

**PROFILES – WP3:**

**Stakeholders Involvement and Interaction**

**PROFILES**

**Curricular Delphi Study on Science Education**

**Interim Report of the UCC Working Group on the Third Round**

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# 1 Introduction

This report outlines the findings of the third round of questionnaires collected by the UCC group as part of the PROFILES Curricular Delphi Study on Science Education. The questionnaires were devised by the PROFILES team at FUB (Freie Universität Berlin).

Cluster analysis of the responses to the questionnaires in Round 2, indicated three broad views ('concepts') of science education:

- A Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts
- B Intellectual education across scientific disciplines
- C General science-related education and facilitation of interest in contexts of nature, everyday life and living

These concepts of science education may be considered to reflect different philosophical perspectives on science:

- science in **human culture**, or science and the global economy
- science as a **discipline** or intellectual pursuit
- science in **everyday life**, or science in society.

These concepts were the subject of the third and final round of the PROFILES Curricular Delphi Study.

On a six-point scale participants in the study were asked to indicate their individual assessment of these concepts in terms of their **priority** (in theory) and the **extent** to which they were realised in practice.

In the six-page questionnaire there were five pages explanation and one page of questions. It is not clear whether participants read all the included text.

The complete questionnaire is reproduced in Appendix 1.

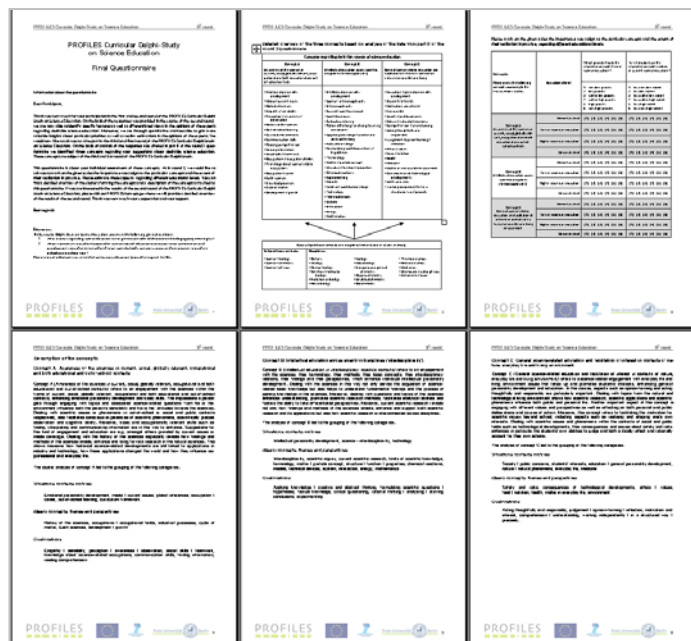


Figure 1: Layout of the questionnaire

## 2. Format of the questionnaires

In the questionnaire for Round 3 of the PROFILES Curricular Delphi Study on Science Education participants were asked to indicate the **priority** that should be given to the three concepts and the **extent** to which they were realised in practice in four levels of education:

1. Elementary level
2. Lower secondary education
3. Higher secondary education
4. University level.

For each of the three concepts and each of the four levels of education there were just two questions:

1. Which **priority** should the respective concepts have in science education?
2. To what **extent** are the respective concepts realised in current science education?

The response to each of these was indicated on a six-point scale from 'very low' to 'very high'.

Which <b>priority</b> should the respective concepts have in science education?	To what <b>extent</b> are the respective concepts realised in current science education?
1 = very low priority 2 = low priority 3 = rather low priority 4 = rather high priority 5 = high priority 6 = very high priority	1 = to a very low extent 2 = to a low extent 3 = to a rather low extent 4 = to a rather high extent 5 = to a high extent 6 = to a very high extent

## 3. The sample population

In all 173 questionnaires were completed and returned. The number in each category was the same as in Round 2 but the individuals involved were not necessarily the same.

<b>52</b>	Students	Junior secondary (~15 years)	<b>21</b>
		Transition year (~17 years)	<b>15</b>
		University students	<b>16</b>
<b>74</b>	Teachers	Trainee teachers	<b>38</b>
		Primary teachers	<b>11</b>
		Established science teachers	<b>25</b>
<b>21</b>	Teacher Educators	Teacher educators	<b>21</b>
<b>26</b>	Employers	Professional scientists	<b>21</b>
		Employers	<b>5</b>

**Table 1:** Number of respondents in each category.

## 4. Responses to the questionnaire

The total frequency of each response is given in Appendix 2. Using a weighted scale the overall responses are shown graphically in Table 2 below. The weightings were as follows:

Response	Low			High		
	1	2	3	4	5	6
Weight	3	2	1	1	2	3

			Low	High
PRIORITY	<b>Concept A</b> Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		
	<b>Concept B</b> Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		
	<b>Concept C</b> General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		
EXTENT	<b>Concept A</b> Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		
	<b>Concept B</b> Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		
	<b>Concept C</b> General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level		
		Lower secondary education		
		Higher secondary education		
		University level		

**Table 2:** Overall response to each question.

The same trend appears in the responses to each concept. This trend is more obvious in the 'Extent' responses but it is also present in the 'Priority' responses. Remarkably, in every case the concepts are regarded as having increasing priority and increasing implementation as students progress from elementary education to university.

The other notable result is the difference between the ‘priority’ and the ‘extent of realisation — or, in other words, the difference between the theory and the practice. **All** the concepts are seen as having relatively high priority but somewhat **low realisation**, especially in the **earlier years** of education.

## 5. Responses of different groups

The general trends found in the responses from the different groups are very similar. The most ‘positive’ group were the **teachers** (primary, secondary and trainee) as is evident in Table 3. The others were all remarkably similar.

			All groups		Employers & Scientists		Students		Teacher Educators		Teachers	
			Low	High	Low	High	Low	High	Low	High	Low	High
<b>PRIORITY</b>	<b>Concept A</b> Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■
	<b>Concept B</b> Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■
	<b>Concept C</b> General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■
<b>EXTENT</b>	<b>Concept A</b> Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■
	<b>Concept B</b> Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■
	<b>Concept C</b> General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level	■	■	■	■	■	■	■	■	■	■
		Lower secondary	■	■	■	■	■	■	■	■	■	■
		Higher secondary	■	■	■	■	■	■	■	■	■	■
		University level	■	■	■	■	■	■	■	■	■	■

**Table 2:** Comparison of responses of different groups

The responses regarding the extent of implementation show a consistent trend from low degree of implementation at elementary level to high degree of implementation at university level. Again this is most obvious in the teachers’ responses.

The numbers used to generate the graphs can be found in **Appendix 3**.

## 6. Conclusion

In this study three concepts of science education were presented which broadly reflected three different philosophical perspectives on science:

1. science in **human culture**, or science and the global economy
2. science as a **discipline** or intellectual pursuit
3. science in **everyday life**, or science in society.

Students, teachers, teacher educators and employers were asked to assign a level of priority to these concepts at various levels of education. They were all seen as having **high priority at all levels** of education and increasing slightly with the age of the students.

The other main conclusion was that the perceived extent of implementation of these concepts was generally **low at elementary and lower secondary levels** and **high at upper secondary and university levels**.

Concept C (science in **everyday life**, or science in society) was assigned the highest priority (by a small margin) and the highest level of implementation (by a small margin).

# Appendix 1: The questionnaire

The source of the original questionnaire was FUB (Freie Universität Berlin).

## PROFILES Curricular Delphi-Study on Science Education

### Final Questionnaire

#### Information about the questionnaire

Dear Participant,

Thank you very much for your participation in the first and second round of the PROFILES Curricular Delphi Study on Science Education. On the basis of the responses you provided in the course of the second round, we are now able to identify specific features as well as differentiated views in the opinions of the experts regarding desirable science education<sup>1</sup>. Moreover, we are through quantitative analyses able to gain more valuable insights about particular priorities as well as reality estimations in the opinions of the experts. We would now like to ask you to take part in the **third and final round** of the PROFILES Curricular Delphi Study on Science Education. On the basis of analysis of the responses you offered in part II of the round 2 questionnaire we identified **three concepts** regarding your suggestions about desirable science education. These concepts are subject of the third and last round of the PROFILES Curricular Delphi Study.

This questionnaire is about **your individual assessment** of these concepts. As in round 2, we would like to ask you to mark on the given scales the importance you assign to the particular concepts and the extent of their realisation in practice. Please estimate these aspects regarding different educational levels. You can find a detailed overview of the clusters forming the concepts and a description of the concepts attached to this questionnaire. If you are interested in the results of the second round of the PROFILES Curricular Delphi Study on Science Education, please visit our PROFILES homepage where we will provide a detailed overview of the results of the second round. Thank you very much your cooperation and your support.

Best regards

#### **1 Reminder:**

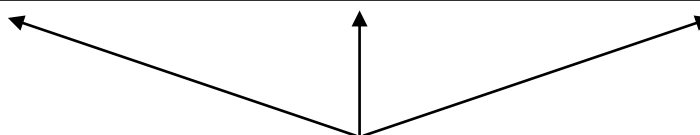
The Curricular Delphi Study on Science Education addresses the following general questions:

- *What aspects regarding science education are in general considered desirable and pedagogically meaningful?*
- *Which experiences should be facilitated in science-related educational practice, which competences and qualifications should be enhanced and which scientific fields, concepts, topics and perspectives should the individual have dealt with?*

*Please think of adolescents at the end of compulsory education (around the age of 15/16).*

**Detailed overview of the three concepts based on analysis of the data from part II of the round 2 questionnaire:**

<b>Concepts regarding desirable aspects of science education</b>		
<b>Concept A</b>	<b>Concept B</b>	<b>Concept C</b>
Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Intellectual education across scientific disciplines ('interdisciplinarity')	General science-related education and facilitation of interest in contexts of nature everyday life and living
<ul style="list-style-type: none"> <li>• Emotional personality development</li> <li>• Media / current issues</li> <li>• Global references</li> <li>• Empathy / sensibility</li> <li>• Perception / awareness / observation</li> <li>• History of the sciences</li> <li>• Out-of-school learning</li> <li>• Curriculum framework</li> <li>• Communication skills</li> <li>• Reading comprehension</li> <li>• Finding information</li> <li>• Social skills / teamwork</li> <li>• Occupations / occupational fields</li> <li>• Knowledge about science-related occupations</li> <li>• Occupation / career</li> <li>• Earth sciences</li> <li>• Industrial processes</li> <li>• Cycle of matter</li> <li>• Development / growth</li> </ul>	<ul style="list-style-type: none"> <li>• Intellectual personality development</li> <li>• Science - interdisciplinarity</li> <li>• Interdisciplinarity</li> <li>• Current scientific research</li> <li>• Scientific inquiry</li> <li>• Critical questioning</li> <li>• Rational thinking / analysing / drawing conclusions</li> <li>• Applying knowledge / creative and abstract thinking</li> <li>• Factual knowledge</li> <li>• Formulating scientific questions / hypotheses</li> <li>• Terminology</li> <li>• Matter / particle concept</li> <li>• Structure / function / properties</li> <li>• Chemical reactions</li> <li>• Experimenting</li> <li>• Models</li> <li>• Limits of scientific knowledge</li> <li>• Technology</li> <li>• Technical devices</li> <li>• System</li> <li>• Interaction</li> <li>• Energy</li> <li>• Mathematics</li> </ul>	<ul style="list-style-type: none"> <li>• Education / general personality development</li> <li>• Students' interests</li> <li>• Motivation and interest</li> <li>• Everyday life</li> <li>• Society / public concerns</li> <li>• Nature / natural phenomena</li> <li>• Comprehension / understanding</li> <li>• Acting thoughtfully and responsibly</li> <li>• Judgement / opinion-forming / reflection</li> <li>• Ethics / values</li> <li>• Food / nutrition</li> <li>• Health</li> <li>• Medicine</li> <li>• Matter in everyday life Environment</li> <li>• Consequences of technological developments</li> <li>• Safety and risks</li> <li>• working independently / in a structured way / precisely</li> </ul>



<b>Basic subject-based contexts and disciplines (not included in cluster analyses)</b>			
<b>Subject-based contexts:</b>	<b>Disciplines:</b>		
<ul style="list-style-type: none"> <li>• Science – biology</li> <li>• Science – chemistry</li> <li>• Science – physics</li> </ul>	<ul style="list-style-type: none"> <li>• Botany</li> <li>• Zoology</li> <li>• Human biology</li> <li>• Genetics / molecular biology</li> <li>• Evolutionary biology</li> <li>• Neurobiology</li> </ul>	<ul style="list-style-type: none"> <li>• Ecology</li> <li>• Microbiology</li> <li>• Inorganic and general chemistry</li> <li>• Organic chemistry</li> <li>• Analytical chemistry</li> <li>• Biochemistry</li> </ul>	<ul style="list-style-type: none"> <li>• Thermodynamics</li> <li>• Electrodynamics</li> <li>• Mechanics</li> <li>• Atomic and nuclear physics</li> <li>• Astronomy / space</li> </ul>



Please mark on the given scales the **importance** you assign to the particular concepts and the **extent** of their realisation in practice, *regarding different educational levels*.

<b>Concepts</b>  Please assess the following concepts according to the two questions stated.	<b>Educational level</b>	Which <b>priority</b> should the respective concepts have in science education?	To what <b>extent</b> are the respective concepts realised in current science education?
		1 = very low priority 2 = low priority 3 = rather low priority 4 = rather high priority 5 = high priority 6 = very high priority	1 = to a very low extent 2 = to a low extent 3 = to a rather low extent 4 = to a rather high extent 5 = to a high extent 6 = to a very high extent
<b>Concept A</b> Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Lower secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Higher secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	University level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
<b>Concept B</b> Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Lower secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Higher secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	University level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
<b>Concept C</b> General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Lower secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	Higher secondary education	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]
	University level	[1] [2] [3] [4] [5] [6]	[1] [2] [3] [4] [5] [6]

## **Description of the concepts**

### **Concept A: Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts**

Concept A (*Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts*) refers to an engagement with the sciences within the frame of current, social, globally relevant, occupational and both educational and out-of-school contexts, enhancing emotional personality development and basic skills. The impressions a person gets through engaging with topics and associated science-related questions from his or her environment influence both the person's sensibility and his or her attitudes towards the sciences. Dealing with scientific issues or phenomena in out-of-school or social and public contexts respectively, also facilitates conscious experiences of scientific phenomena, scientifically precise observation and cognitive ability. Moreover, basic and occupationally relevant skills such as finding, interpreting and communicating information are in this way to enhance. Suggestions for this kind of engagement and education are e.g. amongst others provided by current issues or media coverage. Dealing with the history of the sciences especially reveals how findings and methods of the sciences enable, enhance and bring forward research in the natural sciences. This shows moreover how historical science-related developments are still linked to applications in industry and technology, how these applications changed the world and how they influence our professional and everyday life.

The cluster analysis of concept A led to the grouping of the following categories:

#### **Situations, contexts, motives:**

Emotional personality development, media / current issues, global references, occupation / career, out-of-school learning, curriculum framework

#### **(Basic) concepts, themes and perspectives:**

History of the sciences, occupations / occupational fields, industrial processes, cycle of matter, Earth sciences, development / growth

#### **Qualifications:**

Empathy / sensibility, perception / awareness / observation, social skills / teamwork, knowledge about science-related occupations, communication skills, finding information, reading comprehension

## **Concept B: Intellectual education across scientific disciplines ('interdisciplinarity')**

Concept B (*Intellectual education in interdisciplinary scientific contexts*) refers to an engagement with the sciences, their terminology, their methods, their basic concepts, their interdisciplinary

relations, their findings and their perspectives, which enhance individual intellectual personality development. Dealing with the sciences in this way not only serves the acquisition of science-related basic knowledge but also helps to understand fundamental findings and the process of gaining knowledge in the sciences. Moreover, dealing with questions and topics of the sciences enhances understanding, promotes scientific research methods, facilitates analytical abilities and fosters the ability to take differentiated perspectives. Moreover, current scientific research reveals not only how findings and methods of the sciences enable, enhance and support both scientific research and its applications but also how scientific research is interconnected across disciplines.

The analysis of concept B led to the grouping of the following categories:

### **Situations, contexts, motives:**

Intellectual personality development, science - interdisciplinarity, technology

### **(Basic) concepts, themes and perspectives:**

Interdisciplinarity, scientific inquiry, current scientific research, limits of scientific knowledge, terminology, matter / particle concept, structure / function / properties, chemical reactions, models, technical devices, system, interaction, energy, mathematics

### **Qualifications:**

Applying knowledge / creative and abstract thinking, formulating scientific questions / hypotheses, factual knowledge, critical questioning, rational thinking / analysing / drawing conclusions, experimenting

## Appendix 2: Totals (frequencies)

All responses			very low	low	rather low	rather high	high	very high
			1	2	3	4	5	6
<b>PRIORITY</b>	Concept A Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level	6	25	39	46	34	20
		Lower secondary education	0	5	25	56	49	34
		Higher secondary education	0	1	11	29	67	62
		University level	0	3	6	30	37	94
	Concept B Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level	20	31	43	42	23	12
		Lower secondary education	5	10	42	43	52	18
		Higher secondary education	3	2	20	43	62	39
		University level	2	0	10	25	52	80
	Concept C General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level	3	10	29	46	44	37
		Lower secondary education	1	5	19	44	61	39
		Higher secondary education	0	3	10	32	67	57
		University level	1	4	11	21	58	75
<b>EXTENT</b>	Concept A Awareness of the sciences in current, social, globally relevant, occupational and both educational and out-of-school contexts	Elementary level	40	47	50	26	9	0
		Lower secondary education	8	33	79	37	10	2
		Higher secondary education	4	22	56	63	18	7
		University level	3	15	37	57	42	15
	Concept B Intellectual education across scientific disciplines ('interdisciplinarity')	Elementary level	52	50	36	19	14	1
		Lower secondary education	12	36	67	36	17	2
		Higher secondary education	5	26	56	54	23	5
		University level	3	9	34	61	45	16
	Concept C General science-related education and facilitation of interest in contexts of nature, everyday life and living environment	Elementary level	16	47	49	37	20	3
		Lower secondary education	5	26	55	57	23	4
		Higher secondary education	3	20	44	62	33	7
		University level	5	18	26	48	48	25

## Appendix 3: The questionnaire

Calculation of mean 'scores' using a weighted scale.

### Responses from Employers & Scientists ( $n = 26$ )

		very low	low	rather low	rather high	high	very high					
		weightings =>										
		response options =>										
		1	2	3	4	5	6	$m^-$	$m^+$	Bar length		
<b>PRIORITY</b>	Concept A	Elementary	2	4	6	5	4	2	20	19	7.7	7.3
		Lower secondary	0	0	5	9	6	3	5	30	1.9	12
		Higher secondary	0	0	3	5	8	6	3	39	1.2	15
		University	0	2	2	5	3	9	6	38	2.3	15
	Concept B	Elementary	2	7	7	2	3	2	27	14	10	5.4
		Lower secondary	0	2	5	7	4	5	9	30	3.5	12
		Higher secondary	0	0	2	4	10	7	2	45	0.8	17
		University	0	0	1	1	7	13	1	54	0.4	21
	Concept C	Elementary	0	2	1	9	6	5	5	36	1.9	14
		Lower secondary	0	0	0	10	7	6	0	42	0	16
		Higher secondary	0	2	0	5	8	7	4	42	1.5	16
		University	1	1	2	3	7	8	7	41	2.7	16
<b>EXTENT</b>	Concept A	Elementary	12	7	2	4	0	0	52	4	20	1.5
		Lower secondary	3	13	5	2	1	0	40	4	15	1.5
		Higher secondary	1	10	8	4	1	0	31	6	12	2.3
		University	1	6	8	3	5	0	23	13	8.8	5
	Concept B	Elementary	13	6	3	1	1	0	54	3	21	1.2
		Lower secondary	3	10	6	2	2	0	35	6	13	2.3
		Higher secondary	1	9	8	2	2	1	29	9	11	3.5
		University	1	1	6	10	2	2	11	20	4.2	7.7
	Concept C	Elementary	6	8	5	4	0	0	39	4	15	1.5
		Lower secondary	0	8	12	3	0	0	28	3	11	1.2
		Higher secondary	1	6	10	4	2	0	25	8	9.6	3.1
		University	3	2	7	6	4	0	20	14	7.7	5.4
Total scores (Priority )		5	20	34	65	73	73					
Total scores (Extent)		45	86	80	45	20	3					

### Calculation of 'mean scores'

The 'mean scores' (negative and positive;  $m^-$  and  $m^+$ ) were calculated using the weightings shown in the table. For example, the first row of figures above (2, 4, 6, 5, 4, 2) are given a 'negative score' of 20 (i.e.  $2 \times 3 + 4 \times 2 + 6 \times 1$ ) and a 'positive score' of 19 (i.e.  $5 \times 1 + 4 \times 2 + 2 \times 3$ ). These two numbers are each divided by the number of people in the group (in this case 26) and multiplied by a common scaling factor (10) in order to produce bars from the graphs that indicate the relative strength of the 'low' or 'high' rating given by participants and that are comparable across groups of different size.

## Responses from Students ( $n = 52$ )

		weightings =>								Bar length		
		3	2	1	1	2	3					
		response options =>						<i>m-</i>	<i>m+</i>			
		1	2	3	4	5	6					
<b>PRIORITY</b>	Concept A	Elementary	3	11	10	12	13	3	41	47	7.9	9
		Lower secondary	0	4	9	19	11	9	17	68	3.3	13
		Higher secondary	0	0	4	16	21	11	4	91	0.8	18
		University	0	0	2	15	13	22	2	107	0.4	21
	Concept B	Elementary	11	9	15	10	5	2	66	26	13	5
		Lower secondary	4	4	19	14	8	3	39	39	7.5	7.5
		Higher secondary	2	2	11	15	16	6	21	65	4	13
		University	1	0	7	10	15	19	10	97	1.9	19
	Concept C	Elementary	2	6	14	13	9	8	32	55	6.2	11
		Lower secondary	1	2	12	16	15	6	19	64	3.7	12
		Higher secondary	0	1	4	13	22	12	6	93	1.2	18
		University	0	2	3	9	14	24	7	109	1.3	21
<b>EXTENT</b>	Concept A	Elementary	5	16	16	11	4	0	63	19	12	3.7
		Lower secondary	1	6	28	13	3	0	43	19	8.3	3.7
		Higher secondary	0	6	15	20	7	4	27	46	5.2	8.8
		University	0	6	15	14	9	8	27	56	5.2	11
	Concept B	Elementary	14	15	13	3	7	0	85	17	16	3.3
		Lower secondary	5	11	20	12	3	1	57	21	11	4
		Higher secondary	1	8	24	13	5	1	43	26	8.3	5
		University	1	5	13	15	16	2	26	53	5	10
	Concept C	Elementary	2	19	12	13	5	1	56	26	11	5
		Lower secondary	1	10	23	12	5	1	46	25	8.8	4.8
		Higher secondary	1	8	13	16	11	3	32	47	6.2	9
		University	1	7	5	12	16	11	22	77	4.2	15
	Total scores (Priority )		24	41	110	162	162	125				
	Total scores (Extent)		32	117	197	154	91	32				

## Responses from Teachers ( $n = 54$ )

		weightings =>								Bar length		
		3	2	1	1	2	3					
		response options =>						m-	m+			
		1	2	3	4	5	6					
<b>PRIORITY</b>	Concept A	Elementary	1	5	16	25	15	12	29	91	5.4	17
		Lower secondary	0	1	6	21	26	20	8	133	1.5	25
		Higher secondary	0	0	4	6	26	38	4	172	0.7	32
		University	0	1	1	8	15	49	3	185	0.6	34
	Concept B	Elementary	4	11	16	27	10	6	50	65	9.3	12
		Lower secondary	0	3	13	15	34	9	19	110	3.5	20
		Higher secondary	0	0	5	19	28	22	5	141	0.9	26
		University	0	0	2	10	24	38	2	172	0.4	32
	Concept C	Elementary	1	0	14	18	23	18	17	118	3.1	22
		Lower secondary	0	2	4	15	30	23	8	144	1.5	27
		Higher secondary	0	0	4	8	29	33	4	165	0.7	31
		University	0	1	5	6	24	38	7	168	1.3	31
<b>EXTENT</b>	Concept A	Elementary	18	17	27	9	3	0	115	15	21	2.8
		Lower secondary	2	10	38	15	6	2	64	33	12	6.1
		Higher secondary	2	6	24	29	9	3	42	56	7.8	10
		University	2	2	8	31	23	7	18	98	3.3	18
	Concept B	Elementary	16	25	18	10	4	1	116	21	21	3.9
		Lower secondary	3	12	30	18	9	1	63	39	12	7.2
		Higher secondary	2	7	19	30	11	4	39	64	7.2	12
		University	1	3	12	27	21	9	21	96	3.9	18
	Concept C	Elementary	5	17	25	17	9	1	74	38	14	7
		Lower secondary	3	6	16	33	12	3	37	66	6.9	12
		Higher secondary	1	4	14	34	16	4	25	78	4.6	14
		University	1	6	10	24	20	12	25	100	4.6	19
	Total scores (Priority )	6	24	90	178	284	306					
	Total scores (Extent)	56	115	241	277	143	47					

## Responses from Teacher Educators ( $n = 21$ )

		weightings =>						Bar length				
		3	2	1	1	2	3					
		response options =>						<i>m-</i>	<i>m+</i>			
		1	2	3	4	5	6					
<b>PRIORITY</b>	Concept A	Elementary	0	5	6	4	3	3	16	19	7.6	9
		Lower secondary	0	0	5	8	5	3	5	27	2.4	13
		Higher secondary	0	1	0	2	13	5	2	43	1	20
		University	0	0	1	2	8	10	1	48	0.5	23
	Concept B	Elementary	3	4	5	3	4	2	22	17	10	8.1
		Lower secondary	1	1	4	8	6	1	9	23	4.3	11
		Higher secondary	1	0	2	4	9	5	5	37	2.4	18
		University	1	0	0	3	9	8	3	45	1.4	21
	Concept C	Elementary	0	2	0	7	6	6	4	37	1.9	18
		Lower secondary	0	1	3	3	9	5	5	36	2.4	17
		Higher secondary	0	0	2	6	9	4	2	36	1	17
		University	0	0	1	3	14	3	1	40	0.5	19
<b>EXTENT</b>	Concept A	Elementary	5	7	5	2	2	0	34	6	16	2.9
		Lower secondary	2	4	9	6	0	0	23	6	11	2.9
		Higher secondary	1	1	10	8	1	0	15	10	7.1	4.8
		University	0	2	5	9	5	0	9	19	4.3	9
	Concept B	Elementary	9	3	2	4	3	0	35	10	17	4.8
		Lower secondary	1	4	10	3	3	0	21	9	10	4.3
		Higher secondary	1	3	5	9	3	0	14	15	6.7	7.1
		University	0	0	4	10	5	2	4	26	1.9	12
	Concept C	Elementary	3	2	8	2	5	1	21	15	10	7.1
		Lower secondary	1	2	6	7	5	0	13	17	6.2	8.1
		Higher secondary	0	3	8	7	3	0	14	13	6.7	6.2
		University	0	3	5	6	6	1	11	21	5.2	10
Total scores (Priority )		6	14	29	53	95	55					
Total scores (Extent)		23	34	77	73	41	4					