Bridging the gap between research and practice - what do teachers find useful from a research report?

Reduciendo la distancia entre investigación y práctica ¿qué toman los profesores de los informes de investigación?

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Abstract

In a previous study, 675 grade nine Estonian students were tested to find out their interest and attitudes towards science. Findings showed differences in interest in school science between boys and girls and also in the importance of the contexts in which science is taught. The current study is an attempt to find out how Estonian science teachers understand and appreciate the need for dissemination of research outcomes. It tries to find out how two different groups of science teachers (single subject teachers (7) and primary school teachers (13) interpret research data and see its use in their teaching, by determining what kind of information/data are interesting for teachers, what can they usefully gain from published materials, how they interpret the data, make conclusions, and determine their readiness to change their teaching strategies and gain ownership where they perceive a need to change?

Key words*: research data interpretation, teacher interest, research into practice*

Resumen

En una investigación previa, se examinaron 675 alumnos estonios de noveno grado para estudiar su interés y actitudes hacia la ciencia. Los hallazgos mostraron diferencias entre el interés en la ciencia escolar por parte de niños y niñas, y también en la importancia de los contextos en que se la enseña. Este estudio muestra cómo los profesores estonios de ciencias entienden y aprecian la necesidad de diseminar resultados de investigación y de, informarse sobre cómo dos grupos diferentes de profesores de ciencias interpretan datos de investigación y cómo ven la utilidad de estos datos en cuanto a la enseñanza, determinando qué tipo de información es interesante para los profesores. Qué también pueden adquirir de los materiales publicados, cómo interpretan los datos, hacen conclusiones, y determinar su disposición para cambiar sus estrategias de enseñanza y dónde perciben la necesidad de cambios.

Palabras clave: interpretación de datos de investigación, interés del profesor, investigación, práctica educativa.

INTRODUCTION

Outcomes from international comparative studies (such as PISA, TIMSS) are shown to be of interest to different members of society, but the context of the message picked up, differs (BAKER & JONES, 2005; European Commission, 2004; SJØBERG, 2002a). There is a danger that such studies may trivialize the purpose of schooling by their implicit definition of how educational quality might be understood, defined and measured. For example, PISA and TIMSS do not reveal much about the reasons why students opt out of science and hence do not offer much insight into what one might do to improve attitudes and interests towards science subjects (European Commission, 2004).

The European Commission report (2004) highlights the need to complement studies of educational achievement against common standards with studies that highlight diversity and analyze affective factors like interest, attitudes, motivation, etc. Studies such as SAS and ROSE are examples in this area (SCHREINER & SJØBERG, 2004; SJØBERG, 2002b). Where the goal is not only international comparisons of student interests, it is being used to assist societies to use the evidence based outcomes as diagnostic tools for improving the teaching and learning by considering factors that explain variations in student achievement.

There are very few studies about how teachers use information/outcomes of such results in their practice (BRISCOE & BELLS, 2002; COCHRAN-SMITH & LYTLE, 1990, 1999) or what kind of views they have on educational research (EVERTON, GALTON & PELL, 2000). YET It is generally agreed that science education should meet the needs of the learners and hence should be relevant and meaningful for their future lives and development (FENSHAM, 2004; HOLBROOK, 2003; ICASE 2003; OSBORNE & COLLINS, 2001). The results of research studies should therefore be of great interest to teachers and teachers utilizing such research data and reflecting on its implications for their own teaching should be an expectation.

Teachers' skill to understand research data has a bearing on how research data can be used. NSTA initiated a series on "What research says to the science teachers" to help teachers to interpret research data which tended to be inaccessible to teachers, or presented in a manner that teachers found difficult to understand (HARMS & YAGER, 1981; YAGER, 1982). And there is always the concern that teachers might interpret the data inappropriately. However, results from an action research approach have shown that teachers involved in research become more aware of their own practices (TABACHNICK & ZEICHENER, 1999; STEVENS, SLANTON & BUNNY, 1992) and this has a positive impact on their teaching (BRISCOE & WELLS, 2002). It thus seems that involving teachers with research is likely to be more rewarding than simply publishing research data for teachers to read. This is particularly so if the goal is to bridge the gap between research and practice.

The current study is an attempt to find out how Estonian science teachers understand and appreciate the need for dissemination of research outcomes from an international study:

Research questions posed were:

- what types of information/data are interesting for teachers?
- what can teachers usefully gain from published materials?
- can teachers interpret the data, make conclusions, and find reasons for the findings?
- are teachers ready to change their teaching strategies and gain ownership of the approach, where they perceive a need to change?

METHODOLOGY

To investigate the research questions, a small group of Estonian science teachers was identified who were from different school-types and recently involved in in-service activities with the following:

1. Single science subject teachers (teaching grades 8 - 12) from Tartu city who were interested to take part and had a range of teaching experiences (7 teachers).
2. Primary school science teachers (teaching grades 6 - 9) with a range of teaching experiences and who were attending an in-service courses at the Open University (13 teachers).

Description of the instruments used to facilitate the study

Based on the Estonian results from the ROSE study (TEPPO & RANNIKMÄE, 2005) outcomes were published in a booklet for dissemination and discussion among teachers. The booklet was presented in six sections (plus two appendixes) and included student results as described in table 1.

Stages of the study

I Pre-research stage

Teachers were asked to study the booklet and act as a group of evaluators (experts). They were informed that they would participate in a group discussion later when their opinions would be sought. It was suggested that the teachers should make comments (write) in the booklet, keeping in mind the following aspects:

- what they do not understand;
- what is essential for them;
- about what they wanted to know more.

Table 1. The structure of the booklet

Section	Descriptor of data obtained from the students	Statistics presented	Type of presentation of data	Explanation
1	Student interest in science related topics. Topics were both single subject related and interdisciplinary	Means, SD	Bar charts Tables of means and standard deviations	The results were presented as bar charts separately for boys and girls showing the means for each item. In the tables, means and SD-s were presented related to the presentation style of science topics.
2	Factors influencing future careers related to science and technology	Factor analysis, Means	Table of factor analysis Bar chart	Factors were illustrated through a table of factor analysis. Separately bar charts were used for boys and girls showing the means of each item.
3	Seriousness of Environmental challenges within society as perceived by students	Means	Bar chart	The results were presented as bar charts separately for boys and girls showing the means for each item.
4	Student interest in learning science (and technology) in school	Means	Bar chart	The results were presented as bar charts separately for boys and girls showing the means for each item.
5	Perceived usefulness of Science & Technology within society	Means	Bar chart	The results were presented as bar charts separately for boys and girls showing the means for each item.
6	Diversity of science related experiences outside of school	Means	Bar chart	The results were presented as bar charts separately for boys and girls showing the means for each item
7	Personal aspects of interest in science	-	Descriptive	An open ended question where students were asked to express their opinions about being a scientist.
8	Student perception of information that can be an indicator of socio-economic status of the home (books at home)	Percentages	Bar chart	Results in percentages covering seven different categories were presented as bar charts with separate bars for boys and girls.
Appendix 1 on section 1	Additional results on interest in science related topics	Means	Bar charts	The results were presented as bar charts separately for boys and girls showing the means for each item.
Appendix 2 on section 6	Additional result on science related experiences out-of-school	Means	Bar charts	The results were presented as bar charts separately for boys and girls showing the means for each item.

II Group Research Interviews (with the 2 groups separately)

Participants were divided into 2 groups – group 1, science subject teachers and group 2, primary teachers. During the separate group sessions, all participants took part individually and also as part of the group. Participants were asked the first question by the interviewers, one by one in sequence. The other participants were allowed to interrupt or add to these comments. Individuals were permitted to refer to comments by others when it came to their turn to respond. All interactions were noted by the researchers.

At the end of the first round of interviews, the researchers posed the second question and the procedure was repeated. Again the researchers noted comments made. Comments made by teachers were grouped phenomenographically. The questions asked were:

- What results, given in the booklet, did you find interesting?
- Is it important to introduce this research data to teachers?
- How could you consider using the data from the research?

The researchers also recorded differences in responses by the two groups.

RESEARCH FINDINGS

1. Importance of the booklet

Table 2 gives an overview of the interest shown by the 13 primary science and 7 single science subject teachers (judged by the amount and quality of comments) towards the different booklet sections. Almost all (15 out of 20) made comments on the results showing students' interest towards science learning. Hence these teachers seemed eager to know the topics in which students' were interested and not interested. They were definitely interested in knowing want to teach (as opposed to how to teach).

Conversely, little interest was shown by teachers towards students' results related to the science & technology and personal aspects of interest in science. None of the teachers interpreted the results; only a few added comments or facts and most didn't comment on this section of the results.

Besides the science & technology section, teachers showed little interest (almost half of them didn't comment on the results) towards environmental protection. It seemed that they know well about environmental problems and did not find anything new in the responses of students. These student findings were expected by teachers.

Few teachers gave comments on the section about students' future career, science class and out-of-school experiences. Surprisingly, only a few teachers seemed to be able to interpret research data and make conclusions. For example, only one teacher interpreted students' results relating to classroom climate.

Teachers' interest towards the appendices giving additional results linked to interest in science and out-of-school experiences was not high – few wrote some comments and only very few (2 or 3 from 13) tried to interpret the results.

2. Teacher Understandability

Teacher comments identified several misunderstandings. For example:

- 8 teachers out of 20 didn't understand the essence of factor analysis and therefore couldn't interpret one of the given tables in the booklet.
- Standard deviations did not have any meaning for 6 teachers.
- Two science teachers misunderstood the Likert-type scale and the mean values derived from the data. For them, the tables and graphs needed more careful explanation and more explicit interpretations were necessary;

More than half of the teachers struggled to understand the statistics and found the booklet not sufficiently well structured to show simple and easily understood tables. They felt data on which teachers were expected to

Table 2

Teacher interest in different sections of the booklet

Section	Teachers' responses written in the booklet					
	No comments		Some factual comments		Comments linked to interpretation	
	N=20	%	N=20	%	N=20	%
1. Student interest in science related topics	3	15,0	2	10,0	15	**75,0**
2. Factors influencing future careers related to science and technology	11	55,0	6	30,0	3	15,0
3. Seriousness of environmental challenges within society as perceived by students	9	45,0	9	45,0	2	10,0
4. Student interest in learning science in school	11	55,0	8	40,0	1	5,0
5. Perceived usefulness of science & technology in the society	15	**75,0**	5	25,0	0	0
6. Diversity of science related experiences outside of school	11	55,0	7	35,0	2	10,0
7. Personal aspects of interest in science	18	**90,0**	2	10,0	0	0
8. Student perception of information that can be an indicator of socio-economic status of the home (books at home)	10	50,0	8	40,0	2	10,0
Appendix 1 on domain 1 (Additional results on interest in science related topics)	10	50,0	7	35,0	3	15,0
Appendix 2 on domain 6 (Additional result on science related experiences out of school)	10	50,0	8	40,0	2	10,0

make their own interpretation should be separated from the main body of the booklet. Also they felt results in the booklet should be described in sequence of the research outcomes. And no teacher commented on overall aspects of the study such as the reliability and validity of the study, nor about any limitations about the generalisability of the data.

3. Usefulness of the Booklet

Figures 1 and 2 indicate the interactions between the teachers during the two separate group interviews. The arrangement illustrates the positions in which the researchers and teachers sat. The numbers indicate the sequence in which teachers commented. The letters provide extra descriptors of the teacher background. The shape associated with each teacher refers to a categorization of characteristics exhibited by that teacher which is described later. In both tables, when responding to the semi-structured questions in the group interview, teacher 1 was asked to comment first, followed by teacher 2, etc.

The arrows with dotted lines indicate where another teacher interrupted the response and commented further. The solid arrows indicate where a teacher added comments during the answers by another teacher, even though they had previous responded to the question.

The following summarizes the findings:

Question 1. Interesting components and Importance to introduce research results

All 20 teachers, covering groups 1 and 2, considered an introduction to research results important. However there were differences between the two groups. The separate science group of teachers concentrated on data related to their specialization and tended to dismiss findings in other areas. The primary teachers were more willing to consider the data as a whole.

The interruption and comments made by the teachers largely occurred in very specific areas. These were linked to areas of student interest. For example one comment was: *"girls are more interested in health than boys"*.

An interruption/extra comment was – *"this is because it is fashionable to be slim and girls' journals emphasize slimness"*.

In the group interview with the single science teachers, further discussion focused on whether topics were chemistry or physics e.g. using plants in medicine. Or explaining why students would be interested in tornadoes.

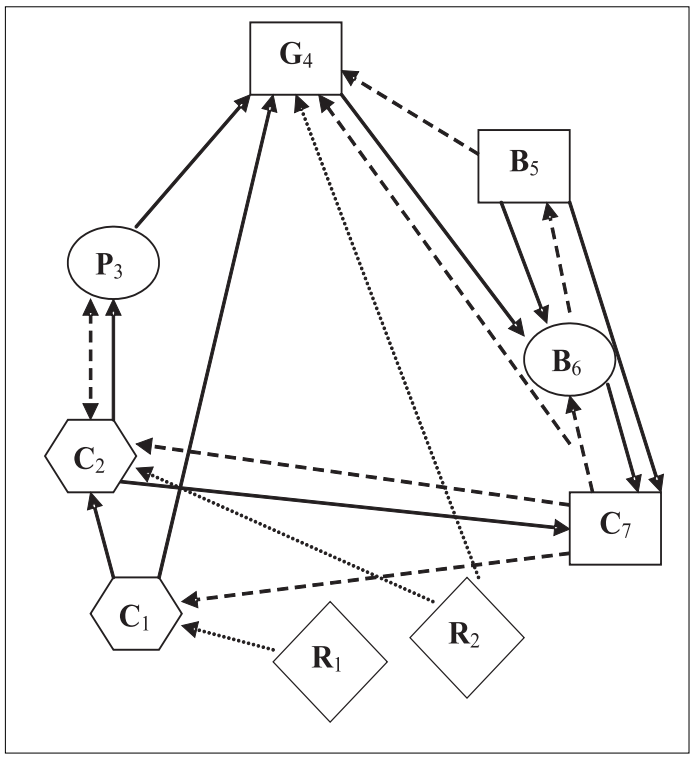

Figure 1. Interactions between single science subject teachers during the group interview

P-physics teacher, C-chemistry teacher, B-biology teacher, G-geography teacher, S-science teacher, R-researchers

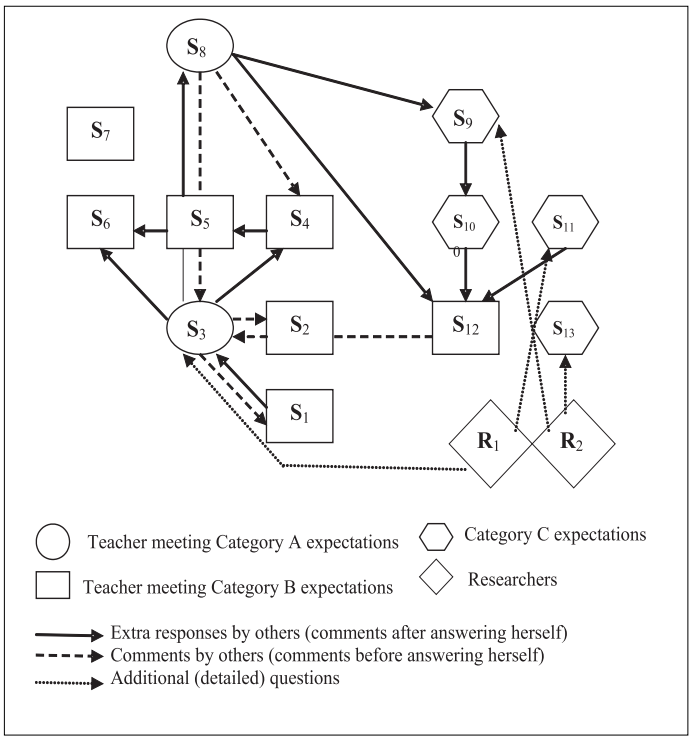

Figure 2. Interactions between primary science teachers during the group interview

The majority of the teachers (15 out of 20), indicated interest in the concrete examples and considered these useful for their own teaching. This was directly related to their teaching and interested diminished sharply whenever it went outside the curriculum. Even so, few teachers made comments drawing conclusions from the tables and by and large teachers directly repeated actual comments given in the booklet.

For abstract topics, such as atoms and molecules, teachers commented that students do not like these, because they are very abstract and complicated. On the other hand teachers commented that topical events, such as the recent tsunami in Asia, or tornados, cyclones etc to be of interest to students (These comments were made even though the students completed the questionnaire before the recent tsunami occurred in Asia!).

Student responses showing high means related to environmental ethics, such as the rights of animals, were not surprising to teachers, but they still questioned whether this area should be part of science curricula. The low means from students on items related to science and technology were also not surprising to teachers. Here the teachers felt that students would be at a loss as to how to answer as these are areas which do not figure in current science teaching. The teachers did not see any contradiction in their comments related to high and low student means on environmental ethics and science and technology aspects.

Interruption by researchers were to stimulate comments about the components on 'my future job' or 'classroom environment'. This was because teachers tended to neglect these sections. From the additional questions asked, some teachers commented that they did not understand the meaning of the items on classroom atmosphere.

Question 2. Putting research results into practice

Some teachers (4 of 20) felt that the outcomes giving examples of student interest would influence their teaching emphases in the future. About half the teachers (9 of 20) suggested they would talk more about the work and lives of scientists. Unfortunately the impression given was not to involved students more, but simply to give more information.

Half the teachers felt they would like to carry out the same study in other classes or similar schools. This was mainly related to students' interests Teachers suggested it would be useful to include a comparison between participating schools illustrating schools needed to develop further. About half the teachers thought it interesting to show an international comparison. Following the stimulus provided by the extra questions from the

Table 3
Categories of teachers' responses

Characteristics	Description of categories derived from grouping characteristics, exhibited by teachers, during the interviews					
	Comments indicate results taken into consideration, wants to know more and investigate (category A descriptors)		Comments subject-centered with cross section lines; takes into consideration findings, doesnt want to investigate further (category B)		Comments subject-centered, facts oriented, do not indicate interest about findings (category C)	
1. Number of teachers	2 group 1	2 group 2	3 group 1	7 group 2	2 group 1	4 group 2
2. General description of teachers related to descriptors	Previous research experience	Previous study experience	Confident subject teaching not recognizing need for change	Traditional teaching, but interested in change	Traditional teaching appreciating subject and textbooks	Traditional teaching appreciating subject and textbooks
3. Comparison	International and national comparison		International and national comparison		No comparison	
4. Reasoning	Reasoning research results		Not reasoning research results		Not reasoning research results	
5. Using research results, application	Using of research results in her/his teaching, makes suggestions including additional research		Using of several research results in her/his teaching		Not using of research results in her/his teaching	
6. Research results into practice	Wants to know about research findings carried out among her/his students		Wants to know about research findings carried out among her/his students		Wants to know about research findings carried out among her/his students	
7. Sections for attention	Interest, future career, my science class, science & technology, out-of-school experiences		Interest, future career, out-of-school experiences		Interest	
8. Interaction	Initiators of the new ideas		Bring forward some new ideas		Repeated others ideas, not offered anything new	

researchers, a few teachers were interested to know about international data related to classroom atmosphere.

Noting the student interest in non-curricular components such as UFOs, etc some teachers felt these topics should be considered for general class teacher sessions to further develop the student interests. However there was no suggestion that such topics could form part of science lessons, or that the science curricula should change.

In general, teachers felt that there was a lot of information in the booklet and that it was difficult to follow it all. They suggested the booklet needs to be short with limited data included.

DISCUSSION

Based on the interviews and a phenomenographic style analysis (MARTON, 1992, 1981), characteristics exhibited by the teachers, related to the type and frequency of teacher responses during the interviews, three groups (A, B and C) of teachers' responses were identified (table 3).

Category A comments came from teachers, who wanted to know more about students' interest and wished to test students in other classes (for example with 7 or 8 graders), such as getting to know their interests and attitudes towards science learning. They wanted to compare students' interests, opinions, attitudes and experiences from one school with another, or internationally. These teachers were eager to use research results in their teaching and wanted to investigate themselves ways of making school science more relevant for students.

For example: *"I want to know more about students' interests and attitudes so as to change my teaching for the better", "I can use research results for finding out misunderstandings and therefore improve teaching"*.

Their comments were often critical and they held views placing high demands on teachers (including themselves) and teaching: *"Teachers have to be creative and use different active learning methods (role plays, discussions, practical works, experiments etc.)", "Good science teacher must be a patriot of her/his subject"*.

Teachers, who gave comments which formed **category B**, highlighted facts mostly connected with one science (biology, chemistry, physics, geography) subject and tried to use this or that method in teaching. They illustrated their teaching experiences with examples *"In chemistry lessons, students have to carry out experiments about change of substances. Chemistry is not a series of formulas"*. They recommended some suggestions, including wanting to see national and international comparative tables about students' interests or attitudes towards school science. For example: *"Want to see a comparison between countryside and town schools students' interests and attitudes"*,

Category C responses were from teachers, who put forward some facts about students' interests due to one or another science subject. They did not interpret the research results, nor offer any teaching activity. These teachers did not exhibit an action plan related to the possible findings and were not interested to investigate further. Their comments were very simple, brief and repetitive. For example: *"It is natural that girls are interested in eating disorders, plastic surgery and food additives", "It is normal that boys are interested in electricity and electrical equipment"*.

CONCLUSIONS

The following conclusions can be drawn given:

1) Without in-service, teachers need special training to interpret research data. However a booklet stating the importance of how science subjects are taught was not taken into the consideration by teachers. Students' opinions related to their future job highlighted the need for developing general skills – that was not seen as a task for science teachers.

2) It is possible to identify three categories describing teacher's readiness and interest to use research outcomes. Based on the comments and discussions, most teacher answers indicate they were not ready to make use of research data in a meaningful way. It is important to recognize the diversity of teacher interests and the wide range of teacher abilities to use research data.

3) Disseminating research data to teachers is recognized by teachers as important. When undertaking this through written materials, such as a booklet, certain criteria should be followed. The criteria are:

- the booklet needs to be short with limited data included;
- the booklet needs to be well structured and include simple and easily understood tables;
- tables and graphs need careful explanation and interpretations are necessary;
- data, where teachers are asked to make their own interpretation, should be separated from the main body of the booklet;
- results in the booklet should be described in sequence of the research outcomes.

4) It should not be assumed that once research data reaches teachers and the teachers have been guided in its interpretation that the teachers will then be willing or able to use the research to benefit their future teaching. This reservation is especially an issue where research findings indicate a need for teachers to change their practice and take ownership of a new approach.

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