PROFILES – WP3: Stakeholders Involvement and Interaction

PROFILES
Curricular Delphi Study on Science Education

Interim Report on the Second Round of the UEF Working Group

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September 2012
1 Introduction

The aim of this PROFILES Curricular Delphi Study on Science Education is to engage different, so-called stakeholders, in reflecting on the contents and aims of science education, as well as outlining aspects and approaches of modern science education. In general, the main question of the PROFILES Curricular Delphi Study on Science Education focuses on those aspects of science education that are considered relevant and pedagogically desirable for the individual, both in society today and in the near future. In order to derive more specific responses, the main question is divided into three parts, referring to contexts, situations and motives, as well as to fields and qualifications respectively. The curricular Delphi group of Finland has decided to use the e-questionnaire in the second round of the Delphi study. The questionnaire was constructed on the website [http://elomake.joensuu.fi/lomakkeet/3135/lomake](http://elomake.joensuu.fi/lomakkeet/3135/lomake) (Appendix 1). Participants of the first round were sent an email asking to them to participate in the second round of the Delphi study on 23 November 2011. The website was available until 16th January 2012.

The second round offered participants the possibility to express their ideas on the importance of the desired science education found in the first round. The participants were informed about the allocated categories of the first round; they were asked both to assess to what extent the aspects expressed in the categories had been realized in practice and also to prioritize the given categories. In order to identify the concepts that are considered important regarding science education, the participants were also asked to combine categories from the given set of categories. In the third round, those concepts identified by cluster analytical methods are to be fed back to the participants for a weighted assessment, in the same way as in the second round.

The framework, the procedure and the results of the second round of the UEF PROFILES Curricular Delphi Study on Science Education, will be presented in this interim report.

2 Leading questions of the second round

The second round of the Curricular Delphi study aims to find answers to:

1. Which characteristics do the participants consider as being important in a desirable science education?
2. Which conceptual frameworks are considered as being necessary and important for science education?

3 Method

In order to answer the first question, the 85 categories (Appendix 1: Table 1) that were identified in the first round of the PROFILES Curricular Delphi Study in Science Education, were presented to the 187 participants (see Table 2) of this study, for their assessment (part I of the questionnaire). The categories were to be assessed from two points of view ("priority" and "practice") on a six-tier scale; both points of view are specified by the following questions:
1. Which priority should the respective aspects have in science education (priority)?
2. To what extent are the respective aspects realized in current science education (practice)?

With regard to the second question (part II of the questionnaire), the participants were asked to put together concepts of desirable science education by combining the categories that had been presented to them (Appendix 1: Table 1). The data regarding the first part of the questionnaire was analyzed by means of descriptive and variance analytical methods. The second question was worked on by the FUB team, using the method of hierarchical cluster analyses and Ward cluster analysis. For both points of view, the data in part I was coded with the numbers 1-6 according to the six-tier scale. The data in part II was transcribed by coding every selected category entry with “1” and non-selected categories with “0”.

4 Sample structure and form of responses

109 participants took part in the second round of the PROFILES Curricular Delphi Study on Science Education (see Table 1); the sample of participants in the second round included a number from the first round (101) as well as some who had not taken part in the first round (6).

Table 1: Sample structure UEF

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>Student teachers</th>
<th>Teachers</th>
<th>Teachers together</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of participants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>round 1</td>
<td>76</td>
<td>39</td>
<td>25</td>
<td>64</td>
<td>25</td>
<td>22</td>
<td>187</td>
</tr>
<tr>
<td>round 2</td>
<td>30</td>
<td>10</td>
<td>22</td>
<td>32</td>
<td>24</td>
<td>18</td>
<td>104</td>
</tr>
<tr>
<td>round 2 taking part</td>
<td>30</td>
<td>9</td>
<td>22</td>
<td>31</td>
<td>22</td>
<td>15</td>
<td>98</td>
</tr>
<tr>
<td>also in round 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Number of form sheets  |          |                  |          |                   |                   |            |       |
| (part II), round 2     |          |                  |          |                   |                   |            |       |
| 1 form sheet           | 30(30)   | 10(10)           | 20(20)   | 29(29)            | 18 (18)           | 16(16)     |       |
| 2 form sheets          |          |                  | 1(2)     | 1(2)              | 1 (3)             | 1(3)       |       |
| 3 form sheets          |          |                  | 1(3)     | 1(3)              | 5 (20)            | 1(4)       |       |
| 4 form sheets          |          |                  |          |                   | 2 (1)             | 3(6)       |       |
| New participants       |          |                  |          |                   |                   |            |       |
| Total                  | 30       | 11               | 25       | 35                | 42                | 29         | 136   |

5 Results of the descriptive analyses

In the next chapters the results of descriptive analyses is presented for priority, practice and their difference by categories and participants’ groups.

5.1 Priority-assessment differentiated according to the groups

Tables 2-5 show the mean of the priority, standard deviation and the number of valid participants in the first part of the e-questionnaire, namely the situation, event or motive. Each participant group is presented in one table.
Table 2. The priority of the situation, event or motive; science educators

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators’ priority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>4.42a</td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>5.54a</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>4.87ab</td>
</tr>
<tr>
<td>A4 everyday life (pets,garden,living, hobbies,tourism, actions at home)</td>
<td>4.88ab</td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>4.79a</td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>5.17a</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>4.70a</td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>5.63a</td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>4.67a</td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>5.17a</td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.96a</td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>5.00a</td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>5.21a</td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>4.38a</td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>5.08a</td>
</tr>
<tr>
<td>A16 media</td>
<td>4.42a</td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>5.08a</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.83a</td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>4.58a</td>
</tr>
</tbody>
</table>

Note: Values in the same row and sub table not sharing the same subscript are significantly different at p< 0.05 in the two-sided test of equality for column means. Cells with no subscript are not included in the test. Tests assume equal variances.

1. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Table 3. The priority of the situation, event or motive; scientists

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Scientists’ priority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>3.44a</td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>4.89ab</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>4.56ab</td>
</tr>
<tr>
<td>A4 everyday life (pets,garden,living, hobbies,tourism, actions at home)</td>
<td>4.50ab</td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>4.50a</td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>4.50a</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>4.00a</td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>5.11ab</td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>4.39a</td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>4.11b</td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.78ab</td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>4.83ab</td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>4.72a</td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>4.00a</td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>3.67b</td>
</tr>
<tr>
<td>A16 media</td>
<td>4.17a</td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>4.50ab</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.94a</td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>4.11ab</td>
</tr>
</tbody>
</table>
### Table 4. The priority of the situation, event or motive; teachers

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Teachers’ priority</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
<td></td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>4.25&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>.950</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>5.06&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.759</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>5.03&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.706</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A4 everyday life (pets, garden, living, hobbies, tourism, actions at home)</td>
<td>5.06&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.840</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>4.59&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.103</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>5.00&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.775</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>4.39&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.145</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>5.13&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>.806</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>4.52&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.029</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>4.72&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>.958</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.81&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.931</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>4.94&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.801</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>4.74&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.893</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>4.03&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.062</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>4.44&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>1.105</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A16 media</td>
<td>4.28&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.888</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>4.53&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>.915</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.75&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.047</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>4.52&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.029</td>
<td>31</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5. The priority of the situation, event or motive; students

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Students’ priority</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
<td></td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>4.03&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>1.426</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>4.25&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.206</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>4.25&lt;sub&gt;b&lt;/sub&gt;</td>
<td>.799</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A4 everyday life (pets, garden, living, hobbies, tourism, actions at home)</td>
<td>4.31&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.257</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>4.79&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.082</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>4.79&lt;sub&gt;a&lt;/sub&gt;</td>
<td>.861</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>4.57&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.136</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>4.59&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.181</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>4.03&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.210</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>4.59&lt;sub&gt;ab&lt;/sub&gt;</td>
<td>1.119</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.10&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.263</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>4.21&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.146</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>4.64&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.129</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>4.34&lt;sub&gt;b&lt;/sub&gt;</td>
<td>.857</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>4.28&lt;sub&gt;b&lt;/sub&gt;</td>
<td>.922</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>A16 media</td>
<td>4.32&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.056</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>4.00&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.145</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.57&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.357</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>3.37&lt;sub&gt;b&lt;/sub&gt;</td>
<td>1.189</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>
In Table 6, the variance in analytical results is shown to compare the participant groups. We have to note that the size of the groups of participants is quite small, the smallest being 18 (scientists). From this viewpoint, results have to be considered very carefully. The analysis does, however, give some insight into the differences.

Table 6. Comparisons of Column Means* in the situation, event or motive categories (part 1)

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>B (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A4 everyday life (pets, garden, living, hobbies, tourism, actions at home)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A16 media</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>D (A)</td>
<td>D (B)</td>
<td>D (C)</td>
<td>D (D)</td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pairwise comparisons within a row of each innermost subtable using the Bonferroni correction.

For example, the science educators' view of priority in the category 'managing in nature' differs from that of the scientists, as also is the case in categories 'biology content' and 'moving around in nature'. The teachers' view of ethical choices as a starting point for science education differs from that of the students, also in 'interest', 'everyday life', 'physics' and 'chemistry', and 'situations at school'. In seven categories, science educators' views differ from students' views.

Tables 7-10 concerning perspective in instruction, show the mean of the priority, standard deviation and the number of valid participants. Each participant group is presented in one table.
### Table 7. The priority of the contents or themes: perspective of instruction; science educators

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Science educators’ priority</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td>5.71a</td>
<td>.464</td>
<td>24</td>
</tr>
<tr>
<td>A21 energy</td>
<td>5.29</td>
<td>.690</td>
<td>24</td>
</tr>
<tr>
<td>A22 health/medicine</td>
<td>4.83</td>
<td>.702</td>
<td>24</td>
</tr>
<tr>
<td>A23 natural phenomena and catastrophes</td>
<td>4.79</td>
<td>1.062</td>
<td>24</td>
</tr>
<tr>
<td>A24 technical devices/function of appliances</td>
<td>4.38</td>
<td>1.013</td>
<td>24</td>
</tr>
<tr>
<td>A25 managing in nature</td>
<td>4.39</td>
<td>.941</td>
<td>23</td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td>4.83</td>
<td>.868</td>
<td>24</td>
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<tr>
<td>A27 food and eating</td>
<td>4.79</td>
<td>.884</td>
<td>24</td>
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<tr>
<td>A28 global warming</td>
<td>5.13</td>
<td>.920</td>
<td>23</td>
</tr>
<tr>
<td>A29 chemical reaction</td>
<td>4.62</td>
<td>.924</td>
<td>24</td>
</tr>
<tr>
<td>A30 water</td>
<td>5.46</td>
<td>.779</td>
<td>24</td>
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<tr>
<td>A31 home economics</td>
<td>4.46</td>
<td>1.141</td>
<td>24</td>
</tr>
<tr>
<td>A32 first aid</td>
<td>4.54</td>
<td>1.062</td>
<td>24</td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
<td>4.42</td>
<td>1.100</td>
<td>24</td>
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</table>

### Table 8. The priority of the contents or themes: perspective of instruction; scientists

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Scientists’ priority</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td>5.44a</td>
<td>.705</td>
<td>18</td>
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<tr>
<td>A21 energy</td>
<td>5.11</td>
<td>.676</td>
<td>18</td>
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<td>A22 health/medicine</td>
<td>4.56</td>
<td>.616</td>
<td>18</td>
</tr>
<tr>
<td>A23 natural phenomena and catastrophes</td>
<td>4.44</td>
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<tr>
<td>A24 technical devices/function of appliances</td>
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<td>17</td>
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<td>3.33</td>
<td>1.029</td>
<td>18</td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td>4.28</td>
<td>1.179</td>
<td>18</td>
</tr>
<tr>
<td>A27 food and eating</td>
<td>4.17</td>
<td>1.043</td>
<td>18</td>
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<tr>
<td>A28 global warming</td>
<td>4.78</td>
<td>.878</td>
<td>18</td>
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<tr>
<td>A29 chemical reaction</td>
<td>4.28</td>
<td>1.018</td>
<td>18</td>
</tr>
<tr>
<td>A30 water</td>
<td>5.11</td>
<td>1.023</td>
<td>18</td>
</tr>
<tr>
<td>A31 home economics</td>
<td>3.83</td>
<td>1.043</td>
<td>18</td>
</tr>
<tr>
<td>A32 first aid</td>
<td>4.17</td>
<td>1.200</td>
<td>18</td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
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<td>1.145</td>
<td>18</td>
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### Table 9. The priority of the contents or themes: perspective of instruction; teachers

<table>
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<tr>
<th>Contents or themes; perspective</th>
<th>Teachers’ priority</th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
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<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
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<td>.773</td>
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<tr>
<td>A22 health/medicine</td>
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<td>1.013</td>
<td>31</td>
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<tr>
<td>A23 natural phenomena and catastrophes</td>
<td>4.65</td>
<td>.839</td>
<td>31</td>
</tr>
<tr>
<td>A24 technical devices/function of appliances</td>
<td>4.39</td>
<td>.803</td>
<td>31</td>
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<tr>
<td>A25 managing in nature</td>
<td>4.48</td>
<td>.996</td>
<td>31</td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td>4.87</td>
<td>.763</td>
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<td>A27 food and eating</td>
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<td>.950</td>
<td>31</td>
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<td>A28 global warming</td>
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<td>.851</td>
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<tr>
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<td>.832</td>
<td>31</td>
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<tr>
<td>A30 water</td>
<td>4.97</td>
<td>.706</td>
<td>31</td>
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<tr>
<td>A31 home economics</td>
<td>4.23</td>
<td>.920</td>
<td>31</td>
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<tr>
<td>A32 first aid</td>
<td>4.65</td>
<td>.915</td>
<td>31</td>
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<td>A33 societal issues/land use/regulations/production</td>
<td>3.97</td>
<td>1.140</td>
<td>31</td>
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</table>
### Table 10. The priority of the contents or themes: perspective of instruction; students

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Students' priority</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Valid N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td></td>
<td>4.43</td>
<td>1.251</td>
<td>30</td>
</tr>
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<td>A21 energy</td>
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<td>4.17</td>
<td>.950</td>
<td>30</td>
</tr>
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<td>A22 health/medicine</td>
<td></td>
<td>4.37</td>
<td>.964</td>
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<td>A23 natural phenomena and catastrophes</td>
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<td>1.177</td>
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<td>3.77</td>
<td>1.223</td>
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<td>1.095</td>
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</tr>
<tr>
<td>A27 food and eating</td>
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<td>4.37</td>
<td>1.159</td>
<td>30</td>
</tr>
<tr>
<td>A28 global warming</td>
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<td>4.43</td>
<td>1.165</td>
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<tr>
<td>A29 chemical reaction</td>
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<td>3.93</td>
<td>1.048</td>
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<tr>
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<td>1.167</td>
<td>30</td>
</tr>
<tr>
<td>A31 home economics</td>
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<td>4.23</td>
<td>1.223</td>
<td>30</td>
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<tr>
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<td>4.66</td>
<td>1.203</td>
<td>29</td>
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<td>3.80</td>
<td>1.126</td>
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</tbody>
</table>

In Table 11 the variance in analytical results is shown to compare the participant groups.

### Table 11. Comparisons of Column Means\(a\) in contents or themes: perspective of instruction

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
</tr>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A21 energy</td>
<td></td>
<td>B</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>A22 health/medicine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A23 natural phenomena and catastrophes</td>
<td></td>
<td>B</td>
<td>B</td>
<td>D</td>
</tr>
<tr>
<td>A24 technical devices/function of appliances</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A25 managing in nature</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A27 food and eating</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A28 global warming</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A29 chemical reaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A30 water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A31 home economics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A32 first aid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Students have pointed out sustainable development less than any other groups and also consider chemical reactions to be less important. Managing in nature is, however, considered more important for students than for the teachers. Science educators and teachers prioritize technical devices as being a starting point more than the scientists do.
The results of themes are shown next.

### Table 12. The priority of the contents or themes: themes to be taught; science educators

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Science educators’ view</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
<td>4.92</td>
<td>1.018</td>
</tr>
<tr>
<td>A35 animals</td>
<td>4.88</td>
<td>.992</td>
</tr>
<tr>
<td>A36 evolution</td>
<td>5.00</td>
<td>.933</td>
</tr>
<tr>
<td>A37 human biology</td>
<td>5.46</td>
<td>.588</td>
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<tr>
<td>A38 ecology</td>
<td>5.42</td>
<td>.654</td>
</tr>
<tr>
<td>A39 genetics / molecular biology</td>
<td>4.79</td>
<td>.977</td>
</tr>
<tr>
<td>A40 chemistry: substances, materials and their properties</td>
<td>5.00</td>
<td>.978</td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td>4.96</td>
<td>.908</td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td>4.71</td>
<td>.999</td>
</tr>
<tr>
<td>A43 electricity / magnetism / electronics</td>
<td>4.92</td>
<td>.830</td>
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<tr>
<td>A44 mechanics</td>
<td>4.62</td>
<td>.970</td>
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<tr>
<td>A45 heat</td>
<td>4.75</td>
<td>.989</td>
</tr>
<tr>
<td>A46 optics (or light)</td>
<td>4.75</td>
<td>.989</td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td>4.25</td>
<td>1.073</td>
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<tr>
<td>A48 sound</td>
<td>4.50</td>
<td>.978</td>
</tr>
<tr>
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<td>4.33</td>
<td>1.090</td>
</tr>
<tr>
<td>A50 geography / geology</td>
<td>4.96</td>
<td>.859</td>
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<tr>
<td>A51 basics of sciences in general</td>
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<td>.780</td>
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</table>

### Table 13. The priority of the contents or themes: themes to be taught; scientists

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Scientists’ view</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
<td>4.11</td>
<td>1.023</td>
</tr>
<tr>
<td>A35 animals</td>
<td>3.94</td>
<td>1.110</td>
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<tr>
<td>A36 evolution</td>
<td>4.33</td>
<td>1.328</td>
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<tr>
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<td>4.83</td>
<td>1.150</td>
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<td>A38 ecology</td>
<td>5.06</td>
<td>.899</td>
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<td>1.042</td>
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<td>1.037</td>
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<td>1.200</td>
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<td>1.043</td>
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<td>A45 heat</td>
<td>4.28</td>
<td>1.018</td>
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<tr>
<td>A46 optics (or light)</td>
<td>4.17</td>
<td>1.098</td>
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<tr>
<td>A47 nuclear physics</td>
<td>3.72</td>
<td>1.274</td>
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<td>4.00</td>
<td>1.188</td>
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<td>.985</td>
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</table>
Table 14. The priority of the contents or themes: themes to be taught; teachers

<table>
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<tr>
<th>Contents or themes: themes to be taught</th>
<th>Teachers' view</th>
<th>Validation:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
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<td>.907</td>
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<tr>
<td>A35 animals</td>
<td>4.47</td>
<td>.879</td>
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<tr>
<td>A36 evolution</td>
<td>4.38</td>
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<td>.832</td>
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<td>.762</td>
</tr>
<tr>
<td>A43 electricity / magnetism / electronics</td>
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<td>.851</td>
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<td>.880</td>
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<tr>
<td>A46 optics (or light)</td>
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<td>.842</td>
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<tr>
<td>A47 nuclear physics</td>
<td>3.94</td>
<td>1.318</td>
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<td>4.19</td>
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<td>1.105</td>
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<tr>
<td>A50 geography / geology</td>
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<td>.851</td>
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<tr>
<td>A51 basics of sciences in general</td>
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<td>.660</td>
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</tbody>
</table>

Table 15. The priority of the contents or themes: themes to be taught; students

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Students' view</th>
<th>Validation:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
<td>3.93</td>
<td>1.172</td>
</tr>
<tr>
<td>A35 animals</td>
<td>4.20</td>
<td>1.215</td>
</tr>
<tr>
<td>A36 evolution</td>
<td>4.57</td>
<td>1.073</td>
</tr>
<tr>
<td>A37 human biology</td>
<td>5.10</td>
<td>.712</td>
</tr>
<tr>
<td>A38 ecology</td>
<td>4.50</td>
<td>1.075</td>
</tr>
<tr>
<td>A39 genetics / molecular biology</td>
<td>4.17</td>
<td>1.085</td>
</tr>
<tr>
<td>A40 chemistry: substances, materials and their properties</td>
<td>3.70</td>
<td>.988</td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td>3.67</td>
<td>1.124</td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td>3.20</td>
<td>1.126</td>
</tr>
<tr>
<td>A43 electricity / magnetism / electronics</td>
<td>3.57</td>
<td>1.073</td>
</tr>
<tr>
<td>A44 mechanics</td>
<td>3.43</td>
<td>1.006</td>
</tr>
<tr>
<td>A45 heat</td>
<td>3.93</td>
<td>1.081</td>
</tr>
<tr>
<td>A46 optics (or light)</td>
<td>3.63</td>
<td>1.098</td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td>3.38</td>
<td>1.178</td>
</tr>
<tr>
<td>A48 sound</td>
<td>3.50</td>
<td>1.167</td>
</tr>
<tr>
<td>A49 space / astronomy</td>
<td>3.70</td>
<td>1.264</td>
</tr>
<tr>
<td>A50 geography / geology</td>
<td>4.47</td>
<td>.973</td>
</tr>
<tr>
<td>A51 basics of sciences in general</td>
<td>4.93</td>
<td>1.172</td>
</tr>
</tbody>
</table>

Table 16 shows the comparison in priorities of themes to be taught.
Table 16. Comparisons of Column Means* in contents or themes; themes to be taught

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Science educators (A)</th>
<th>Scientists (B)</th>
<th>Teachers (C)</th>
<th>Students (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A34 plants /berries/mushrooms</td>
<td>D</td>
<td>B</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A35 animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A36 evolution</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A37 human biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A38 ecology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A39 genetics/molecular biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A40 chemistry: substances, materials and their properties</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A43 electricity/magnetism/electronics</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A44 mechanics</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>A45 heat</td>
<td>D</td>
<td></td>
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<tr>
<td>A46 optics (or light)</td>
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<td></td>
<td>D</td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A48 sound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A49 space/astronomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A50 geography/geology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A51 basics of sciences in general</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Yet again the students' views appear to be different from that of the other participants. The priority of teaching about animals also differs amongst the groups of science educators and scientists; educators giving preference to these studies. Participants shared the same views only in the categories of 'evolution', 'human biology', 'genetics', 'chemistry', 'nuclear physics', 'space', 'geography', and 'basics of sciences'. Tables 17-20 show the priorities for methods.

Table 17. The priority of the contents or themes: methods, which should be used in instruction; science educators

<table>
<thead>
<tr>
<th>Contents or themes: methods, which should be used</th>
<th>Science educators</th>
<th>Valid N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A52 maps</td>
<td>5.25</td>
<td>.897</td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>4.58</td>
<td>1.176</td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>5.25</td>
<td>.897</td>
</tr>
<tr>
<td>A55 models</td>
<td>5.12</td>
<td>.992</td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>5.21</td>
<td>1.03</td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>5.42</td>
<td>1.060</td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>5.62</td>
<td>.576</td>
</tr>
<tr>
<td>A59 applying</td>
<td>5.62</td>
<td>.495</td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.71</td>
<td>.999</td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>5.17</td>
<td>.917</td>
</tr>
<tr>
<td>A62 interest as starting point</td>
<td>5.17</td>
<td>.761</td>
</tr>
<tr>
<td>A63 societal participation</td>
<td>4.71</td>
<td>1.083</td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>5.57</td>
<td>.788</td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>5.25</td>
<td>.847</td>
</tr>
<tr>
<td>A67 entrepreneurship approach</td>
<td>3.96</td>
<td>1.398</td>
</tr>
</tbody>
</table>
### Table 18. The priority of the contents or themes: methods, which should be used in instruction; scientists

<table>
<thead>
<tr>
<th>Contents or themes: methods, which should be used</th>
<th>Scientists’ view</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
<td></td>
</tr>
<tr>
<td>A52 maps</td>
<td>4.50</td>
<td>.924</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>4.39</td>
<td>1.195</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>4.44</td>
<td>1.338</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A55 models</td>
<td>4.17</td>
<td>.924</td>
<td>18</td>
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</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>4.83</td>
<td>.924</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>4.83</td>
<td>1.098</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>5.50</td>
<td>.924</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A59 applying</td>
<td>5.17</td>
<td>1.043</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.67</td>
<td>1.237</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>4.24</td>
<td>.903</td>
<td>17</td>
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<td>A62 interest as a starting point</td>
<td>4.72</td>
<td>.958</td>
<td>18</td>
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<tr>
<td>A63 societal participation</td>
<td>4.61</td>
<td>.850</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A64 system thinking</td>
<td>4.61</td>
<td>.850</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>5.41</td>
<td>.939</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>4.89</td>
<td>.832</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>3.67</td>
<td>1.455</td>
<td>18</td>
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</table>

### Table 19. The priority of the Contents or Themes: methods, which should be used in instruction; teachers

<table>
<thead>
<tr>
<th>Contents or themes: methods, which should be used</th>
<th>Teachers’ view</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
<td></td>
</tr>
<tr>
<td>A52 maps</td>
<td>5.00</td>
<td>.762</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>4.06</td>
<td>.982</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>4.78</td>
<td>.906</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A55 models</td>
<td>4.72</td>
<td>.683</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>4.91</td>
<td>.856</td>
<td>32</td>
<td></td>
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<tr>
<td>A57 inquiries</td>
<td>4.72</td>
<td>.729</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>5.34</td>
<td>.745</td>
<td>32</td>
<td></td>
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<tr>
<td>A59 applying</td>
<td>5.16</td>
<td>.808</td>
<td>32</td>
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</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.50</td>
<td>.762</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>4.19</td>
<td>.738</td>
<td>32</td>
<td></td>
</tr>
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<td>A62 interest as a starting point</td>
<td>5.13</td>
<td>.871</td>
<td>32</td>
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<tr>
<td>A63 societal participation</td>
<td>4.66</td>
<td>1.035</td>
<td>32</td>
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<tr>
<td>A64 system thinking</td>
<td>3.91</td>
<td>1.027</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>5.09</td>
<td>.995</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>5.19</td>
<td>.738</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>3.78</td>
<td>1.070</td>
<td>32</td>
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</tr>
</tbody>
</table>
Table 20. The priority of the contents or themes: methods, which should be used in instruction; students

<table>
<thead>
<tr>
<th>Contents or themes: methods, which should be used</th>
<th>Students' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>A52 maps</td>
<td>4.38</td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>3.83</td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>3.75</td>
</tr>
<tr>
<td>A55 models</td>
<td>3.79</td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>4.14</td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>3.97</td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>4.97</td>
</tr>
<tr>
<td>A59 applying</td>
<td>4.79</td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.34</td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>3.93</td>
</tr>
<tr>
<td>A62 interest as a starting point</td>
<td>4.86</td>
</tr>
<tr>
<td>A63 societal participation</td>
<td>3.97</td>
</tr>
<tr>
<td>A64 system thinking</td>
<td>4.00</td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>4.83</td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>4.86</td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>4.07</td>
</tr>
</tbody>
</table>

Table 21 shows comparisons in prioritizing teaching methods.

Table 21. Comparisons of Column Means* in contents or themes: methods, which should be used in instruction

<table>
<thead>
<tr>
<th>Contents or themes: methods, which should be used</th>
<th>Science educators (A)</th>
<th>Scientists (B)</th>
<th>Teachers (C)</th>
<th>Students (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A52 maps</td>
<td>D</td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>D</td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>B D</td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A55 models</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>D</td>
<td>D</td>
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<td></td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A59 applying</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A62 interest as a starting point</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A63 societal participation</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A64 system thinking</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>D</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pairwise comparisons within a row of each innermost subtable using the Bonferroni correction.

The science educators and the scientists differ only in pointing out ‘models’. To some extent, science educators highlight ‘system thinking’ whereas teachers do not. In other categories, differences in views are apparent between the students and the other groups. In 6 out of 16 categories, teachers’ views are different those of the students’ and in 8 categories, science educators’ views are different from the students’ views. Like the teachers and educators, scientists prefer inquiries whereas the students do not. We have to note that inquiries are an important part of the Finnish curriculum.
The following Tables 22-25 present priorities in abilities, knowledge and skills.

### Table 22. The priority of abilities, knowledge and skills which should be acquired: science educators

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Science educators’ view</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>5.67</td>
<td>.565</td>
<td>24</td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td>5.58</td>
<td>.504</td>
<td>24</td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td>5.13</td>
<td>.797</td>
<td>24</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td>5.04</td>
<td>.955</td>
<td>24</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>5.50</td>
<td>.780</td>
<td>24</td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td>5.25</td>
<td>.737</td>
<td>24</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>4.96</td>
<td>.859</td>
<td>24</td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td>5.46</td>
<td>.779</td>
<td>24</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>5.54</td>
<td>.779</td>
<td>24</td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td>5.54</td>
<td>.509</td>
<td>24</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>5.54</td>
<td>.588</td>
<td>24</td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td>5.58</td>
<td>.717</td>
<td>24</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>5.29</td>
<td>.908</td>
<td>24</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>5.46</td>
<td>.779</td>
<td>24</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td>4.75</td>
<td>1.032</td>
<td>24</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td>5.17</td>
<td>.816</td>
<td>24</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td>5.63</td>
<td>.495</td>
<td>24</td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td>5.17</td>
<td>.963</td>
<td>24</td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td>5.54</td>
<td>.779</td>
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<tr>
<td>A87 skills for innovation</td>
<td>5.00</td>
<td>.978</td>
<td>24</td>
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</tbody>
</table>

### Table 23. The priority of abilities, knowledge and skills which should be acquired: scientists

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Scientists’ view</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>5.33</td>
<td>.907</td>
<td>18</td>
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<tr>
<td>A69 ability to make healthy choices</td>
<td>5.17</td>
<td>.985</td>
<td>18</td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td>4.72</td>
<td>1.227</td>
<td>18</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td>4.94</td>
<td>1.211</td>
<td>18</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>4.94</td>
<td>.998</td>
<td>18</td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td>4.50</td>
<td>.985</td>
<td>18</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>4.61</td>
<td>.916</td>
<td>18</td>
</tr>
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<td>A75 knowledge to be able to act/make choices</td>
<td>5.22</td>
<td>.878</td>
<td>18</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>5.50</td>
<td>.857</td>
<td>18</td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td>4.94</td>
<td>.938</td>
<td>18</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>4.88</td>
<td>.993</td>
<td>17</td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td>5.56</td>
<td>.856</td>
<td>18</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>5.28</td>
<td>.826</td>
<td>18</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>4.94</td>
<td>1.144</td>
<td>17</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td>4.44</td>
<td>1.097</td>
<td>18</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td>4.83</td>
<td>1.098</td>
<td>18</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td>5.50</td>
<td>.857</td>
<td>18</td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td>4.28</td>
<td>.958</td>
<td>18</td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td>5.39</td>
<td>.850</td>
<td>18</td>
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<tr>
<td>A87 skills for innovation</td>
<td>4.33</td>
<td>.970</td>
<td>18</td>
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</table>
Table 24. The priority of abilities, knowledge and skills which should be acquired: teachers

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Teachers’ view</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>5.26</td>
<td>.773</td>
<td>31</td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td>5.42</td>
<td>.620</td>
<td>31</td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td>5.10</td>
<td>.746</td>
<td>31</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td>5.16</td>
<td>.820</td>
<td>31</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>5.48</td>
<td>.769</td>
<td>31</td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td>5.13</td>
<td>.763</td>
<td>31</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>4.71</td>
<td>.739</td>
<td>31</td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td>5.55</td>
<td>.568</td>
<td>31</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>5.74</td>
<td>.445</td>
<td>31</td>
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<tr>
<td>A77 skills to exploit or apply</td>
<td>5.33</td>
<td>.661</td>
<td>30</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>5.23</td>
<td>.805</td>
<td>31</td>
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<td>A79 skills to search for and read information</td>
<td>5.42</td>
<td>.672</td>
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<td>A80 skills to value things</td>
<td>5.23</td>
<td>.717</td>
<td>31</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>4.97</td>
<td>.850</td>
<td>30</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td>4.81</td>
<td>.873</td>
<td>31</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td>4.94</td>
<td>.814</td>
<td>31</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td>5.32</td>
<td>.832</td>
<td>31</td>
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<td>A85 inquiry skills</td>
<td>4.71</td>
<td>.739</td>
<td>31</td>
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<td>A86 critical thinking skills</td>
<td>5.52</td>
<td>.724</td>
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<tr>
<td>A87 skills for innovation</td>
<td>4.68</td>
<td>1.107</td>
<td>31</td>
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</tbody>
</table>

Table 25. The priority of abilities, knowledge and skills which should be acquired: students

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Students’ view</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Valid N</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>4.70</td>
<td>1.208</td>
<td>30</td>
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<tr>
<td>A69 ability to make healthy choices</td>
<td>5.20</td>
<td>.997</td>
<td>30</td>
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<tr>
<td>A70 ability to contribute for safety</td>
<td>5.00</td>
<td>1.017</td>
<td>30</td>
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<tr>
<td>A71 eligibility for further studies</td>
<td>5.27</td>
<td>.828</td>
<td>30</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>4.73</td>
<td>.907</td>
<td>30</td>
</tr>
<tr>
<td>A73 ability to interest in sciences</td>
<td>4.27</td>
<td>1.015</td>
<td>30</td>
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<tr>
<td>A74 knowledge in general/about energy</td>
<td>4.13</td>
<td>.973</td>
<td>30</td>
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<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td>5.10</td>
<td>.885</td>
<td>30</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>5.23</td>
<td>.935</td>
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<tr>
<td>A77 skills to exploit or apply</td>
<td>4.93</td>
<td>.868</td>
<td>30</td>
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<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>4.60</td>
<td>.997</td>
<td>30</td>
</tr>
<tr>
<td>A79 skills to search and read information</td>
<td>4.80</td>
<td>.997</td>
<td>30</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>4.47</td>
<td>1.137</td>
<td>30</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>4.53</td>
<td>.776</td>
<td>30</td>
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<tr>
<td>A82 technical and ICT skills</td>
<td>4.17</td>
<td>1.020</td>
<td>30</td>
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<tr>
<td>A83 skills to generalize and combine</td>
<td>4.50</td>
<td>.861</td>
<td>30</td>
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<tr>
<td>A84 problem solving skills</td>
<td>4.80</td>
<td>.925</td>
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<tr>
<td>A85 inquiry skills</td>
<td>4.03</td>
<td>1.098</td>
<td>30</td>
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<tr>
<td>A86 critical thinking skills</td>
<td>5.07</td>
<td>.944</td>
<td>30</td>
</tr>
<tr>
<td>A87 skills for innovation</td>
<td>4.47</td>
<td>.973</td>
<td>30</td>
</tr>
</tbody>
</table>
Table 26 shows the differences between the participant groups.

### Table 26. Comparisons of Column Means in abilities, knowledge and skills which should be acquired

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
<td></td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td>D</td>
<td>B</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A76 skills to act/take care of one's own life</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>D</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td></td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td></td>
<td>B</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A87 skills for innovation</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Science educators' views differ from the scientists' view concerning 'ability to be interested in sciences' and 'inquiry skills'. Again the students' views are different. More differences are apparent between the science educators' views and the students' views (12 out of 20 categories) than between the scientists' and students' views (3 out of 20). Also the teachers' views are nearer those of the students than those of the science educators.
5.2 The differentiation of practice-assessment according to the groups

Tables 27-28 present participants' views regarding practice at schools in the case of situation, event or motive.

### Table 27. Practice regarding situation, event or motive; science educators and scientists

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators' view</th>
<th>Scientists' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>2.75 .794</td>
<td>23</td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>3.67 1.007</td>
<td>24</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>3.70 .974</td>
<td>23</td>
</tr>
<tr>
<td>A4 everyday life(pets, garden, living, hobbies, tourism, actions at home)</td>
<td>3.83 .868</td>
<td>24</td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>3.79 .833</td>
<td>24</td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>4.33 .917</td>
<td>24</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>3.83 1.029</td>
<td>23</td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>3.92 .974</td>
<td>24</td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>3.21 .779</td>
<td>24</td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>4.38 .875</td>
<td>24</td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.46 .932</td>
<td>24</td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>4.46 .884</td>
<td>24</td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>4.50 .885</td>
<td>24</td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>2.92 .881</td>
<td>24</td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>3.33 1.049</td>
<td>24</td>
</tr>
<tr>
<td>A16 media</td>
<td>3.58 .830</td>
<td>24</td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>2.87 .947</td>
<td>24</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.25 .847</td>
<td>24</td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>3.67 1.090</td>
<td>24</td>
</tr>
</tbody>
</table>

### Table 28. Practice regarding situation, event or motive; teachers and students

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Teachers' view</th>
<th>Students' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td>2.84 .987</td>
<td>32</td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td>3.81 1.148</td>
<td>32</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>3.90 .870</td>
<td>31</td>
</tr>
<tr>
<td>A4 everyday life(pets, garden, living, hobbies, tourism, actions at home)</td>
<td>4.06 1.014</td>
<td>32</td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
<td>3.72 1.054</td>
<td>32</td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
<td>4.37 .833</td>
<td>32</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>3.58 1.148</td>
<td>31</td>
</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td>4.19 1.176</td>
<td>32</td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td>3.81 1.167</td>
<td>31</td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td>4.66 1.066</td>
<td>32</td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td>4.78 .832</td>
<td>32</td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td>4.94 .716</td>
<td>32</td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td>4.55 1.028</td>
<td>31</td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td>3.09 1.353</td>
<td>32</td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td>3.47 .915</td>
<td>32</td>
</tr>
<tr>
<td>A16 media</td>
<td>3.59 .979</td>
<td>32</td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td>3.03 .897</td>
<td>32</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>3.03 .897</td>
<td>32</td>
</tr>
<tr>
<td>A19 situations at school</td>
<td>3.31 1.176</td>
<td>32</td>
</tr>
</tbody>
</table>

Project funded within the EC FP7 Programme: 5.2.2.1 – SiS-2010-2.2.1
Grant Agreement No.: 266589
Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe
Table 29 shows the comparison between participant groups.

Table 29. Comparisons of Column Means in situation, event or motive categories: practice

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1 managing in nature and nature dependence</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>A2 ethical choices/consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4 everyday life(pets, garden, living, hobbies, tourism, actions at home)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A5 health (health, medicines, human being, beauty care)</td>
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<td></td>
</tr>
<tr>
<td>A6 nature/nature phenomena/nature catastrophes</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A7 food and eating</td>
<td></td>
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</tr>
<tr>
<td>A8 sustainable development (recycling, waste, nature protection, cultures, environmental problems)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A9 technology and traffic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A10 biology content (plants, animals, berries, mushrooms, evolution, gene modification)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A11 physics content (phenomena, radiation, energy)</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>A12 chemistry content (phenomena, water, combustion, materials, models)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A13 geography content (climate change, space, weather conditions, spatial knowledge, globe)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A14 working life/production/entrepreneurship</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A15 moving around in nature and the close environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A16 media</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A17 societal involvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A18 accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A19 situations at school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

In comparison to priority assessment, there appear to be very few differences regarding the participants’ views in the situation, event or motive categories used at school. Teachers’ views differ from those of the students on everyday issues and teachers also prefer more chemistry content than the scientists.

Tables 30-31 present the views on practice regarding perspective in instruction and Table 32 shows comparison between the groups.
### Table 30. Practice concerning contents or themes: perspective of instruction; science educators and scientists

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Science educators' view</th>
<th>Scientists' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td>3.79</td>
<td>1.141</td>
</tr>
<tr>
<td>A21 energy</td>
<td>3.96</td>
<td>.806</td>
</tr>
<tr>
<td>A22 health/medicine</td>
<td>3.54</td>
<td>.977</td>
</tr>
<tr>
<td>A23 natural phenomena and catastrophes</td>
<td>3.63</td>
<td>.875</td>
</tr>
<tr>
<td>A24 technical devices/function of appliances</td>
<td>3.25</td>
<td>.847</td>
</tr>
<tr>
<td>A25 managing in nature</td>
<td>2.63</td>
<td>.970</td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td>3.67</td>
<td>1.049</td>
</tr>
<tr>
<td>A27 food and eating</td>
<td>3.71</td>
<td>.806</td>
</tr>
<tr>
<td>A28 global warming</td>
<td>3.67</td>
<td>1.167</td>
</tr>
<tr>
<td>A29 chemical reaction</td>
<td>4.17</td>
<td>1.007</td>
</tr>
<tr>
<td>A30 water</td>
<td>4.13</td>
<td>.869</td>
</tr>
<tr>
<td>A31 home economics</td>
<td>3.46</td>
<td>1.021</td>
</tr>
<tr>
<td>A32 first aid</td>
<td>3.08</td>
<td>1.018</td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
<td>2.63</td>
<td>.970</td>
</tr>
</tbody>
</table>

### Table 31. Practice regarding contents or themes: perspective of instruction; teachers and students

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Teachers' view</th>
<th>Students' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A20 sustainable development/environmental effects/nature protection, recycling/waste/cultures</td>
<td>4.10</td>
<td>1.029</td>
</tr>
<tr>
<td>A21 energy</td>
<td>4.32</td>
<td>.909</td>
</tr>
<tr>
<td>A22 health/medicine</td>
<td>3.19</td>
<td>.910</td>
</tr>
<tr>
<td>A23 natural phenomena and catastrophes</td>
<td>4.06</td>
<td>1.153</td>
</tr>
<tr>
<td>A24 technical devices/function of appliances</td>
<td>2.97</td>
<td>.983</td>
</tr>
<tr>
<td>A25 managing in nature</td>
<td>2.87</td>
<td>.957</td>
</tr>
<tr>
<td>A26 safety/dangerous substances and events</td>
<td>3.74</td>
<td>.965</td>
</tr>
<tr>
<td>A27 food and eating</td>
<td>3.74</td>
<td>.930</td>
</tr>
<tr>
<td>A28 global warming</td>
<td>3.97</td>
<td>1.080</td>
</tr>
<tr>
<td>A29 chemical reaction</td>
<td>4.19</td>
<td>.833</td>
</tr>
<tr>
<td>A30 water</td>
<td>4.06</td>
<td>.964</td>
</tr>
<tr>
<td>A31 home economics</td>
<td>3.68</td>
<td>.909</td>
</tr>
<tr>
<td>A32 first aid</td>
<td>2.94</td>
<td>.964</td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
<td>2.58</td>
<td>1.119</td>
</tr>
</tbody>
</table>

### Table 32. Comparisons of Column Means* in practice regarding contents or themes: perspective of instruction

<table>
<thead>
<tr>
<th>Contents or themes; perspective</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
</tr>
<tr>
<td>A33 societal issues/land use/regulations/production</td>
<td></td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pairwise comparisons within a row of each innermost subtable using the Bonferroni correction.

Category A33 alone is presented because only here was any difference apparent.

---

Project funded within the EC FP7 Programme: 5.2.2.1 – SIS-2010-2.2.1
Grant Agreement No.:266589
Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe
From the view of perspective, contents or themes were seen in quite a similar way. Only one difference was found: students differ from teachers when considering societal issues.

Tables 33-34 present views on practice with regard to what themes should be taught.

**Table 33. Practice regarding contents or themes: themes to be taught; science educators and scientists**

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Science educators' view</th>
<th>Scientists' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
<td>4.37</td>
<td>1.096</td>
</tr>
<tr>
<td>A35 animals</td>
<td>4.46</td>
<td>.932</td>
</tr>
<tr>
<td>A36 evolution</td>
<td>3.96</td>
<td>.955</td>
</tr>
<tr>
<td>A37 human biology</td>
<td>4.58</td>
<td>.776</td>
</tr>
<tr>
<td>A38 ecology</td>
<td>4.08</td>
<td>.881</td>
</tr>
<tr>
<td>A39 genetics / molecular biology</td>
<td>3.92</td>
<td>.929</td>
</tr>
<tr>
<td>A40 chemistry: substances, materials and their properties</td>
<td>4.17</td>
<td>.816</td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td>4.29</td>
<td>.908</td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td>4.13</td>
<td>1.227</td>
</tr>
<tr>
<td>A43 electricity / magnetism / electronics</td>
<td>4.29</td>
<td>1.042</td>
</tr>
<tr>
<td>A44 mechanics</td>
<td>4.46</td>
<td>.932</td>
</tr>
<tr>
<td>A45 heat</td>
<td>4.17</td>
<td>1.007</td>
</tr>
<tr>
<td>A46 optics (or light)</td>
<td>4.29</td>
<td>.999</td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td>3.67</td>
<td>1.090</td>
</tr>
<tr>
<td>A48 sound</td>
<td>4.00</td>
<td>1.022</td>
</tr>
<tr>
<td>A49 space / astronomy</td>
<td>3.67</td>
<td>1.129</td>
</tr>
<tr>
<td>A50 geography / geology</td>
<td>4.21</td>
<td>1.021</td>
</tr>
<tr>
<td>A51 basics of sciences in general</td>
<td>3.88</td>
<td>1.076</td>
</tr>
</tbody>
</table>

**Table 34. Practice regarding contents or themes: themes to be taught; teachers and students**

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Teachers' view</th>
<th>Students' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A34 plants / berries / mushrooms</td>
<td>4.16</td>
<td>.920</td>
</tr>
<tr>
<td>A35 animals</td>
<td>4.19</td>
<td>.896</td>
</tr>
<tr>
<td>A36 evolution</td>
<td>3.72</td>
<td>1.085</td>
</tr>
<tr>
<td>A37 human biology</td>
<td>4.47</td>
<td>.879</td>
</tr>
<tr>
<td>A38 chemistry: substances, materials and their properties</td>
<td>3.81</td>
<td>1.120</td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td>4.28</td>
<td>.924</td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td>3.87</td>
<td>1.040</td>
</tr>
<tr>
<td>A43 electricity / magnetism / electronics</td>
<td>4.03</td>
<td>.861</td>
</tr>
<tr>
<td>A44 mechanics</td>
<td>4.00</td>
<td>.880</td>
</tr>
<tr>
<td>A45 heat</td>
<td>4.13</td>
<td>.833</td>
</tr>
<tr>
<td>A46 optics (or light)</td>
<td>4.03</td>
<td>.897</td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td>3.06</td>
<td>1.216</td>
</tr>
<tr>
<td>A48 sound</td>
<td>3.72</td>
<td>.888</td>
</tr>
<tr>
<td>A49 space / astronomy</td>
<td>3.03</td>
<td>1.356</td>
</tr>
<tr>
<td>A50 geography / geology</td>
<td>4.06</td>
<td>.998</td>
</tr>
<tr>
<td>A51 basics of sciences in general</td>
<td>3.97</td>
<td>1.062</td>
</tr>
</tbody>
</table>

Table 35 compares the groups.
Table 35. Comparisons of Column Means in contents or themes; themes to be taught, practice

<table>
<thead>
<tr>
<th>Contents or themes: themes to be taught</th>
<th>Science educators (A)</th>
<th>Scientists (B)</th>
<th>Teachers (C)</th>
<th>Students (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A34 plants/berries/mushrooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A35 animals</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A36 evolution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A37 human biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A38 ecology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A39 genetics/molecular biology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A40 chemistry: substances, materials and their properties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A41 carbon, its compounds and cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A42 chemical methods and symbols</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A43 electricity/magnetism/electronics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A44 mechanics</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A45 heat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A46 optics (or light)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A47 nuclear physics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A48 sound</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A49 space/astronomy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A50 geography/geology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A51 basics of sciences in general</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

The students differ from the scientists in their views on the themes 'human biology', 'genetics', 'chemistry', and 'geography'; in this last theme students differ also from the views of science educators and teachers. Some other differences exist: the way in which science educators experience teaching about animals and heat differs from other groups and teachers and students differ in how they consider the teaching of evolution in our schools. Tables 36-37 present the views on methods in practice and Table 38 shows comparison between the groups.

Table 36. Practice regarding contents or themes: methods which should be used in instruction; science educators and scientists

<table>
<thead>
<tr>
<th>Contents or themes: methods which should be used</th>
<th>Science educators' view</th>
<th>Scientists' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A52 maps</td>
<td>4.29</td>
<td>.955</td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>3.12</td>
<td>1.035</td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>3.17</td>
<td>.868</td>
</tr>
<tr>
<td>A55 models</td>
<td>3.71</td>
<td>.806</td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>3.42</td>
<td>1.018</td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>3.38</td>
<td>.970</td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>3.08</td>
<td>.717</td>
</tr>
<tr>
<td>A59 applying</td>
<td>3.13</td>
<td>.797</td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.17</td>
<td>1.090</td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>3.04</td>
<td>.806</td>
</tr>
<tr>
<td>A62 interest as a starting point</td>
<td>3.17</td>
<td>.917</td>
</tr>
<tr>
<td>A63 societal participation</td>
<td>2.83</td>
<td>.868</td>
</tr>
<tr>
<td>A64 system thinking</td>
<td>2.74</td>
<td>.810</td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>3.43</td>
<td>.945</td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>3.04</td>
<td>.806</td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>2.58</td>
<td>.929</td>
</tr>
</tbody>
</table>
Table 37. Practice regarding contents or themes: methods which should be used in instruction; teachers and students

<table>
<thead>
<tr>
<th>Contents or themes: methods which should be used</th>
<th>Teachers' view</th>
<th>Students' view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A52 maps</td>
<td>4.16</td>
<td>1.139</td>
</tr>
<tr>
<td>A53 spatial information applications</td>
<td>2.84</td>
<td>1.081</td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>3.50</td>
<td>1.016</td>
</tr>
<tr>
<td>A55 models</td>
<td>4.13</td>
<td>0.907</td>
</tr>
<tr>
<td>A56 learning through phenomena</td>
<td>3.91</td>
<td>1.058</td>
</tr>
<tr>
<td>A57 inquiries</td>
<td>3.50</td>
<td>0.984</td>
</tr>
<tr>
<td>A58 critical thinking</td>
<td>3.75</td>
<td>1.047</td>
</tr>
<tr>
<td>A59 applying</td>
<td>3.53</td>
<td>0.950</td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td>4.53</td>
<td>0.879</td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td>3.13</td>
<td>1.212</td>
</tr>
<tr>
<td>A62 interest as a starting point</td>
<td>3.50</td>
<td>0.984</td>
</tr>
<tr>
<td>A63 societal participation</td>
<td>2.72</td>
<td>0.958</td>
</tr>
<tr>
<td>A64 system thinking</td>
<td>3.00</td>
<td>1.244</td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td>3.91</td>
<td>1.027</td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td>3.47</td>
<td>1.047</td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td>2.50</td>
<td>1.016</td>
</tr>
</tbody>
</table>

Table 38. Comparisons of Column Means\(^a\) in contents or themes: methods which should be used in instruction

<table>
<thead>
<tr>
<th>Contents or themes: methods which should be used</th>
<th>Science educators (A)</th>
<th>Scientists (B)</th>
<th>Teachers (C)</th>
<th>Students (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A52 maps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A53 spatial information</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A54 nature of science</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A55 models</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>A56 learning through phenomena</td>
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</tr>
<tr>
<td>A57 inquiries</td>
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<td></td>
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</tr>
<tr>
<td>A58 critical thinking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A59 applying</td>
<td></td>
<td></td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>A60 calculating and measuring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A61 affective approaches</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A62 interest as a starting point</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A63 societal participation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A64 system thinking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A65 cause-effect relations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A66 future viewpoint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A67 entrepreneur approach</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

\(a\). Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Teachers and scientists differ in their views on the category 'model'; teachers perceive that models are used at schools and students experience ‘applying’ and ‘future viewpoint’ differently from science educators.

Tables 39-40 present views on practice regarding abilities, knowledge and skills and Table 41 shows comparison between the groups.
Table 39. Practice regarding the abilities, knowledge and skills which should be acquired: science educators and scientists

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Science educators’ view</th>
<th>Scientists’ view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>3.50</td>
<td>1.022</td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td>3.71</td>
<td>.908</td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td>3.42</td>
<td>.929</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td>4.46</td>
<td>1.021</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>3.54</td>
<td>.721</td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td>3.29</td>
<td>.859</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>3.63</td>
<td>.824</td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td>3.29</td>
<td>.751</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>3.30</td>
<td>.926</td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td>3.04</td>
<td>.806</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>2.92</td>
<td>.974</td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td>3.79</td>
<td>1.021</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>2.75</td>
<td>.794</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>2.87</td>
<td>.850</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td>3.79</td>
<td>.779</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td>3.04</td>
<td>.690</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td>3.25</td>
<td>.676</td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td>3.25</td>
<td>.944</td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td>2.96</td>
<td>.859</td>
</tr>
<tr>
<td>A87 skills for innovation</td>
<td>2.67</td>
<td>.816</td>
</tr>
</tbody>
</table>

Table 40. Practice regarding the abilities, knowledge and skills which should be acquired: teachers and students

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Teachers’ view</th>
<th>Students’ view</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
<td>3.84</td>
<td>.735</td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td>4.06</td>
<td>.727</td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td>3.55</td>
<td>.810</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td>4.71</td>
<td>.783</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td>3.87</td>
<td>.846</td>
</tr>
<tr>
<td>A73 ability to interest in sciences</td>
<td>3.90</td>
<td>.700</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td>4.06</td>
<td>.629</td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td>3.94</td>
<td>.814</td>
</tr>
<tr>
<td>A76 skills to act/take care of one’s own life</td>
<td>3.71</td>
<td>.864</td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td>3.52</td>
<td>.811</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td>3.58</td>
<td>.886</td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td>3.94</td>
<td>.892</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>3.60</td>
<td>.894</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td>3.29</td>
<td>1.039</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td>3.65</td>
<td>1.050</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td>3.55</td>
<td>.810</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td>3.65</td>
<td>1.050</td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td>3.10</td>
<td>1.012</td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td>3.39</td>
<td>.803</td>
</tr>
<tr>
<td>A87 skills for innovation</td>
<td>2.84</td>
<td>1.098</td>
</tr>
</tbody>
</table>
### Table 41. Comparisons of Column Means$^a$ regarding the abilities, knowledge and skills which should be acquired in practice

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills which should be acquired</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>A68 ability to act for sustainability</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A69 ability to make healthy choices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A70 ability to contribute for safety</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A73 ability to be interested in sciences</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A74 knowledge in general/about energy</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A75 knowledge to be able to act/make choices</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A76 skills to act/take care of one's own life</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A77 skills to exploit or apply</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A78 skills to enter into discussion/into societal actions</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A79 skills to search for and read information</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A80 skills to value things</td>
<td>D</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A81 skills to understand relationships (STS)</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A82 technical and ICT skills</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A83 skills to generalize and combine</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A84 problem solving skills</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A85 inquiry skills</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A86 critical thinking skills</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A87 skills for innovation</td>
<td></td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

$^a$Tests are adjusted for all pairwise comparisons within a row of each innermost sub table using the Bonferroni correction.

The views of scientists, teachers and students regarding knowledge of how to act, differ from those of the science educators. The students' views also differ from the science educators in experiencing categories such as 'skills to exploit', 'enter into discussion', 'value things', 'generalize and combine', as well as in 'critical thinking skills'. Students' views on real 'inquiry skills' differ from those of the teachers and scientists' views on 'technical and ICT skills' also differ from the students' views.
5.3 Priority-practice-differences, differentiated according to the groups

Tables 42-51 show differences between priority and practice regarding situation, the event or motive as a starting point in instruction, the perspective to be used, themes to be studied, methods and abilities to be used, knowledge and skills, as well as comparisons between the groups.

Table 42. Difference in situation, event or motive

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>N</td>
<td>Mean</td>
</tr>
<tr>
<td>A1 managing in nature</td>
<td>1.67</td>
<td>1.049</td>
<td>24</td>
<td>.62</td>
</tr>
<tr>
<td>A2 ethical choices</td>
<td>1.87</td>
<td>1.116</td>
<td>24</td>
<td>1.23</td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td>1.13</td>
<td>1.254</td>
<td>23</td>
<td>1.00</td>
</tr>
<tr>
<td>A4 everyday life</td>
<td>1.04</td>
<td>1.083</td>
<td>24</td>
<td>1.00</td>
</tr>
<tr>
<td>A5 health</td>
<td>1.00</td>
<td>1.251</td>
<td>24</td>
<td>.69</td>
</tr>
<tr>
<td>A6 nature</td>
<td>.83</td>
<td>1.090</td>
<td>24</td>
<td>.54</td>
</tr>
<tr>
<td>A7 food and eating</td>
<td>.87</td>
<td>1.217</td>
<td>23</td>
<td>.50</td>
</tr>
<tr>
<td>A8 sust. development</td>
<td>1.71</td>
<td>1.042</td>
<td>24</td>
<td>1.00</td>
</tr>
<tr>
<td>A9 technology</td>
<td>1.46</td>
<td>1.560</td>
<td>24</td>
<td>1.00</td>
</tr>
<tr>
<td>A10 biology content</td>
<td>.79</td>
<td>.833</td>
<td>24</td>
<td>-.08</td>
</tr>
<tr>
<td>A11 physics content</td>
<td>.50</td>
<td>1.103</td>
<td>24</td>
<td>.46</td>
</tr>
<tr>
<td>A12 chemistry cont.</td>
<td>.54</td>
<td>1.103</td>
<td>24</td>
<td>.85</td>
</tr>
<tr>
<td>A13 geography cont.</td>
<td>.71</td>
<td>.955</td>
<td>24</td>
<td>.46</td>
</tr>
<tr>
<td>A14 working life</td>
<td>1.46</td>
<td>1.693</td>
<td>24</td>
<td>1.17</td>
</tr>
<tr>
<td>A15 moving in nature</td>
<td>1.75</td>
<td>1.189</td>
<td>24</td>
<td>.31</td>
</tr>
<tr>
<td>A16 media</td>
<td>.83</td>
<td>1.049</td>
<td>24</td>
<td>.54</td>
</tr>
<tr>
<td>A17 societal involvem.</td>
<td>2.21</td>
<td>1.382</td>
<td>24</td>
<td>1.38</td>
</tr>
<tr>
<td>A18 accidents</td>
<td>.58</td>
<td>.929</td>
<td>24</td>
<td>.92</td>
</tr>
<tr>
<td>A19 situations at sch.</td>
<td>.92</td>
<td>1.176</td>
<td>24</td>
<td>.54</td>
</tr>
</tbody>
</table>

Table 43. Comparisons of Column Means: situation, event or motive

<table>
<thead>
<tr>
<th>Situation, event or motive</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
</tr>
<tr>
<td>A1 managing in nature</td>
<td>B</td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A2 ethical choices</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3 interest/knowledge</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4 everyday life</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A5 health</td>
<td></td>
<td>D</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A6 nature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A7 food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A8 sustainable development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A9 technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A10 biology content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A11 physics content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A12 chemistry content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A13 geography content</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A14 working life</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A15 moving around in nature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A16 media</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A17 societal involvem.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A18 accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A19 situations at sch.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

Project funded within the EC FP7 Programme: 5.2.2.1 – SiS-2010-2.2.1
Grant Agreement No.:266589
Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe
The science educators and scientists view 'managing in nature' differently, when considering the difference between priority and practice and science educators experience differences in 'ethical choices' differently from students. Science educators hold a different view of 'sustainable development', 'technology', 'biology', 'chemistry', 'physics', 'geography' and 'societal involvement' whereas scientists differ only from the students in the way they experience 'chemistry'. The teachers differ from the views of students in 'societal involvement' and 'situations at school' (teachers prefer situations at school, students do not).

Table 44. Difference in contents or themes: perspective

| Contents or themes: perspective | Science educators | | | | Scientists | | | | Teachers | | | | Students | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Mean | SD | N | Valid |
| A20 sust. development | 1.92 | 1.100 | 24 | 1.00 | .707 | 13 | 1.17 | 1.167 | 29 | .67 | 1.561 | 30 |
| A21 energy | 1.33 | 1.007 | 24 | 1.23 | .927 | 13 | .94 | 1.093 | 31 | .33 | .884 | 30 |
| A22 health | 1.29 | 1.301 | 24 | 1.00 | .707 | 13 | 1.48 | .962 | 31 | .80 | .997 | 30 |
| A23 natural phenom. | 1.17 | 1.090 | 24 | .69 | 1.032 | 13 | .58 | 1.089 | 31 | .77 | 1.073 | 30 |
| A24 technical devices | 1.12 | 1.227 | 24 | 1.17 | 1.030 | 12 | 1.42 | .992 | 31 | .87 | 1.074 | 30 |
| A25 manag. in nature | 1.78 | 1.313 | 23 | .62 | .870 | 13 | 1.61 | 1.054 | 31 | 1.13 | 1.697 | 30 |
| A26 safety | 1.17 | 1.049 | 24 | 1.08 | .760 | 13 | 1.13 | 1.957 | 31 | .93 | 1.172 | 30 |
| A27 food | 1.08 | 1.060 | 24 | .85 | .689 | 13 | .90 | .831 | 31 | .53 | .860 | 30 |
| A28 global warming | 1.43 | 1.472 | 23 | .85 | .899 | 13 | .52 | 1.122 | 31 | .07 | 1.639 | 30 |
| A29 chemical reaction | .46 | .932 | 24 | .85 | 1.068 | 13 | .13 | .763 | 31 | -.07 | .813 | 28 |
| A30 water | 1.39 | .988 | 23 | 1.15 | .689 | 13 | .90 | 1.076 | 31 | .10 | .885 | 30 |
| A31 home economics | 1.00 | 1.063 | 23 | .62 | .870 | 13 | .55 | .810 | 31 | 1.23 | 1.569 | 30 |
| A32 first aid | 1.46 | 1.351 | 24 | 1.23 | 1.166 | 13 | 1.71 | 1.039 | 31 | 1.38 | 1.656 | 29 |
| A33 societal issues | 1.79 | 1.382 | 24 | 1.23 | 1.235 | 13 | 1.39 | 1.202 | 31 | .43 | 1.406 | 30 |

Table 45. Comparisons of Column Means: differences in contents or themes: perspective

| Contents or themes: perspective | Science educators | | | | Scientists | | | | Teachers | | | | Students | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (A) | (B) | (C) | (D) |
| A20 sustainable development | D | | | |
| A21 energy | D | | | |
| A22 health | | | D | |
| A23 natural phenomena | | | | D |
| A24 technical devices | | | | |
| A25 managing in nature | | | | |
| A26 safety | | | | |
| A27 food | | | | |
| A28 global warming | | | | |
| A29 chemical reaction | | | | |
| A30 water | | | | |
| A31 home economics | | | | |
| A32 first aid | | | | |
| A33 societal issues | | | | |

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

The students' group differs from other groups in the measure to which they experience differences: compared to the students, the science educators experience the differences as being greater in ‘sustainable development’, ‘energy’, ‘global warming’, ‘water’ and ‘societal issues’; the scientists differ from the students as they experience greater differences in ‘energy’, ‘chemical reaction’, and ‘water’. The teachers differ from the students in ‘societal involvement’ and ‘situations at school’ (teachers prefer situations at school, students do not).
perspectives whereas the teachers experience greater differences than the students in the perspective of ‘water’ and ‘societal issues’.

Table 46. Differences in contents or themes: themes

<table>
<thead>
<tr>
<th>Contents or themes: themes</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Valid N</td>
<td>Mean</td>
</tr>
<tr>
<td>A34 plants</td>
<td>.54</td>
<td>1.382</td>
<td>24</td>
<td>.62</td>
</tr>
<tr>
<td>A35 animals</td>
<td>.42</td>
<td>1.176</td>
<td>24</td>
<td>.54</td>
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Table 47. Comparisons of Column Means: differences in contents or themes: themes

<table>
<thead>
<tr>
<th>Contents or themes: themes</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
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<td>A43 electricity</td>
<td>D</td>
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<td>A44 mechanics</td>
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<td>A45 heat</td>
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<td>A46 optics</td>
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<td>A48 sound</td>
<td>D</td>
<td>D</td>
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<td>D</td>
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<td>A49 space &amp; astronomy</td>
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<td>A50 geography</td>
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<tr>
<td>A51 basics of sciences.</td>
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<td>D</td>
<td>D</td>
</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pair wise comparisons within a row of each innermost sub table using the Bonferroni correction.

The science educators’ views differ from those of the students in 12 out of 18 categories (in the way they consider the differences), the scientists in 11, and the teachers in 9 categories. The scientists differ from the teachers only concerning ‘carbon category’.

Project funded within the EC FP7 Programme: 5.2.2.1 - SiS-2010-2.2.1
Grant Agreement No.:266589
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Differences in opinions occur between the students and other groups on the subject of methods; likewise, there are also differences between the science educators and the teachers (models, inquiries, critical thinking, system thinking, cause-effect relations). The scientists differ from the teachers in their experience of calculation and its priority at school.

Table 48. Differences in contents or themes: methods

<table>
<thead>
<tr>
<th>Contents or themes: methods</th>
<th>Science educators</th>
<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>SD</td>
<td>Valid N</td>
<td>Mean</td>
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<td>1.233</td>
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<td>.85</td>
</tr>
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<td>A53 spatial information</td>
<td>1.46</td>
<td>1.141</td>
<td>24</td>
<td>1.46</td>
</tr>
<tr>
<td>A54 nature of science</td>
<td>2.08</td>
<td>1.316</td>
<td>24</td>
<td>1.46</td>
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<td>A55 models</td>
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<td>1.042</td>
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<tr>
<td>A58 critical thinking</td>
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<tr>
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<tr>
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<tr>
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Table 49. Comparisons of Column Means\(^a\): differences in contents or themes: methods

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<th>Contents or themes: methods</th>
<th>Science educators</th>
<th>Scientists</th>
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<th>Students</th>
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<td>A64 system thinking</td>
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<td>A65 cause effect relations</td>
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</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean. Differences are adjusted for all pairwise comparisons within a row of each innermost suitable using the Bonferroni correction.

Project funded within the EC FP7 Programme: 5.2.2.1 – SIS-2010-2.2.1
Grant Agreement No.: 266589
Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe
Table 50. Differences in abilities, knowledge and skills

<table>
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<th>Abilities, knowledge and skills</th>
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<th>Teachers</th>
<th>Students</th>
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<td>N</td>
<td>Mean</td>
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<td>1.62</td>
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<tr>
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<td>1.31</td>
</tr>
<tr>
<td>A70 ab.to contr.for saf</td>
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<td>1.042</td>
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<td>1.08</td>
</tr>
<tr>
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<td>24</td>
<td>1.15</td>
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<tr>
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<td>.85</td>
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<td>1.62</td>
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<td>24</td>
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<td>1.77</td>
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<td>1.215</td>
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<tr>
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<td>1.316</td>
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<td>1.50</td>
</tr>
<tr>
<td>A82 tech. and ICT sk.</td>
<td>.96</td>
<td>1.367</td>
<td>24</td>
<td>.46</td>
</tr>
<tr>
<td>A83 sk. to gen./ comb.</td>
<td>2.13</td>
<td>.900</td>
<td>24</td>
<td>1.54</td>
</tr>
<tr>
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<td>1.77</td>
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<td>A85 inquiry skills</td>
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<td>1.38</td>
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<td>A86 critical thinking sk.</td>
<td>2.58</td>
<td>1.139</td>
<td>24</td>
<td>2.17</td>
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<tr>
<td>A87 skills for innovation</td>
<td>2.33</td>
<td>1.373</td>
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<td>1.62</td>
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</table>

Table 51. Comparisons of Column Means*: differences in abilities, knowledge and skills

<table>
<thead>
<tr>
<th>Abilities, knowledge and skills</th>
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<th>Scientists</th>
<th>Teachers</th>
<th>Students</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
</tr>
<tr>
<td>A68 ability to act for sustainability</td>
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<td></td>
<td></td>
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<tr>
<td>A69 ability to make healthy choices</td>
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<tr>
<td>A70 ability to contribute for safety</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A71 eligibility for further studies</td>
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<td></td>
</tr>
<tr>
<td>A72 ability to respect nature</td>
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</tr>
<tr>
<td>A73 ability to interest in sciences</td>
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<tr>
<td>A74 knowledge in general about energy</td>
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<td></td>
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<td>A77 skills to exploit or apply</td>
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<tr>
<td>A78 skills to enter into discussion</td>
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<tr>
<td>A79 skills to search for and read information</td>
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<td>D</td>
<td></td>
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<tr>
<td>A80 skills to value things</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
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<tr>
<td>A81 skills to understand STS-relationships</td>
<td>C</td>
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<td>A83 skills to generalize and combine</td>
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<tr>
<td>A87 skills for innovation</td>
<td>D</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Results are based on two-sided tests assuming equal variances with significance level 0.05. For each significant pair, the key of the smaller category appears under the category with the larger mean.

a. Tests are adjusted for all pairwise comparisons within a row of each innermost suitable using the Bonferroni correction.

In relation to abilities, knowledge and skills, lots of differences are apparent between the groups. Only the differences concerning ‘safety’, ‘eligibility for further studies’, ‘technical and ICT skills’, seem to be at the same level for each group.

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6 Results of the cluster analyses

6.1 Clustering based on the cases

Cluster analysis is a technique for grouping individuals or objects into unknown groups; the number and characteristics of the groups are to be derived from the data and are not usually known prior to analysis. Cluster analysis is highly empirical. It groups data objects based only on information found in the data that describes the objects and their relationships; hierarchical clusters have sub-clusters. (see e.g. Afifi and Clark 1996; Mooi and Sarstedt 2011.)

6.2 Clustering based on the variables

It is also possible to cluster the variables rather than the cases. Clustering of variables is sometimes used in analyzing items in a scale, to determine which items tend to be close together in terms of the individual’s response to them. Clustering of the Finnish data has been carried out by the FUB team. The method used in the first stage for the Delphi Cluster Analyses was YulesQ /most distant neighbour.

6.3 Description of the clusters

In the following, the variables (categories) chosen by the participants have been clustered (see Appendix 2, hierarchical cluster analysis) and the clusters formed have been named and described. The combination ‘context-content-skills’ has also been sketched out (Table 52).

Table 52. Clusters and the categories which form the cluster

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cluster formed from the variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanics</td>
<td>1. Physics Cluster includes physics knowledge for acting and making choices</td>
</tr>
<tr>
<td>Knowledge to act or make choices</td>
<td>Physics-physics contents-knowledge to act or make choices</td>
</tr>
<tr>
<td>Optics</td>
<td>2. Sustainable development Cluster includes health and nature related issues for sustainable living</td>
</tr>
<tr>
<td>Sound</td>
<td>Sustainable development issues-ecology-managing in life</td>
</tr>
<tr>
<td>Heat</td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Food 2</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
</tr>
<tr>
<td>Health 2</td>
<td></td>
</tr>
<tr>
<td>Ability to make healthy choices</td>
<td></td>
</tr>
<tr>
<td>Human biology</td>
<td></td>
</tr>
<tr>
<td>Everyday life</td>
<td></td>
</tr>
<tr>
<td>Skills to act/take care of one’s own life</td>
<td></td>
</tr>
<tr>
<td>Sustainable development2</td>
<td></td>
</tr>
<tr>
<td>Ability to act for sustainability</td>
<td></td>
</tr>
<tr>
<td>Sustainable development</td>
<td></td>
</tr>
<tr>
<td>Ecology</td>
<td></td>
</tr>
<tr>
<td>Ethical choices</td>
<td></td>
</tr>
<tr>
<td>Global warming</td>
<td></td>
</tr>
<tr>
<td>Moving around in nature</td>
<td></td>
</tr>
<tr>
<td>Ability to respect nature</td>
<td></td>
</tr>
<tr>
<td>Managing in nature</td>
<td></td>
</tr>
<tr>
<td>Managing in nature 2</td>
<td></td>
</tr>
<tr>
<td>Evolution</td>
<td></td>
</tr>
<tr>
<td>Variables</td>
<td>Cluster formed from the variables</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Accidents First aid</td>
<td>3. Safety Cluster includes first aid to be able to manage in the case of accidents</td>
</tr>
<tr>
<td>Space/astronomy</td>
<td>Accidents-first aid-ability to make safety choices</td>
</tr>
<tr>
<td>Ability to make safety choices</td>
<td></td>
</tr>
<tr>
<td>Technical and ICT skills</td>
<td></td>
</tr>
<tr>
<td>Situations at schools</td>
<td>4. Media Cluster includes media related issues</td>
</tr>
<tr>
<td>Skills to enter into discussions</td>
<td>Media/situations at school-carbon-skills to interact</td>
</tr>
<tr>
<td>Carbon</td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td></td>
</tr>
<tr>
<td>Skills to search for information</td>
<td></td>
</tr>
<tr>
<td>Skills to value</td>
<td></td>
</tr>
<tr>
<td>Genetics</td>
<td>5. Societal issues Cluster includes issues which are generally interesting and actual in society such as genetics, energy and nuclear physics</td>
</tr>
<tr>
<td>Skills of critical thinking</td>
<td>Energy-physics contents-critical thinking</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
</tr>
<tr>
<td>Knowledge in general/of energy</td>
<td></td>
</tr>
<tr>
<td>Physics contents</td>
<td></td>
</tr>
<tr>
<td>Nuclear physics</td>
<td></td>
</tr>
<tr>
<td>Technology and traffic</td>
<td>6. Technology Cluster includes technology and working for innovations</td>
</tr>
<tr>
<td>Technical devices</td>
<td>Working life-technical devices-skills for innovation</td>
</tr>
<tr>
<td>Skills for innovation</td>
<td></td>
</tr>
<tr>
<td>Working life</td>
<td></td>
</tr>
<tr>
<td>Societal involvement</td>
<td>7. Everyday life Cluster includes biological and geographical issues as well as home and societal issues</td>
</tr>
<tr>
<td>Societal issues</td>
<td>Societal issues-biology/geography-skills to understand relationships between science, technology and society</td>
</tr>
<tr>
<td>Geography content</td>
<td></td>
</tr>
<tr>
<td>Geography</td>
<td></td>
</tr>
<tr>
<td>Plants</td>
<td></td>
</tr>
<tr>
<td>Animals</td>
<td></td>
</tr>
<tr>
<td>Biology content</td>
<td></td>
</tr>
<tr>
<td>Home economics</td>
<td></td>
</tr>
<tr>
<td>Nature</td>
<td></td>
</tr>
<tr>
<td>Natural phenomena</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Skills to understand STS relationships</td>
<td></td>
</tr>
<tr>
<td>Ability for further studies</td>
<td>8. Chemistry Cluster includes chemistry issues and many skills: problem solving, applying, generalizing and combining</td>
</tr>
<tr>
<td>Problem solving skills</td>
<td>Chemistry-chemistry concepts-inquiry skills</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>Skills to exploit and apply</td>
<td></td>
</tr>
<tr>
<td>Chemistry content</td>
<td></td>
</tr>
<tr>
<td>Chemical methods</td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>Chemical reaction</td>
<td></td>
</tr>
<tr>
<td>Interest in knowledge</td>
<td></td>
</tr>
<tr>
<td>Ability interest in science</td>
<td></td>
</tr>
<tr>
<td>Basics of sciences</td>
<td></td>
</tr>
<tr>
<td>Skills to generalize and combine</td>
<td></td>
</tr>
<tr>
<td>Inquiry skills</td>
<td></td>
</tr>
</tbody>
</table>
Having already formed these clusters, we got another clustering from FUB which was made using the Ward cluster method (Appendix 3). It was necessary to consider once again the differences in these two clustering methods and also to consider the clusters formed from the German data.

6.4 Summary of the cluster analyses

In the hierarchical cluster analyses, eight clusters or groups have been found:

1. Physics
2. Sustainable development
3. Safety
4. Media
5. Societal issues
6. Technology
7. Everyday
8. Chemistry

Physics and chemistry have been clustered for separate groups, but biology and geography have been included as an essential part in the group ‘societal issues’. The number of categories in a group vary from 4 to 13. Ward clustering produced two clusters: one concerning sustainability and the other including all other variables. When comparing Ward clusters with the former analysis and the concepts chosen in Germany for the third round, we decided to use three concepts which seem to suit best for these three criteria. These concepts are presented below.

**Concept I: Studying scientific knowledge which is needed when moving around and managing in nature, acting according to sustainable development and in societal participation.**

Science will be studied through everyday situations, nature phenomena or societal participation, gaining knowledge and skills which will help in making ethical, sustainable choices, for example regarding nutrition and food as well as health. Important skills are also critical thinking, taking care of one’s own life, respecting nature and enhancing sustainable development. Knowledge about issues such as energy, water and climate change, are important from the viewpoint of environmental protection and for understanding the relationships between society and science.

The cluster analysis linked the following groups to this concept.

**Situation, event or motive as a starting point:**
Everyday life, Food and nutrition, Health and medicines, Sustainable development/recycling/waste/nature protection/cultures/environmental problems, Ethical choices/responsibility for one’s own life/nature and nature phenomena, Moving around in nature, Managing in nature, Societal participation

**Contents or themes to be studied and the perspectives to be used:**
Food and nutrition, Health and medicines, Human biology, Sustainable development/environmental effects/nature protection/recycling and waste/cultures, Climate change, Managing in nature, Evolution, Nature phenomena and catastrophes, Water, Energy, Societal issues, Chemical methods/reactions, Plants, Animals
Abilities, knowledge and skills to be acquired:
Skill to act/take care of one’s own life, Readiness to make healthy choices, Readiness to act for sustainable development, Knowledge to act/make choices, Readiness to respect nature, Critical thinking, Skill to understand relationships between science, technology and society, Inquiry skills, Knowledge about energy

**Concept II: Studying which is based on interesting issues in the media, events at school or different types of accidents. Science studies enhance problem solving skills which are needed in working life.**
Science will be studied by examining technology, current events and situations in working life. The science issues to be studied are related to how equipment works, first aid, dangerous substances and events, as well as situations in the home. Studies enhance important professional skills such as finding, interpreting and applying information, as well as problem solving and innovation skills. Skills which should be acquired are, for example, technical skills and the skill to evaluate and take part in societal actions and discussions. The student will become interested in science and will acquire abilities to participate in further studies.

The cluster analysis linked the following groups to this concept.

**Situation, event or motive as a starting point:**
Technology and traffic, Accidents, Situations at school, Working life/occupations/production/entrepreneurship, Media, Interests/knowledge

**Contents or themes to be studied and perspectives to be used:**
Technical equipment/function of equipment, First aid, Safety/dangerous substances and events, Home economics

Abilities, knowledge and skills to be acquired:
Technical and tele informatic (ICT) skills, Skills for innovation, Readiness to influence safety, Skills to benefit or apply, Skill to search for and read information, Skill to evaluate, Skill to enter into discussion/societal actions, Readiness to become interested in science, Skill to generalize and connect, Ability for further studies, Problem solving skills

**Concept III: Studies which will enhance important, scientific, interdisciplinary understanding concerning scientific methods and concepts, the goal being to develop the student’s intelligence.**
Studying science helps in understanding the results of basic science studies and research methods, develops student’s skills of analysis and enhances the ability to observe different viewpoints. Becoming familiar with current science research helps the student to understand how research results and methods support scientific research and its applications, as well as being interdisciplinary. Examples of important contents to be studied are substances, chemical reactions, models and technical equipment. Abilities which should be acquired are, for example, decision making skills, applying knowledge and creative thinking.

The cluster analysis linked the following groups to this concept.
Situation, event or motive as a starting point:
Intelligent personal development, Science-interdisciplinary, Technology

Contents or themes to be studied and perspectives to be used:
Interdisciplinary, Scientific research, Current scientific research, Limits of scientific knowledge, Terminology, Substance/particle concepts, Structure/action/properties, Chemical reactions, Models, Technical equipment, System, Interaction, Energy, Mathematics

Abilities, knowledge and skills to be acquired:
Critical thinking, Logical thinking/analyzing/drawing conclusions, Applying information/creative and abstract thinking, Cognitive knowledge, Formulating scientific questions/making hypotheses, Making inquiries

References


Appendix 1
E-questionnaire, elomake.joensuu.fi/lomakkeet/3135/lomake.html

Development of Science Education, Delphi study, second round
Start
Your name
We have categorized the answers from the first round and grouped the findings. The groups are shown in five parts in the following table (parts I, IIa, IIb, IIc and III):

<table>
<thead>
<tr>
<th>Part I: Situation, event or motive</th>
<th>Part IIa: Contents or themes: Perspectives</th>
<th>Part IIb: Contents or themes: Themes</th>
<th>Part IIc: Contents or themes: Methods</th>
<th>Part III: Abilities, knowledge and skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing in nature</td>
<td>Sustainable development/ environmental effects/nature protection/recycling/waste/cultures</td>
<td>Plants, berries, mushrooms</td>
<td>Maps</td>
<td>Abilities</td>
</tr>
<tr>
<td>Ethical choices/ response of own life</td>
<td>Energy</td>
<td>Animals</td>
<td>Spatial information applications</td>
<td>To act for sustainability</td>
</tr>
<tr>
<td>Interest/knowledge</td>
<td>Health/medicine</td>
<td>Evolution</td>
<td>Nature of science</td>
<td>To make healthy choices</td>
</tr>
<tr>
<td>Everyday life</td>
<td>Nature phenomena and catastrophes</td>
<td>Human biology</td>
<td>Models</td>
<td>To contribute for safety</td>
</tr>
<tr>
<td>Health and medicines</td>
<td>Technical devices/function of appliances</td>
<td>Ecology</td>
<td>Learning through phenomena</td>
<td>Eligibility for further studies</td>
</tr>
<tr>
<td>Nature and nature phenomena</td>
<td>Managing in nature</td>
<td>Genetics/ molecular biology</td>
<td>Inquiries</td>
<td>Respect for nature</td>
</tr>
<tr>
<td>Food and nutrition</td>
<td>Safety/dangerous substances and events</td>
<td>Chemistry: substances/materials/their properties</td>
<td>Critical thinking</td>
<td>Interest in sciences</td>
</tr>
<tr>
<td>Sustainable development/ recycling/waste/ nature protection/ cultures/ environmental problems</td>
<td>Food and nutrition</td>
<td>Carbon/its compounds/cycle</td>
<td>Applying</td>
<td></td>
</tr>
<tr>
<td>Technology and traffic</td>
<td>Global warming</td>
<td>Chemical methods/symbols</td>
<td>Calculating and measuring</td>
<td></td>
</tr>
<tr>
<td>Biology issues</td>
<td>Chemical reaction</td>
<td>Electricity/ Magnetism/Electronics</td>
<td>Affective approaches</td>
<td></td>
</tr>
<tr>
<td>Physics issues</td>
<td>Water</td>
<td>Mechanics</td>
<td>Interest as a starting point</td>
<td></td>
</tr>
<tr>
<td>Chemistry issues</td>
<td>Home economics</td>
<td>Heat</td>
<td>Societal participation</td>
<td></td>
</tr>
<tr>
<td>Geography issues</td>
<td>First aid</td>
<td>Optics</td>
<td>System thinking</td>
<td></td>
</tr>
<tr>
<td>Working life/ occupation/ production/ entrepreneurship</td>
<td>Societal issues/land use/ regulations/ production</td>
<td>Nuclear physics</td>
<td>Cause-effect relations</td>
<td></td>
</tr>
<tr>
<td>Moving in nature</td>
<td></td>
<td>Sound</td>
<td>Future viewpoint</td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td></td>
<td>Space/astronomy</td>
<td>Entrepreneur approach</td>
<td></td>
</tr>
<tr>
<td>Societal involvement</td>
<td></td>
<td>Geography/geology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents</td>
<td></td>
<td>Basics of sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situations at school</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Firstly we would ask you to evaluate the above mentioned groups from two viewpoints: how important do you think they are in instruction and to what extent are they realized nowadays in school instruction; see the following page.

Next
Part I: The event, situation or motive, to which the instruction relates.

Evaluate, in your opinion, how important could the events, situations or motives mentioned below be as a starting point of instruction; also how well they are taken into account in school instruction at present.

<table>
<thead>
<tr>
<th>Event, Situation, or Motive</th>
<th>How important in your mind</th>
<th>How do you think an event, situation or motive is used nowadays</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing in nature and nature dependence</td>
<td>1= not at all</td>
<td>1= not at all</td>
</tr>
<tr>
<td>Ethical choices/consumption</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Choices/responsibility for one’s own life</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Interest/knowledge</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Everyday life (pets, garden, living activity at home)</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Health (health, medicines, human being, beauty care)</td>
<td>6</td>
<td>very well</td>
</tr>
<tr>
<td>Nature/nature phenomena</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nature catastrophes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food and eating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainable development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(recycling/waste/ nature protection/ cultures/ environmental problems)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technology and traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biology content (plants, animals, Berries, mushrooms, evolution, gene modification)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics content (phenomena, radiation, energy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry content (phenomena, Water, burning, materials, models)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geography content (climate change, Space, weather conditions, spatial knowledge, globe)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working life/production/entrepreneurship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moving around in nature and the close environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Societal involvement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situations at school</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Former Next
Part IIa: Contents or themes: perspective of instruction
Evaluate, in your opinion, how important the perspectives mentioned below are in school instruction and how well they are taken into account in school instruction at present.

Sustainable development/environmental effects/nature protection/recycling and waste/cultures
Energy
Health/medicine
Nature phenomena and catastrophes
Technical devices/function of appliances
Managing in nature
Safety/dangerous substances and events
Food and eating
Global warming
Chemical reaction
Water
Home economics
First aid
Societal issues/land use/ regulations/production

Former     Next

PAGE 4

Part IIb: Contents or themes: themes to be taught
Evaluate, in your opinion, how important the themes mentioned below, would be in school instruction, and how well they are taken into account in school instruction at present.

Plants/berries/mushrooms
Animals
Evolution
Human biology
Ecology
Genetics/ molecular biology
Chemistry: substances, materials and their properties
Carbon, its compounds and cycle
Chemical methods and symbols
Electricity/ Magnetism/Electronics
Mechanics
Heat
Optics (in Finland 'light')
Nuclear physics
Sound
Space/astronomy
Geography/geology
Basics of sciences in general

Former     Next
Part IIc: Contents and themes: methods, which should be used in instruction
Evaluate, in your opinion, how important the methods mentioned below would be in school instruction and how much the methods are used in school instruction at present.

Maps
Spatial information applications
Nature of science
Models
Learning through phenomena
Inquiries
Critical thinking
Applying
Calculating and measuring
Affective approaches
Interest as a starting point
Societal participation
System thinking
Cause-effect relations
Future viewpoint
Entrepreneur approach

FormerNext

PAGE 6
Part III: Abilities, knowledge and skills, which should be acquired
Evaluate, in your opinion, how important it would be to acquire the abilities, knowledge and skills mentioned below and how well they are acquired in school instruction at present.

Ability to act for sustainability
Ability to make healthy choices
Ability to contribute to safety
Eligibility for further studies
Ability to respect nature
Ability to be interested in sciences
Knowledge in general/about energy
Knowledge to be able to act/make choices
Skills to act/take care of one’s own life
Skills to exploit or apply
Skills to enter into discussion/into societal actions
Skills to search for and read information
Skills to value things
Skills to understand the relationships between nature, technology and society
Technical and ICT skills
Skills to generalize and connect
Problem solving skills
Inquiry skills
Critical thinking skills
Skills for innovation
Creating of meaningful instruction entities

We now ask you now to create a combination of the groups, which in your opinion form a meaningful instruction entity. In creating the entity, choose at least one and a maximum of five groups, from each of the four parts (from every column).

First read the example. The following fictional viewpoint represents choices from the example table below.

'Sciences should be taught starting from everyday situations related to eating, so that the pupils would think about ethical choices. The instruction of carbon compounds and the chemical structure of different matters could be handled from the perspective of health, food and eating, as well as sustainable development. The pupils will acquire abilities to make healthy choices, to act for sustainability, gain knowledge to make choices and learn to think critically.'

<table>
<thead>
<tr>
<th>Part I: Situation, event or motive</th>
<th>Part IIa: Contents or themes: Perspectives</th>
<th>Part IIb: Contents or themes: Themes</th>
<th>Part III: Qualifications, knowledge and skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Managing in nature</td>
<td>Sustainable development/ environmental effects/nature protection/recycling/waste/cultures</td>
<td>Plants, berries, mushrooms</td>
<td>Qualifications</td>
</tr>
<tr>
<td>Ethical choices/ response of own life</td>
<td>Energy</td>
<td>Animals</td>
<td>To act for sustainability</td>
</tr>
<tr>
<td>Interest/knowledge</td>
<td>Health/medicine</td>
<td>Evolution</td>
<td>To make healthy choices</td>
</tr>
<tr>
<td>Everyday life</td>
<td>Health and medicines</td>
<td>Human biology</td>
<td>To contribute for safety</td>
</tr>
<tr>
<td>Health and medicines</td>
<td>Nature and nature phenomena</td>
<td>Ecology</td>
<td>Eligibility for further studies</td>
</tr>
<tr>
<td>Nature and nature phenomena</td>
<td>Sustainable development/recycling/waste</td>
<td>Genetics/ molecular biology</td>
<td>Respect for nature</td>
</tr>
<tr>
<td>Food and nutrition</td>
<td>nature protection/cultures/environmental problems</td>
<td>Chemistry: substances/materials/their properties</td>
<td>Interest in sciences</td>
</tr>
<tr>
<td>Sustainable development/ recycling/waste/ nature protection/ cultures/environmental problems</td>
<td>Technical devices/function of appliances</td>
<td>Carbon/its compounds/cycle</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Technology and traffic</td>
<td>Managing in nature</td>
<td>Chemical methods/symbols</td>
<td>In general/about energy</td>
</tr>
<tr>
<td>Biology issues</td>
<td>Safety/dangerous substances and events</td>
<td>Electricity/ Magnetism/Electronics</td>
<td>Be able to act/make choices</td>
</tr>
<tr>
<td>Physics issues</td>
<td>Food and nutrition</td>
<td>Mechanics</td>
<td>Skills</td>
</tr>
<tr>
<td>Chemistry issues</td>
<td>Global warming</td>
<td>Heat</td>
<td>To act/take care of one’s own life</td>
</tr>
<tr>
<td>Geography issues</td>
<td>Chemical reaction</td>
<td>Optics</td>
<td>Exploit or apply</td>
</tr>
<tr>
<td>Working life/ occupation/ production/ entrepreneurship</td>
<td>Water</td>
<td>Nuclear physics</td>
<td>Enter into discussion</td>
</tr>
<tr>
<td>Moving around in nature</td>
<td>Home economics</td>
<td>Sound</td>
<td>Search for and read information</td>
</tr>
<tr>
<td>Media</td>
<td>First aid</td>
<td>Space/astronomy</td>
<td>Evaluation</td>
</tr>
<tr>
<td>Societal involvement</td>
<td>Societal issues/land use/regulations/production</td>
<td>Geography/geology</td>
<td>To understand the relationships between nature, technology and society</td>
</tr>
<tr>
<td>Accidents</td>
<td></td>
<td>Basics of sciences</td>
<td>Technical and ICT skills</td>
</tr>
<tr>
<td>Situations at school</td>
<td></td>
<td></td>
<td>To generalize and connect</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Problem solving skills</td>
</tr>
</tbody>
</table>

Each column will be shown on its own page. With the aid of the table, think of a meaningful entity.
Part I: An event, situation or motive, to which instruction is related.
Choose at first at least one and a maximum of five events, situations or motives, which are related to the instruction entity you have created.

Managing in nature and nature dependence
Ethical choices/consumption
Choices/responsibility for one’s own life
Interest/knowledge
Everyday life (pets, garden, living, hobbies, tourism, everyday actions at home)
Health (health, medicines, human being, beauty care)
Nature/nature phenomena/nature catastrophes
Food and eating
Sustainable development (recycling/waste/ nature protection/cultures/ environmental problems)
Technology and traffic
Biology content (plants, animals, berries, mushrooms, evolution, gene modification)
Physics content (phenomena, radiation, energy)
Chemistry content (phenomena, water, burning, materials, models)
Geography content (climate change, space, weather conditions, spatial knowledge, Globe)
Working life/production/entrepreneurship
Moving around in nature and the close environment
Media
Societal involvement
Accidents
Situations at school

Former     Next

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Part IIa: Perspectives of instruction
Choose suitable perspectives for your instruction entity, at least one and a maximum of five.

Sustainable development/environmental effects/nature protection/recycling and waste/cultures
Energy
Health/medicine
Nature phenomena and catastrophes
Technical devices/function of appliances
Managing in nature
Safety/dangerous substances and events
Food and eating
Global warming
Chemical reaction
Water
Home economics
First aid
Societal issues/land use/ regulations/production

Former     Next
Part IIb: Themes to be taught
Choose the themes which are suitable to your entity, at least one and a maximum of five.
Plants/berries/mushrooms
Animals
Evolution
Human biology
Ecology
Genetics/ molecular biology
Chemistry: substances, materials and their properties
Carbon, its compounds and cycle
Chemical methods and symbols
Electricity/ Magnetism/Electronics
Mechanics
Heat
Optics (in Finland 'light')
Nuclear physics
Sound
Space/astronomy
Geography/geology
Basics of sciences in general

Part III: Abilities, knowledge and skills to be acquired
Choose the abilities, knowledge and skills which should be reached in your instruction entity, at least one and a maximum of five.

Abilities
- to act for sustainability
- to make healthy choices
- to contribute to safety
- for further studies
- to respect nature
- to interest in sciences

Knowledge
- in general/about energy
- to be able to act/make choices

Skills
- to act/take care of one's own life
- to exploit or apply
- to enter into discussion/into societal actions
- to search for and read information
- to value things
- to understand the relationships between nature, technology and society
- technical and ICT skills
- to generalize and connect
- problem solving skills
- inquiry skills
- critical thinking
- skills for innovation

If you want you can create three other entities. If you do not want to make any more entities choose next.
I want to create another entity
Former Next
Thank you for your answers. We will contact you in the third stage of the study. Choose next and on the following page ready.

Are you satisfied with the information you have given? After this page, the data will be saved so that you cannot make any change in your choices.

Sending of the data
Former Ready
### Project funded within the EC FP7 Programme: 5.2.2.1 – SiS-2010-2.2.1
Grant Agreement No.:266589

Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe

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**Osa IIb: Sisällöt tai aiheet: opetettavat teemat**

Arvioiden, miten tärkeitä alla mainitut teemat mielestämä olisivat koulutuksessa, sekä sitä, miten hyvin ne huomioidaan nykyisessä koulutuksessa.

<table>
<thead>
<tr>
<th>Miten tärkeää on mielestädä opettaa ko. teeman sisältöjä?</th>
<th>Kuinka laajaa ko. teeman käsittely on mielestädä nykyisessä opetukessa?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = erittäin vähäinen</td>
<td>2</td>
</tr>
</tbody>
</table>

- Kasvit / sienet / marjat
- Eläimet
- Evoluutio
- Ihmisen biologia
- Ekologia
- Perinnöllisyys / molekyylibiology
- Kemian aineet ja niiden ominaisuudet
- Hiili, sen yhdisteet ja kierto
- Kemian tutkimusmenetelmät ja symbolit
- Sähkö / magnetismi / elektroniikka
- Mekaniikka
- Lämpö
- Valo
- Ydinfysiikka
- Ääni
- Avaruus / ühtisiede
- Maantiede / geologia
Appendix 2: Hierarchical cluster analysis
Supporting and coordinating actions on innovative methods in science education: teacher training on inquiry based teaching methods on a large scale in Europe