 represents the lowest and 5 the highest level of confidence. Teachers without qualifications in Science have a lower score (mean = 2.89) manifesting less confidence to teach Science.

Table 3: Teachers' confidence to teach Primary Science v. highest Science qualification

Highest Science Qualification	**Mean Score**	**Standard Deviation**	**95% Confidence Interval for Mean**	
			Lower Bound	**Upper Bound**
'O' level	3.23	0.858	3.08	3.37
'A' level	3.62	0.752	3.31	3.92
None	2.89	0.873	2.70	3.09

A Senior Lecturer in Primary Science (Faculty of Education, University of Malta) confirms that student teachers fear Science: "*even students who would probably have obtained a B grade in Environmental Science ... feel uncomfortable teaching it because they feel or label themselves as arts or language people*". This might explain why the mean score of teachers in possession of 18+ qualifications is not higher than 3.62.

Confidence and Interest in Science

A positive relationship was found between teachers' interest in Science and the confidence to teach the subject (Pearson Correlation Coefficient = 0.44, p-value < 0.0005). Interest in Science was inferred from ratings of statements on enthusiasm for Science teaching and interest in watching Science TV programmes. Confidence to teach Primary level Science also depends on one's inherent interest. It can be inferred that Primary teachers need to be motivated to search for information and attend professional development (PD) activities to enhance personal interests and, moreover, their confidence to teach.

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[19] Hernandez, P, Arrington, J. & Witworth, J. (2002). Professional Development for Elementary Science Teachers, In P. A. Rubba, J. A. Rye, W. J. DiBiase, & B. A. Crawford (Eds), *Proceedings of the Annual International Conference of the Association for the Education of Teachers in Science*

[20] Murphy,C. & Beggs, J., Hickey, I., O'Meara, J. & Sweeney, J. (2001). National Curriculum: compulsory school science – is it improving scientific literacy? *Educational Research,* 42(2), pp.189-199

[21] Murphy, C., Beggs, J., Carlisle, K. & Greenwood, J. (2004). Students as 'catalysts' in the classroom: the impact of co-teaching between science student teachers and primary classroom teachers on children's enjoyment and learning of science. *International Journal of Science Education,* 26 (8), 1023-1035

Confidence in Teaching Science with respect to other Subjects

Teachers show high levels of confidence in teaching Maltese, English and Math. Out of all the subjects specified in the NMC, teachers are least confident in teaching Science. Only 34% of teachers rated confidence in Science at 4 or 5, which is very low compared to Maltese, Math and English at 92%, 90% and 84% respectively. Whilst the confidence of local teachers in Math and English is comparable to that of UK teachers – at 95% and 88% respectively – the Maltese teachers' confidence in Science is much lower than that of their UK counterparts (34% v. 80%).[22] Studies in Scotland, carried out in 1995, show that teachers rated their confidence in teaching Science 8th out of 11 subjects.[23]

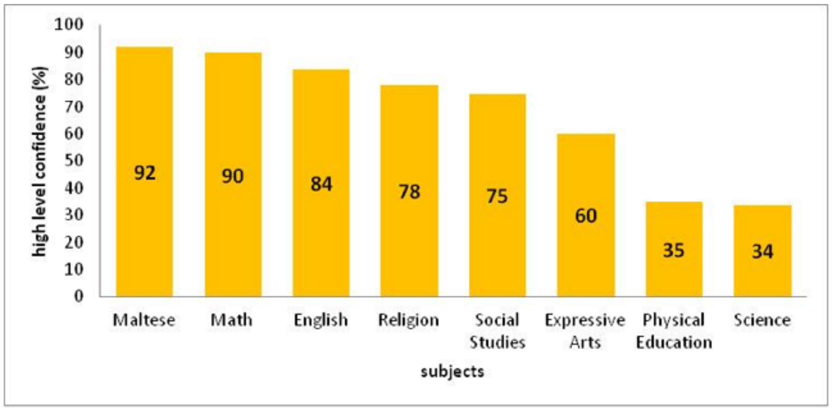

Figure 3: High levels of confidence (4 and 5) in Science teaching v. other subjects

In the UK, 10 years later, teachers rated their confidence to teach Science 3rd out of 6, below English and Math. The Science Students in Primary Schools (SSIPS) project targeted teacher confidence to teach investigative Science, providing PD in terms of in-class and ICT-based support, out-of-class intensive workshops and production of materials by teachers.[24] Effective PD programmes have increased teacher confidence in Primary Science teaching, and in turn influenced teachers' perception of self-efficacy.[25] Teachers who perceive themselves as capable will give better results.

Confidence in Teaching Particular Topics

Following the analysis of teachers' confidence in teaching Primary Science topics, the one-way ANOVA test revealed that the differences in confidence are statistically significant ($F = 54.07$, $df1 = 2$, $df2 = 616$, $p < 0.0005$) (Figure 4). Teachers feel least confident in teaching "Energy" topics, and most confident in topics from "Sharing our world". These topics come from different areas of science: "Energy" topics belong to Physics, "Materials around us" originates from Chemistry, and "Sharing our world" – which teachers feel most confident in – contains Biological topics. "Weather watch" (76%) and "Other animals and us" (73%) portray the highest levels of confidence, while "Forces" (31%) and "Electricity" (30%) denote the lowest levels.

Murphy and Beggs (2005) report similar findings with UK teachers: the highest confidence is for "Flowering plants" (85%) while Maltese data shows a 59% for "Plant life". UK teachers also assign the lowest confidence for the more conceptually challenging topics of "Renewable/non-renewable energy" and "Circuits", at 62% and 64% respectively.

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[22] Murphy and Beggs (2005)

[23] Harlen, W. (1995) *Understanding and teaching science.* SCRE Newsletter No.57. Glasgow: Scottish Council for Research in Education

[24] Murphy, Beggs, Carlisle & Greenwood (2004)

[25] Weiss, I.R., Banilower, E.R., McMahon, K.C. & Smith, P.S. (2001). *Report of the 2000 National Survey of Science and Mathematics Education.* Chapel Hill, N.C.: Horizon research, Inc.

Although the order in teaching confidence is similar, UK teachers score relatively higher than Maltese teachers (64% v. 30%) for “Circuits” and “Electricity”.

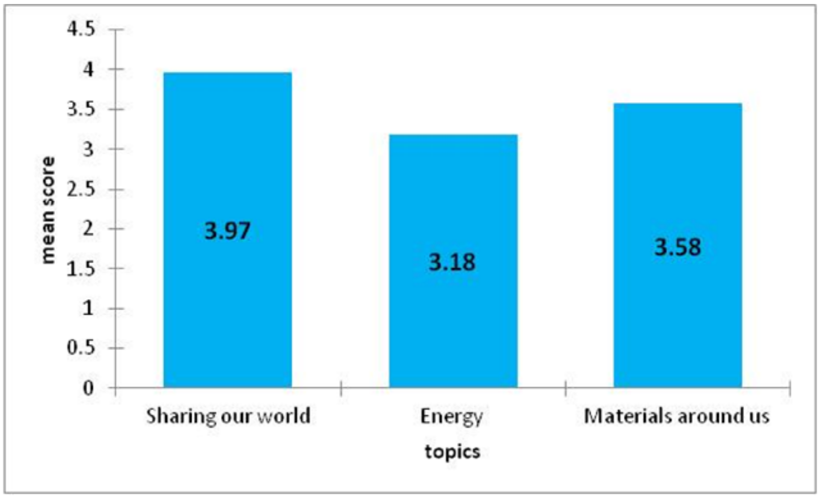

Figure 4: Mean scores of teacher confidence in teaching various Science topics

Despite the fact that most teachers in Malta studied Physics, they feel least confident in teaching topics from this area. Similarly, the UK Office for Standards in Education (OFSTED) reported that teachers’ understanding of particular areas of Science, especially from the Physical Sciences, is not sufficiently well developed.[26]

Frequency of Science lessons

Table 4 reports the weekly time allocation for Science. There is no instance where more than 1.5 hours weekly are dedicated to Science. No statistically significant differences were found for different school types, pupil abilities and number of pupils in class.

Table 4: Time dedicated for Science by class teachers

Hours per week	Frequency	Percentage
< 0.5hr	45	18.1
0.5 - 1hr	145	58.2
1 - 1.5hr	59	23.7

In 2007, the then Education Division (now the Department of Quality and Standards in Education, the DQSE) proposed a schedule of time allocations for Primary school subjects, including Science.[27] Science lessons could be carried out by peripatetic teachers or the class teacher, with a weekly 30 minute lesson for Years 1 and 2 and 2 hours spread over 2 lessons per week for Years 3 to 6. In 2011, a consultation document has been published by the Ministry of Education, Employment and the Family suggesting a weekly slot of 1.5 to 2 hours for Years 3 to 6 in the Primary school.[28]

The chi-square test did not show any statistical significance for the cross tabulation between class taught and hours dedicated to science. Most Year 1 and 2 class teachers satisfy the allocation of 30 minutes to 1 hour weekly as specified by the DQSE (apart from the input of peripatetic teachers, in State schools). On the other hand, for Years 3 to 6 (and

[26] OFSTED, Office For Standards In Education (1995). *Science: A Review of Inspection Findings 1993/1994.* London: HMSO

[27] Letter Circular DCM 28/2007

[28] Ministry of Education, Employment and the Family Towards A Quality Education For All – The National Curriculum Framework 2011

Year 7 being for those who repeat Year 6), where the proposed allocation is 2 hours, teachers dedicate less time in their weekly timetable. Science is given least teaching time in Years 4 and 6 at 26.7% and 28.9% respectively, with less than half an hour per week.

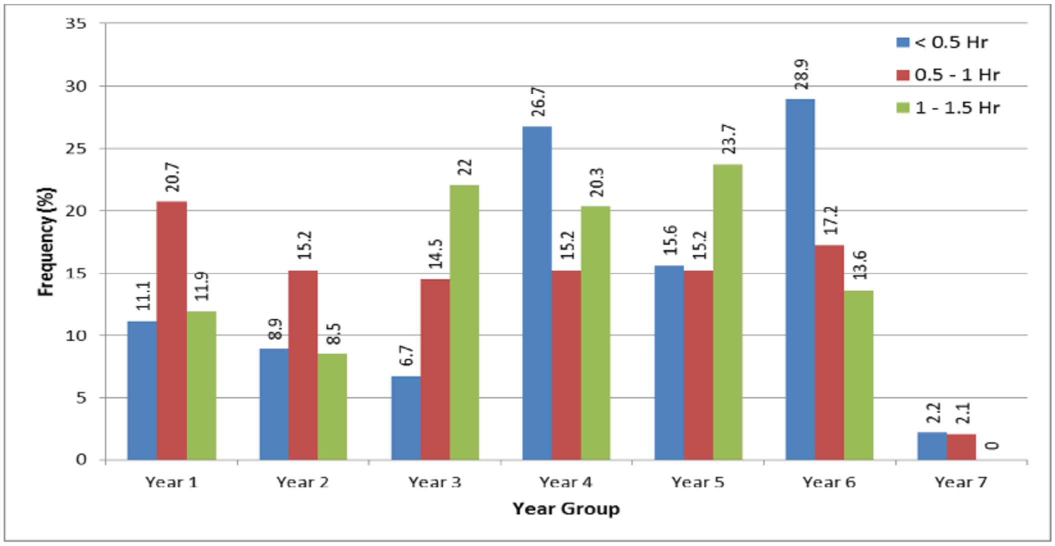

Figure 5: Frequency of Science lessons per year group

This information includes all schools types – State, Church and Independent – confirming the absence of statistically significant differences. It seems that the frequency of Science lessons depends on factors that are common to all schools such as intrinsic characteristics (as confidence, beliefs and attitudes) and extrinsic factors (as the curriculum) common to all teachers, rather than particular characteristics of individual schools, e.g. classroom settings as streaming and class size.

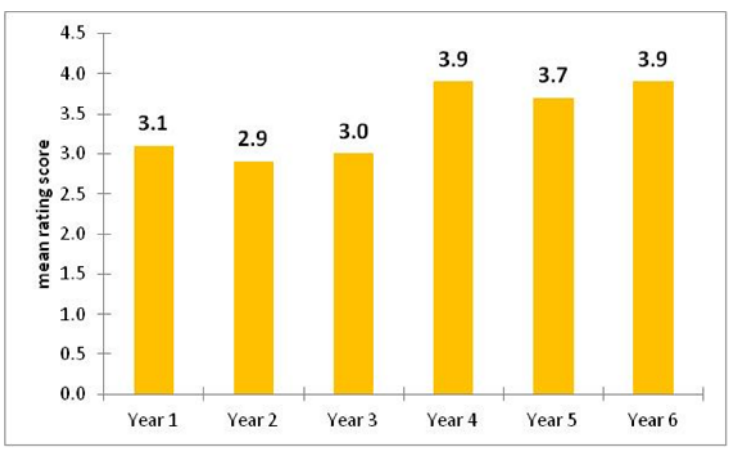

Figure 6: Mean scores for the agreement of teachers of different year groups with the statement 'I don't have enough time for Science'

Year 1, 2 and 3 teachers registered a comparatively low agreement with 'I don't have enough time for Science' while Year 4, 5 and 6 teachers stated otherwise. The one-way ANOVA test confirms this finding as being statistically significant ($F=4.824$, $df1=6$, $df2=242$, $p\text{-value} < 0.0005$). Syllabi for Years 4 to 6 might be more extensive and the pressure on teachers to focus on examinable subjects from school Heads and parents is more pronounced beyond Year 4.

Frequency of Lessons delivered by Peripatetic Teachers

In State schools, where there are peripatetic teachers apart from the class teacher, the frequency of lessons varies according to the school size., Over one third of teachers (36%) claim that the peripatetic teacher visits their class once a month while only 4% have a weekly visit. A further 26% of teachers stated that visits by peripatetic teachers were very rare. In the latter case, the frequency of Science lessons depends on the class teacher.

In the focus group interviews, peripatetic teachers confirmed that the frequency of their lessons depended on school size, where the lower the number of classes in a school, the more lessons they were able to deliver. They pointed out that the school timetable and scheduled outings affected their time allocation negatively. Peripatetic teachers showed concern that class teachers were often not present while they delivered their Science lesson, as they had to participate in teacher planning sessions as per 2007/08 agreement with the Malta Union of Teachers. Such on-the-job training opportunities are missed.

The time dedicated to Science differs extensively from class to class. At one end, where peripatetic teachers visit the classroom weekly and the class teacher backs up with regular lessons, students are exposed weekly to 2 hours of Science. On the other hand, where visits by the peripatetic teacher are rare and the teacher dedicates less than 30 minutes for Science, the monthly allocation would approximately amount to 2 hours.

Figure 7 shows that the allocation for Science by teachers does not depend on the frequency of lessons by peripatetic teachers. The most common time slot is between 30 to 60 minutes, even when the peripatetic teacher's contribution is very rare (52%). This shows lack of co-ordination between the class teacher and peripatetic teachers. Since class teachers are responsible for managing the weekly timetable at Primary level, they should theoretically make up for any lack of Science lessons provided by peripatetic teachers.

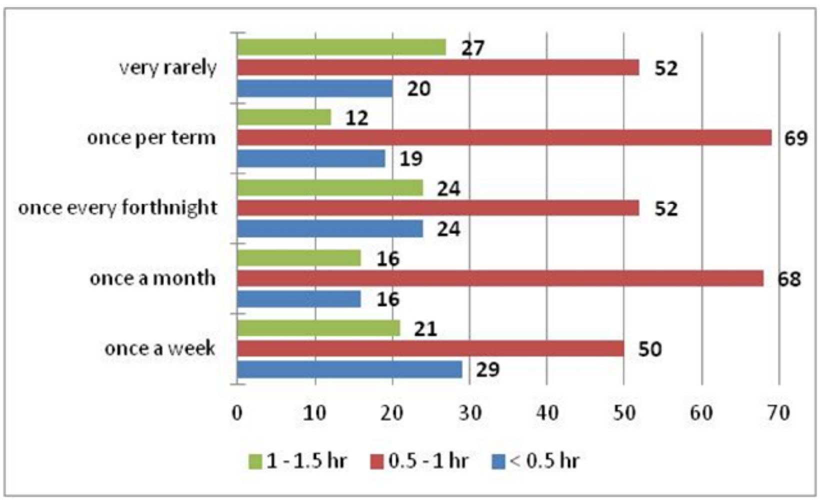

Figure 7: Weekly time for Science by class and peripatetic teachers in state schools

Heads of school and peripatetic teachers maintained that the frequency of Science lessons also depends on the priorities, dispositions and personal interests of the Head and the Senior Management Team (SMT). One Church school Head Teacher specified that the SMT specifies the time dedicated to Science per class: *"...The number of lessons and the time dedicated to Science ... is specified by us as SMT."*

Other school procedures – as the collection of schemes of work, monitoring of Science teaching, engagement in Science-related projects, funds for Science resources – were considered to bear influence on the importance given to the subject. Peripatetic teachers confirmed the influence that the Head has on the importance given to Science in schools and identified him/her as the key person to eliminate teachers' reluctance towards the subject: *"Where the Head takes the 'laissez-faire' attitude, the same attitude is held by teachers."* and further *"In a particular school, the Head had instructed teachers to give priority to Maltese, Maths and English. ... although my lesson could be delivered, the Head instructed the class teacher to give a literacy or numeracy lesson ..."*

Teacher Attitudes: Intrinsic and Extrinsic Factors affecting Teacher Attitudes

The questionnaire also included a list of teacher opinions/attitudes, as shown in Figure 8. The ANOVA test shows that teachers differentiate amongst attitudes towards Science ($F=159.08$, $df1=6$, $df2=1724$, $p\text{-value}<0.0005$). Relatively high mean scores were registered for "teachers' request for help", "teachers' expectations of their students", "at ease with limited scientific knowledge" and "personal interest in Science", ranging from scores of 3.7 to 4.2 that purport positive personal attitudes related to Science teaching.

The highest mean score, at 4.2 for "teachers' request for help", shows concerns regarding the improvement in Science teaching. Teachers reiterated that they need to be supported in order to teach Science. However, teachers held high expectations for their students. This disproves the myth that teachers consider Science to be only for those who perform academically well. Another myth which is attributed to Primary Science teachers is their discomfort with children's questions. In a sub-section of "At ease with limited scientific knowledge" teachers affirmed, with a mean score of 3.9, that they enjoyed children's questions, .

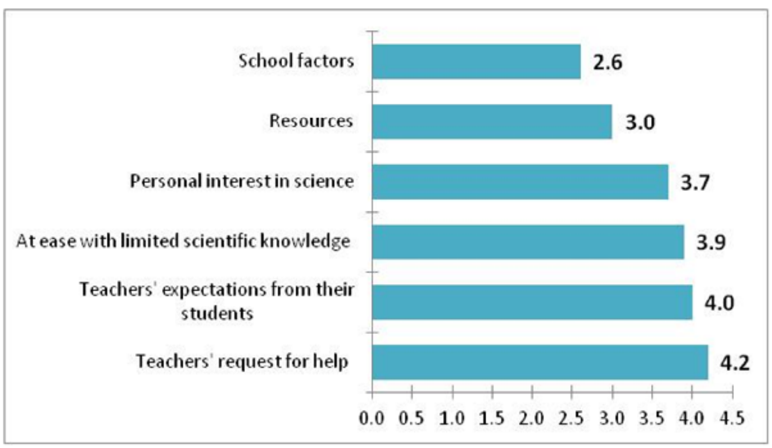

Figure 8: Mean scores for factors affecting teacher attitudes

Teachers' personal interest in Science scored comparatively high, at 3.7: they enjoy watching Science related TV programmes. Since this choice is carried out outside working hours, it shows teachers' interest towards the subject. They also declared their enthusiasm for teaching Science. This finding, together with the readiness of most teachers to undergo PD (44% participated in PD and/or in-service courses and/or research projects in Science education) portrays them as willing to deliver the subject effectively and highlights the desirability for help and PD in the teaching of Science. On the other hand, factors that concerned the school were attributed low mean scores. Indeed, school issues resulted to be the factors that teachers are mostly concerned about, with a mean score of 2.6.

School Factors

School factors, including the frequency of Science lessons and class size, influence teaching practices. Teachers who agreed with the statement that they do not have 'enough time for Science' (mean score = 4.14) dedicated less time to the subject (less than 30 minutes) than those who disagreed with the statement.

Table 5: Time dedicated to Science and scores for 'I don't have enough time for Science'

Time dedicated to Science	Mean	Std. Deviation	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
< 0.5hr	4.14	0.979	3.84	4.43
0.5 - 1hr	3.56	1.225	3.35	3.76
1 - 1.5hr	2.71	1.232	2.39	3.03

This finding strengthened teachers' concerns about the time allocation for Science by the statistically significant ANOVA test score (ANOVA: F= 19.348, df1= 2, df2= 240, p-value < 0.005). Teachers for Years 4 to 6 considered time as a limiting factor as more prevalent with respect to Years 1 to 3 teachers. Teachers, especially Years 4 to 6 ones, did face problems to include Science in their weekly timetable. With packed syllabi and Science not formally assessed, teachers tend to consider it as not important enough. It seems that, without the necessary monitoring of the frequency of Science lessons by the SMT, Primary students will not receive enough coverage in the subject.

Table 6: Class size and mean scores for the statement 'class size limits practical Science'

Class size	Mean	Std. Deviation	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound
10 – 15	2.00	0.943	1.63	2.37
15 – 20	3.12	1.241	2.83	3.41
20 – 25	3.66	1.146	3.41	3.91
> 25	4.33	0.926	4.09	4.57

Teachers state that class size is another factor of influence. A statement in the questionnaire directly referred to class size as a limiting factor for the possibility of implementing Science practical sessions and hands-on activities. Teachers teaching big classes (over 25 pupils) were more likely to regard class size as a limiting factor for carrying out Science practical activities, whereas teachers having smaller classes (10 to 15 pupils) disagreed with the statement, (ANOVA : F= 32.043, df1= 3, df2= 242, p-value < 0.005). Smaller student-to-teacher ratios in classrooms tend to increase the likelihood of practical hands-on activities and, consequently, improved Science teaching.

Resources

In the focus group discussions, the peripatetic teachers identified lack of resources as one of the major constraints facing Primary school teachers. This was confirmed by half the teachers in State schools, who report poor resources for conducting practical Science. Only 10% of teachers from all schools report excellent or very good resources.

Although the decision to dedicate funds for Science is the responsibility of Head teachers and the SMT, teachers are required to forward their proposals and advise about resources considered necessary and appropriate for the execution of their work: "*Advising and co-operating with the Head of School, Assistant Head, Heads of Department, Education Officers, and other teachers in the preparation and development of … teaching materials…*"[29]

Only 37% of the teachers indicate high agreement (4 and 5) for the statement that there are suitable books and ICT resources for Science on the market. The implication is that either

[29] Ministry of Education Youth and Employment, Job Descriptions Handbook, (2007), (p. 5)
Retrieved January 6, 2010, from http://www.education.gov.mt/ministry/doc/pdf/agreement/Handbook_of_Job_Descriptions.pdf

teachers need to have more initiative to search for relevant materials, or that the resources in schools are not sufficient, or that teachers still rely on old resources. Thus teachers need to be more knowledgeable about available resources, and should have access to them. Some of these resources, e.g. measuring instruments, need to be purchased, while others, e.g. online games, require computers in classrooms.

Fostering student attitudes

The NMC specifies that knowledge, skills and attitudes should be developed to provide "greater awareness of the role of Science and Technology in everyday life".[30] The Friedman test shows that, out of the 3 aspects requested by the NMC, the 'attitudes' factor is the least considered during Science lessons by teachers, with a mean of 2.2. ($\chi 2= 20.86$, $df = 2$, $p\text{-value} < 0.0005$). It seems that, although teachers hold positive personal interest and attitudes towards Science teaching, this is not reflected in practice. They tend to focus more on knowledge (mean score = 1.79, on a scale from 1 to 3, where 1 was ranked as most important), that is easily accessed through books or the internet and requires less preparation and background, than fostering skills and attitudes.

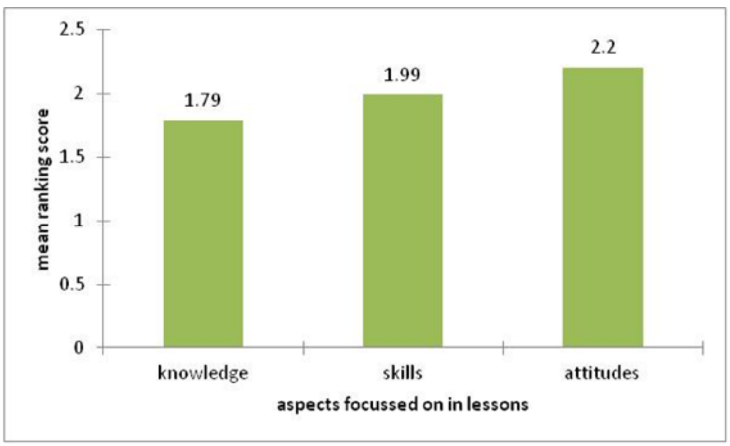

Figure 9: Mean scores of teachers' focus on aspects in lessons

Conclusion

This study reveals that teachers in Maltese Primary schools are less confident to deliver effectively lessons of Science compared to other subjects within the curriculum. Most teachers do not dedicate enough time to Science when compared to the proposed weekly timetable allocation. Moreover, teachers are better trained and equipped to focus on literacy and numeracy rather than Science, although the NMC does not classify any subject taught in Primary schools as superior. One positively notes that teachers show personal interest in becoming more knowledgeable about teaching Science. The support that peripatetic teachers offer in State schools is also limited since they themselves need to be more proficient in both content and pedagogy.

[30] NMC, Objective 12 (p. 65)