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Teaching the PARSEL Way: Students' Reactions to Selected PARSEL Modules

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ABSTRACT: The PARSEL project was initiated to disseminate teaching modules, based on a philosophical model, which was in line with a need to promote scientific literacy, in a manner considered to be both popular and relevant for students. The project was based on the belief that this approach would allow students to better realize that science was for all, would attract more students towards science as a subject worthy of learning, and would encourage students to give greater consideration to careers in science and technology areas. Modules developed by different partners, based on the PARSEL philosophy, were tried out in five Estonian schools, after providing the teachers with in-service guidance. In an effort to determine whether popularity could be conceived separately from relevance, a student questionnaire was developed, discussed with teachers, and tried out in schools. Student responses were analyzed and the results indicated that the modules were very positively received in all schools. However, there was little evidence that students distinguished between interest and enjoyment (as surrogates of popularity), and importance and meaningfulness (as surrogates of relevance). It was thus unclear whether students based their responses on the novelty factor, on the greater attention to student involvement, or on whether students welcomed the effort to initiate the teaching of conceptual science from a societal issue.

KEYWORDS: *PARSEL modules, popularity, relevance, science teaching*

Introduction

While in some European countries students were able to do well in international science tests, such as PISA (OECD, 2006), which supposedly determined learning related to scientific literacy, interest in school science in the very same countries was not high, as illustrated by the ROSE study (EC, 2004). PARSEL modules have been adapted or designed to address the popularity of science taught in school, by making the learning more student-centred, and the relevance of the teaching, by relating the learning to students' everyday life experiences. While popularity focussed on giving the students an enjoyable experience, relevance was promoted by starting from a familiar situation and introducing the conceptual science on a need-to-know basis. Additionally, students were guided to participate in a decision-making exercise in which the newly gained, need-to-know science could be consolidated by being transferred as an input into discussions of a social issue, and considered alongside other factors, which could influence the socio-scientific decision.

It was unclear, however, whether students identified any difference between steps to raise the popularity of a school subject (illustrated by items written on interest in the ROSE study) and relevance (illustrated in ROSE by items describing topics that students would like to study). In fact, both terms, popularity and relevance, were found to be difficult to define, or translate into other languages, and were not used directly in the student and teacher guides of PARSEL modules. Within PARSEL, popularity was intended as an emotional aspect relating to interest in and enjoyment of the science lessons. Unfortunately, it was possible that popularity could be heavily promoted within the teaching without any intended learning taking place, and could be considered by students and teachers as making the science lessons 'fun.' This was clearly not a PARSEL intention and hence popularity by itself was not considered appropriate for the development of the modules. Attributes of learning were clearly essential, especially at the secondary level, as measures of attainment in the form of a final examination that exists in many countries.

Assigning a PARSEL meaning to relevance proved to be even more difficult. Van Aalsvoort (2004), drawing on the literature, had put forward four sub-categories of relevance, namely: (a) personal relevance — education making connections to students' lives; (b) professional relevance — education offering students a picture of possible professions; (c) social relevance — education clarifying science's purpose in human and social issues; and d) personal/social relevance — education helping students to develop into responsible citizens. While it was difficult to appreciate the difference between the last two sub-categories and both could be related to professional relevance, the multifaceted aspect of relevance became clear. For PARSEL modules, the project recognized that both personal and social relevance could be taken together, as in sub-category (d) above. While the philosophy underpinning the PARSEL modules focussed on meeting students' personal needs, the modules were designed to be pertinent to students through starting from a social issue, and thus being familiar to students. The issues were carefully chosen to include a science perspective and, by guiding students to identify with the issues, it was expected that the students' interest for learning the underlying scientific ideas could be promoted. Each module did this by being structured as a three-stage process. The first stage focussed on identifying the relevant issue in the lives of students and also on the degree of students' prior knowledge associated with the science ideas involved. The second stage engaged students in learning the science ideas pertinent to any future discussion on the issue through interestingly presented science challenges, such as, a context-based inquiry learning approach. The final stage revisited the socio-scientific issue, allowing students to participate in discussions where they could transfer their newly acquired scientific learning, and thus to raise the level of argumentation associated with the scientific component of the issue. Science education was conceptualized to be more than the learning of science ideas and to be associated with the development of educational objectives, such as, meta-cognition, problem solving, and decision making. These objectives are considered as important outcomes that promote students' scientific literacy towards responsible citizenry.

But, was it possible to determine whether the modules had both an emotional appeal, identified as popular, and a relevance component, identified as meaningful and important for the student? To address this question, it was hypothesized that concerns in science and technology education expressed by the learners themselves could be considered as relevant to them. This kind of relevance could translate into a motivation to learn and thus to have a positive emotional appeal. Therefore, anything of relevance to students was meant to be something that students considered as having interest and value to be engaged in (Gardner & Tamir, 1989).

This study investigated the way PARSEL modules were related to popularity and relevance (in this study seen as importance and meaningfulness, that is, pertinent to the situation from the students' perspective). In particular, this article examined whether students were able to highlight any differences between a perception of interest and enjoyment (related to popularity) and importance and meaningfulness (linked to relevance), after studying one or more modules.

Methodology

Sample

The sample consisted of five teachers and their students. These teachers had been introduced to the modules via a booklet (see www.parsel.eu) that was fully explained in a teacher seminar. The teachers volunteered to try out some of the modules, which they selected from those developed by the PARSEL partners. These modules were translated from the English version, in whole or in part, into the Estonian language. In the spirit of giving teachers ownership of the teaching (this being important for authenticity), teachers were permitted to modify modules as they felt appropriate, but they were expected to try out the modules following the PARSEL approach and philosophy.

Instrument

A student questionnaire was also developed and this included questions relating to two components. The first set of questions was related to nine aspects of the PARSEL approach involving interest and enjoyment, and the second included a set of questions based on nine aspects covering importance and meaningfulness. The identified aspects for the first and the second components are shown in Table 1. Each aspect was used to formulate a different question, so that each component was evaluated through nine questions.

Each question began with a statement, which could be either positive or negative, while it was followed by three alternative answers, as indicated in the following two examples:

First Component: Question on Aspect 9. The pace of lessons **[did/did not]** make the science lessons more interesting and enjoyable, **because:**

- The pace of the lessons was **[definitely/partly/not at all]** too fast;
- I found that the time provided for each lesson was **[definitely/partly/not at all]** suitable for making the lesson enjoyable.
- In my opinion, the time given to study this topic **[is/is not]** as appropriate for me, as it is for the majority of my classmates.

Table 1
Aspects of the Module Relating to First and Second Components Based on Students' Opinions

Aspects of the First Component	
1	the topic was introduced using a scenario
2	the solving of practical scientific problems coming from an everyday issue
3	undertaken various given tasks to do
4	expectation to appreciate why we were studying this science topic
5	the devising of experiments and carrying out experiments
6	feedback from the teacher in class, which was helpful and encouraging
7	a discussion leading to making a socio-scientific decision at the end of the module
8	needing to think a lot about the science ideas
9	the appropriateness of the pace of learning
Aspects of the Second Component	
1	acquiring science related to making decisions about issues in everyday life
2	studying by using a social issue related to science as the focus
3	including discussions relevant for improving my reasoning skills
4	planning my own experiments allowing me to appreciate that the learning through science can be relevance for my everyday life
5	receiving teacher feedback in class, which emphasized the relevance of science for everyday life
6	being introduced to the topic through a scenario which related to science for everyday life
7	undertaking experimental projects so as to make the understanding of the science more relevant
8	being involved in discussions of a social issue which included a science component
9	appreciating the pace of teaching this module was appropriate

Second Component: Question on Aspect 9. The pace of teaching this module [**did/did not**] make the science lessons more important and meaningful, **because:**

- I [**definitely/partly/not at all**] had sufficient time to think about the points and issues raised;
- There was [**definitely/partly/not at all**] sufficient time to make records of our work in class.
- In my opinion, the pace of the lessons [**is/is not**] as appropriate for me as it is for the majority of my classmates.

The questionnaire was administered to 147 students in five schools. In all cases, the questionnaire was administered after the students had completed at least one PARSEL module.

Analysis

The student responses were coded as 0, if the student did not give a response, 1, if the response was the first of the 2 or 3 choices given, 2, if the response was the second of the 2 or 3 choices given, 3, if the response referred to "not at all," in items with three choices.

Frequencies

A frequency percentage was determined for the students responding to the questionnaire, covering each item of the nine questions under the first component and each item under the nine questions in the second component. The data are presented in Table 2, where the first column indicates the specific item (there are 4 items per question). For question 1, these were labelled 1.1, 1.2, 1.3, and 1.4. The percentage responses by students were given in the sequence of the choices made available. For example, item 1 for each question had the choices "did" or "did not." The first column refers to the percentage of agreements with the "did" choice and the next column to the "did not" choice. For the second and third items within a question, three choices were possible and the percentage response is given in sequence in each case relating to "definitely," "partly," and "not at all." The fourth item in the question asked students whether they felt that their response was the same as their classmates. The first percentage specifies those students who indicated a positive response and the second column the percentage of those who felt their classmates would have responded differently.

The overall reliability of the data, as determined by Cronbach alpha, was 0.924. Table 2 indicates that the students responded positively to each of the items of the first and second components, except for 9.2 in the first component. In this item, students were asked whether the pace of the lesson was definitely, partly, or not at all, too fast. As indicated in Table 2, 46.3% students indicated that the pace was not at all too fast, and only 10.9% students felt the teaching was inappropriately too fast. For items two and three within each question, some students, being less committed, tended to choose the middle path (choosing the 'partly' option).

The findings suggest that there was general agreement among students and that they welcomed the modules. The welcoming was related to the teaching being more interesting and enjoyable, and students also agreed that the modules were geared to highlighting the importance and meaningfulness of science teaching. However, it was difficult to claim a strong positive effect of the PARSEL modules, because there was insufficient information for linking single aspects together, such as, interesting/enjoyable separate from important/meaningful. It was probable, and the teachers did not deny this, that interest was aroused, because the modules were different from the standard teaching. Hence, the change of approach led to more lessons that were different and more unpredictable, and this could have made them more interesting to students. It was also probable that the enhanced and more focussed teaching towards a range of educational goals, provided by the modules, with greater attention to handouts or visual presentations, made the topic to appear more important to students. The relevance of the modules was thus not firmly established, but responses received by teachers during the use of the modules and evidence based on earlier research suggest that student acceptance of the PARSEL aspects was really evident.

Table 2
Frequencies of Responses for Each Item of the First and Second Component of the Questionnaire

Question	Items	Responses (%) to Items within Component 1			Responses (%) to Items within Component 2		
		Choosing 1st option	Choosing 2nd option	Choosing 3rd option	Choosing 1st option	Choosing 2nd option	Choosing 3rd option
1	1.1	95.8	4.2	-	92.5	7.5	-
	1.2	52.0	46.6	1.4	65.1	30.1	4.8
	1.3	37.5	58.3	4.2	71.2	25.3	3.4
	1.4	93.1	6.9	-	90.9	9.1	-
2	2.1	95.9	4.1	-	82.2	17.8	-
	2.2	63.9	33.3	2.7	51.0	43.4	5.5
	2.3	36.6	53.8	9.7	50.3	40.7	9.0
	2.4	84.5	15.5	-	80.0	20.0	-
3	3.1	90.8	9.2	-	87.5	12.5	-
	3.2	44.2	51.7	4.1	75.0	20.0	4.1
	3.3	46.9	42.9	10.2	81.5	17.8	0.7
	3.4	81.9	18.1	-	90.0	10.0	-
4	4.1	81.5	18.5	-	91.5	8.5	-
	4.2	38.8	56.5	4.8	60.6	37.1	2.3
	4.3	65.1	29.5	5.5	42.4	54.5	3.0
	4.4	81.3	18.8	-	86.4	13.6	-
5	5.1	91.8	8.2	-	86.3	13.7	-
	5.2	63.6	32.2	4.1	49.3	43.2	7.5
	5.3	54.9	41.0	4.1	45.1	47.9	6.9
	5.4	86.6	13.4	-	84.6	15.4	-
6	6.1	89.7	10.3	-	87.4	12.6	-
	6.2	55.1	40.1	4.8	45.8	47.2	6.9
	6.3	65.5	31.1	3.4	48.9	47.5	3.5
	6.4	83.0	17.9	-	84.4	15.6	-
7	7.1	88.7	11.3	-	92.0	8.0	-
	7.2	56.5	34.0	9.5	64.2	33.3	2.4
	7.3	54.8	38.4	6.8	58.9	30.6	10.5
	7.4	83.3	16.0	0.7	88.5	11.5	-
8	8.1	86.8	13.2	-	84.6	15.4	-
	8.2	55.9	36.4	7.7	49.0	49.0	2.1
	8.3	43.5	51.0	5.4	55.6	43.8	0.7
	8.4	82.5	17.5	-	82.6	17.4	-
9	9.1	76.7	23.5	-	81.8	18.2	-
	9.2	10.9	42.9	46.3	45.9	45.9	8.1
	9.3	38.5	55.2	6.3	47.6	44.9	7.5
	9.4	77.4	22.6	-	87.5	12.5	-

The students reported that they considered their opinions to be similar to their classmates (item 4 of each question). There was some evidence that students, who responded negatively to the first item in a question (the statement), also suggested that their opinions did not fit with the opinions of their classmates, indicating that they felt being different from their classmates.

Correlations

Spearman rho correlations were determined between responses to the first part (the statement) in each question within component 1 and the responses to the first part within each question in component 2. The data are presented in Table 3.

Table 3

Spearman Rho Correlations between Responses to Question Statements (first part) in the Two Components of the Questionnaire

Question Item in	Question Item in Component 2								
Component 1	Q1.1	Q2.1	Q3.1	Q4.1	Q5.1	Q6.1	Q7.1	Q8.1	Q9.1
1.1	.20*	.09	.34**	.33**	.32**	.23**	.20*	.30**	.35**
2.1	.59**	.44**	.34**	.46**	.32**	.24**	.35**	.30**	.35**
3.1	.29**	.25**	.28**	.38**	.23**	.19*	.21*	.35**	.31**
4.1	.29**	.25**	.28**	.38**	.23**	.19*	.21*	.35**	.31**
5.1	.11	.07	.22**	.32**	.19*	.22**	.46**	.32**	.36**
6.1	.42**	.37**	.28**	.15	.52**	.21*	.34**	.55**	.37**
7.1	.34**	.30**	.43**	.27**	.45**	.22**	.34**	.43**	.48**
8.1	.43**	.40**	.53**	.45**	.45**	.41**	.12	.50**	.51**
9.1	.28**	.35**	.34**	.28**	.44**	.25**	.25**	.46**	.54**

** significant at 0.01 level

* Significant at 0.05 level

The first question for the first component related to the use of a scenario as being interesting and enjoyment. Question 6 in the second component also referred to the scenario, but asked about is importance and meaningfulness for learning science. Positive responses were indicated in both cases, as shown in Table 3, although less so for question 6. A similar pattern was exhibited with other, somewhat matching, questions as shown in Table 4. It would seem that students responded similarly whether the question was about interest and enjoyment, or about importance and meaningfulness.

Table 3 showed the high number of correlations, significantly differing from zero, between the student responses within the two versions of the questionnaire. The data only showed correlations for the first item in each question in which students were asked whether they did, or did not agree to the aspect (see Tables 1 and 2). The strength of the correlation was particularly exhibited between somewhat matching question items 5.1 (component 1) and 7.1 (component 2); 7.1 (component 1) and 8.1 (component 2), and between 9.1 (component 1) and 9.1 (component 2). In addition, question items 2.1, 7.1 and 9.1, in component 1, exhibited strong correlations with all question items in component 2. Likewise question items 8.1 and 9.1 in component 2 exhibited significant correlations with all question items in component 1.

Table 4
Frequencies for Somewhat Matching Questions between Component 1 (Interest and Enjoyment) and Component 2 (Importance and Meaningfulness)

Question	Items	% responses to items within Component 1			Question	% responses to items within Component 2		
		Choosing 1st option	Choosing 2nd option	Choosing 3rd option		Choosing 1st option	Choosing 2nd option	Choosing 3rd option
1	1	95.8	4.2	-	6	87.4	12.6	-
	2	52.0	46.6	1.4		45.8	47.2	6.9
	3	37.5	58.3	4.2		48.9	47.5	3.5
	4	93.1	6.9	-		84.4	15.6	-
5	1	91.8	8.2	-	4	91.5	8.5	-
	2	63.6	32.2	4.1		60.6	37.1	2.3
	3	54.9	41.0	4.1		42.4	54.5	3.0
	4	86.6	13.4	-		86.4	13.6	-
5	1	91.8	8.2	-	7	92.0	8.0	-
	2	63.6	32.2	4.1		64.2	33.3	2.4
	3	54.9	41.0	4.1		58.9	30.6	10.5
	4	86.6	13.4	-		88.5	11.5	-
6	1	89.7	10.3	-	5	86.3	13.7	-
	2	55.1	40.1	4.8		49.3	43.2	7.5
	3	65.5	31.1	3.4		45.1	47.9	6.9
	4	83.0	17.9	-		84.6	15.4	-
7	1	88.7	11.3	-	8	84.6	15.4	-
	2	56.5	34.0	9.5		49.0	49.0	2.1
	3	54.8	38.4	6.8		55.6	43.8	0.7
	4	83.3	16.0	0.7		82.6	17.4	-
9	1	76.7	23.5	-	9	81.8	18.2	-
	2	10.9	42.9	46.3		45.9	45.9	8.1
	3	38.5	55.2	6.3		47.6	44.9	7.5
	4	77.4	22.6	-		87.5	12.5	-

The fact that most correlations were significantly greater than zero could be attributed to the high degree of positive responses towards the first item (the statement) in each question. The lowest positive response was 76.9 % (question 9 in component 1).

Low correlations were nevertheless found in some areas. Clearly responses to interest and enjoyment of the scenario (aspect, component 1) for a number of students were not linked to focusing on science as an aspect of the social issue (aspect 2, component 2) The scenario was largely seen as an aspect in its own right, not specifically linked to science learning. For these students, the purpose of the scenario was probably insufficiently linked to motivating students to inquire about the science ideas involved in making decisions about the issue.

An interest in devising and carrying out experiments (aspect 5, component 1) for some students was not linked to the importance in acquiring science for making everyday life decisions (aspect 1, component 2), nor the importance of focusing on a social issue related to science (aspect 2, component 2). This would suggest that a number of students saw experimentation as an enjoyable activity, but

insufficient attention was paid to drawing the link to science in everyday life. It would seem to point to insufficient student involvement in inquiry teaching and experimental planning.

The interest in teacher feedback (aspect 6, component 1) was not related to the importance in planning experiments, which allowed an appreciation that science could have everyday life relevance (aspect 4, component 2). Again a number of students did not appreciate the relevance of science learning to everyday life. It points to a probable lack in teacher feedback being related to science in everyday life rather than science ideas in the textbook.

Interest in thinking about science ideas (aspect 8, component 1) had little link to the importance in undertaking experimental projects (aspect 7, component 2). This low correlation is surprising and would tend to indicate that for some students their experience is in following guidelines to undertake experimental projects, and not about a consideration of the importance of understanding the science involved in the project. It again suggested that inquiry teaching, with student devising as well as carrying out experiments, was either weak or missing altogether.

Although some teachers determined students' cognitive gains during the teaching, no valid study was undertaken in this area. Responses from the teachers indicated that cognitive gains were positive. Teachers thus felt that PARSEL materials were suitable for the teaching of science and they felt that students were adopting a more positive attitude.

A major concern expressed by teachers was the time required for teaching the modules. The modules incorporated cognitive learning as per their interpretation of the curriculum and also included a greater range of learning attributes, which teachers had tended to ignore as these were not incorporated in the assessment system put forward by the Ministry of Education (who controlled the external examinations). This conflict was obviously very serious and pointed to the need for policy makers to give more attention to the intended learning in science lessons. If this was to promote the wider range of skills as advocated by PARSEL modules (these being developed to address European Commission concerns), then clearly the assessment system needed to be changed.

Conclusion

There was little evidence that students appreciated a difference between interest and relevance. The students found the teaching approach interesting and indicated that they would like more similar modules in their teaching, but there was little evidence that students found the teaching more relevant to themselves. The questionnaire provided limited information, although the small number of low correlations clearly indicates that the student learning was not entirely in the PARSEL direction.

More research is needed to explore whether students were able to detect the difference between interest and relevance as portrayed in the ROSE study. It may well be that students were 'conditioned' by the system and saw interest as a more appropriate criterion for judging science lessons. When a lesson was interesting then, it was also considered important by students. This view was however limited by the translation of the items into Estonian and the use of words in Estonian language familiar to students. For example 'liking' was more easily translated than 'interested in.'

Teachers' responses provided evidence indicating that they considered the PARSEL modules to be valuable in arousing students' interest and curiosity. This led to differences in lessons from the normal teaching pattern and this aroused student interest. From such a point of view, the modules made an impact, but the teachers were apt to comment 'at what cost?' The examinations for science subjects were far from any assessment of student involvement in inquiry learning, or socio-scientific decision making. Was the extra time used in promoting interest and non-examined skills, worthwhile? This question was not answered, but has been put forward for further consideration. Certainly, there was little evidence of cognitive gains as outcomes of teaching using PARSEL modules. The largest complaint was the time needed to teach PARSEL modules, where as much as 50% of the classroom time could be taken up with 'non-content' learning, noting the time required for the development of process skills, presentation (communication) skills, and the ability to be able to meaningfully participate in an informed decision making.

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