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PROFILES

Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science

1st International PROFILES Conference

European Stakeholders' Views on Science Education – Method of and Results from the International PROFILES Curricular Delphi Study

Theresa Schulte – Claus Bolte

Berlin, September 2012

SEVENTH FRAMEWORK PROGRAMME

Structure

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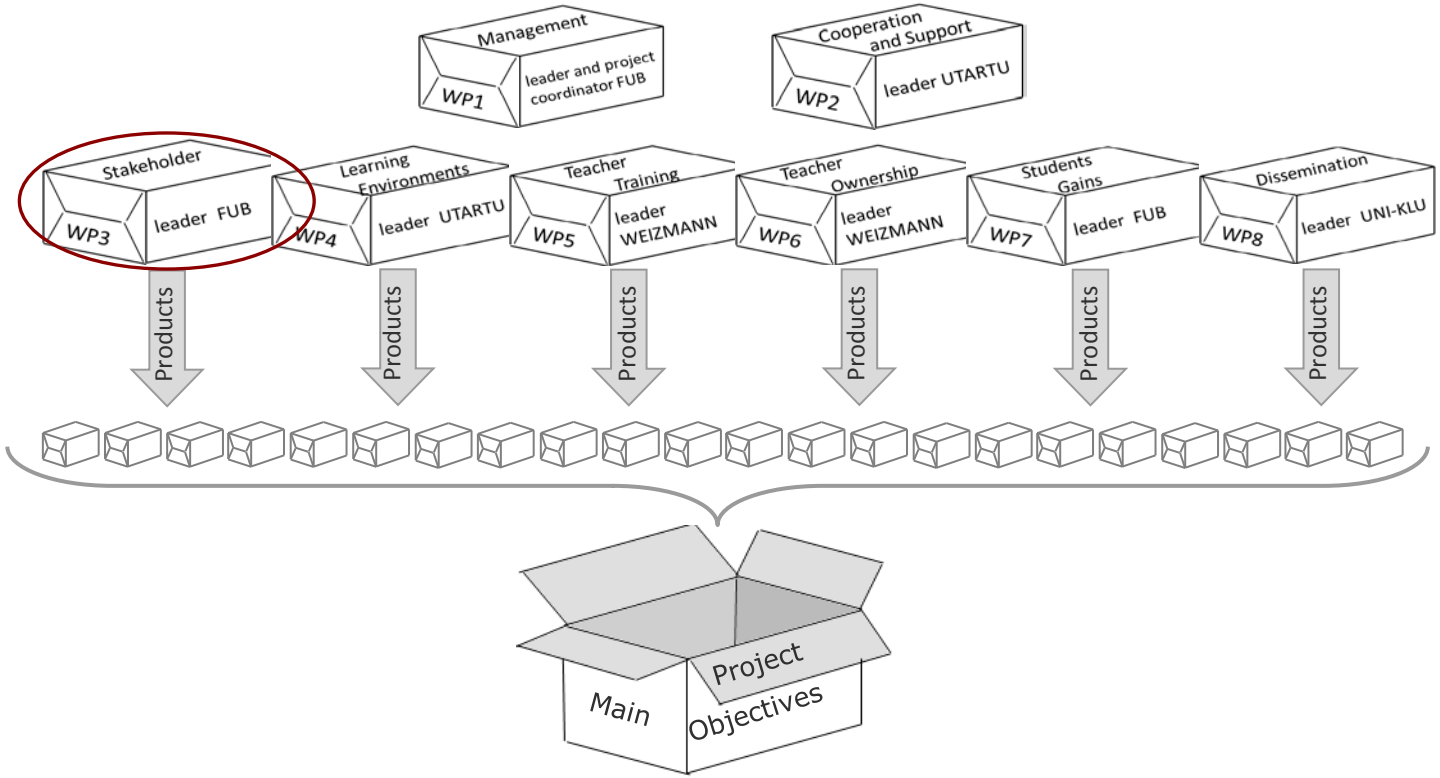
- Introduction
- Research Questions
- Method
- Results
- Discussion
- Outlook

Introduction and Background

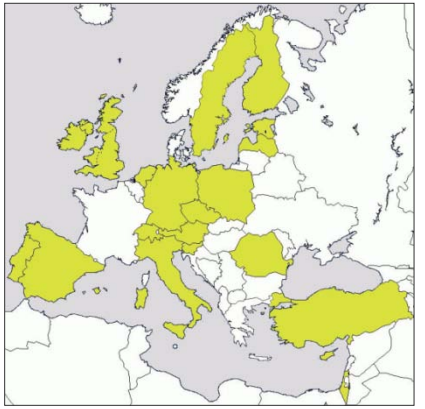


PROFILES promotes IBSE through raising the self-efficacy of **science teachers** to take **ownership** of more effective ways of **teaching students**, supported by **stakeholders**.

Fig.: PROFILES DoW (2010, p.26)

WP 3 – Stakeholder Involvement and Interaction

- Bridging the gap between science education researchers, teachers, and other local actors
- Involving a wide range of stakeholders
- Stakeholder involvement and interaction through the **International PROFILES Curricular Delphi Study on Science Education**
  - → What kind of opinions and expectations of modern and desirable science education exist among different stakeholder groups?
  - → In which way are there differences and agreements between different stakeholder groups' opinions?
- Consideration of the questions in national contexts as well as in PROFILES wide comparison



Method of Curricular Delphi Studies

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The Delphi Method

- several rounds
- fixed group of participants (“experts”)
- formalized questionnaire
- calculation of statistically firm group answers
- group answers are fed back to the participants
- participants interact and cooperate anonymously
- condensation of the general question

Curricular Elements:

- *criteria for selecting the participants*
- *formalized question and answering formats*

(Häder and Häder 1998, 10-11, Frey 1980, 32, Bolte 2008, 334)

Design of the PROFILES Curricular Delphi Study on Science Education

Central Question of the Curricular Delphi Study on Science Education:

“Which aspects of science education do you consider advisable and pedagogically desirable for the individual in the society of today and in the near future?” (following Häußler et al. 1980; Mayer 1992)

Three-part questionnaire:

1. Which **situations and motives** can be taken as a basis and in which context should science lessons be put in order to stimulate and facilitate science-related educational processes?
2. Which **contents, methods and themes** related to science should be taught in science lessons?
3. Which **skills, competencies and attitudes** should be developed and enhanced to support students in becoming scientifically educated?

Design of the PROFILES Curricular Delphi Study on Science Education

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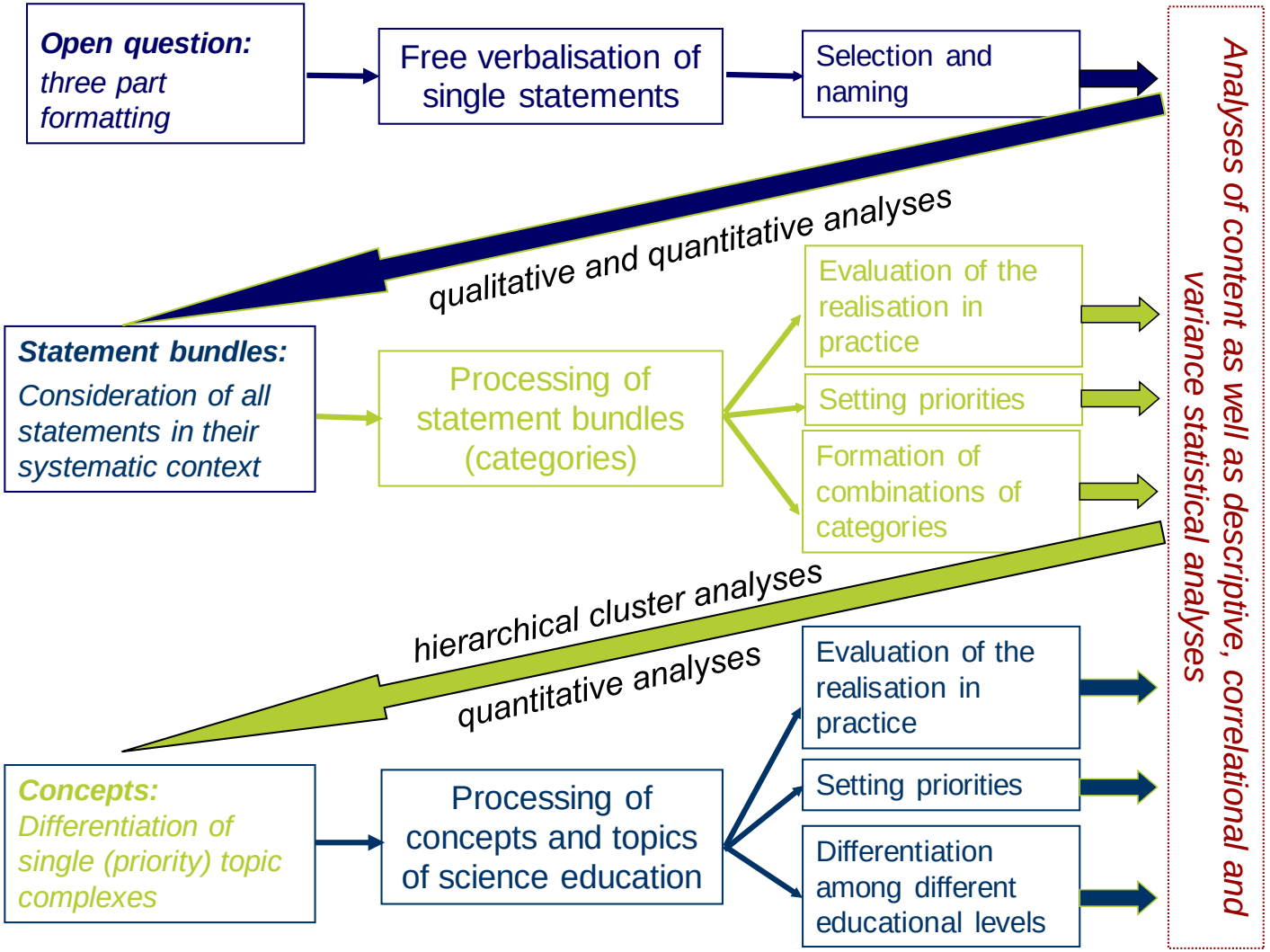
Sample Structure

Group I: Students ($n_s \approx 25$)	Students with basic science courses Students with advanced / A-level science courses
Group II: Teachers ($n_t \approx 25$)	Education students at university Trainee teachers Experienced teachers (in-service) Lecturers / mentors
Group III: Education researchers, didactics and in-service teacher educators ($n_e \approx 25$)	Teacher education associations Didactics of biology, chemistry, physics, geo-science Didactics of general sciences and elementary science Curriculum developers / examination personnel
Group IV: Scientists ($n_n \approx 25$)	Chemists, physicists, biologists Other researchers in science-associated fields Employees in other scientific professions (engineers, pharmacists, biochemists,…)

Design of the PROFILES Curricular Delphi Study on Science Education



Round 1

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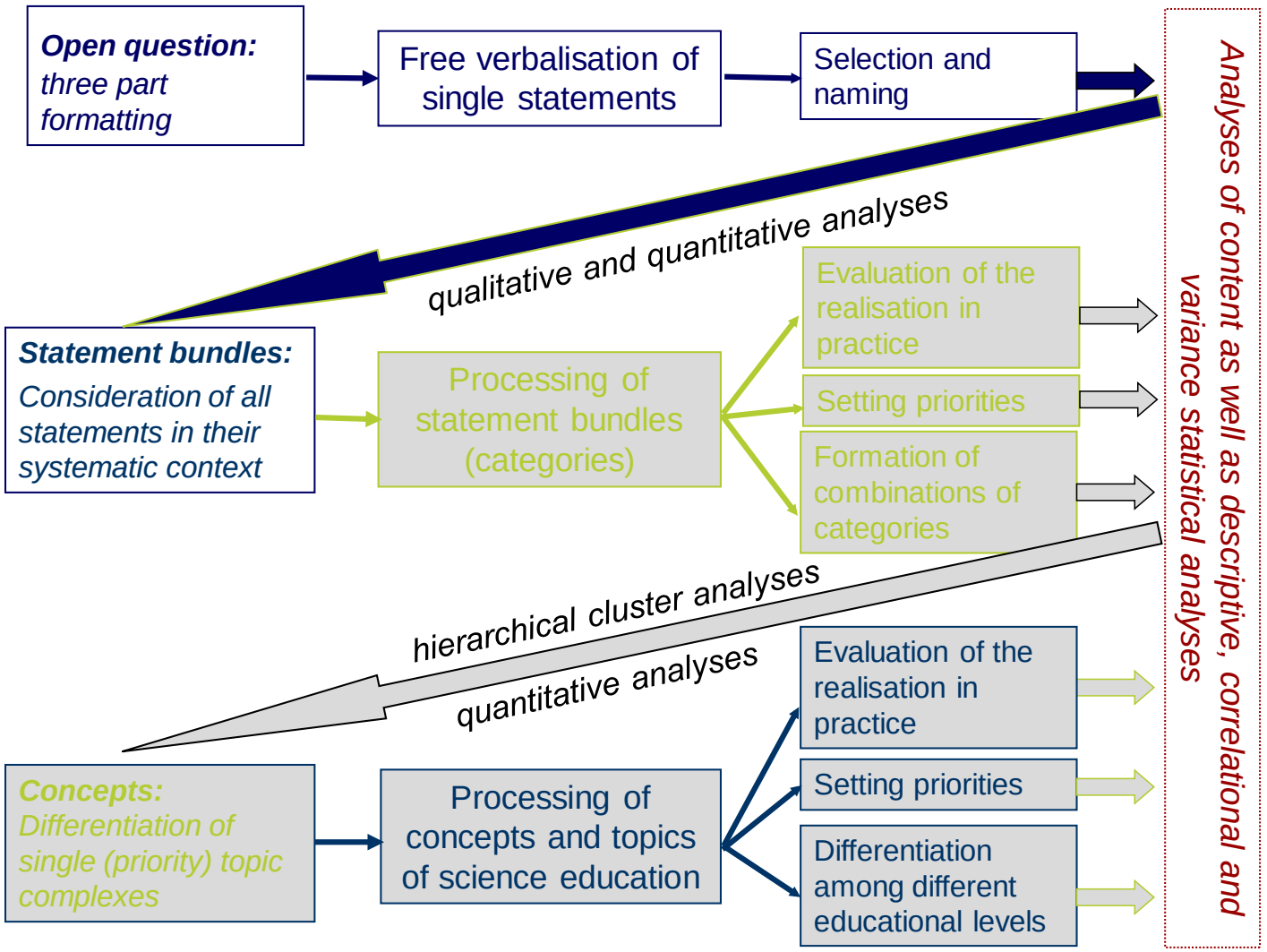

Samples Round 1

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	Students	Teachers	Education researchers	Scientists	Total
FUB_Germany	39	63	30	61	193
UTARTU_Estonia	20	30	2	21	73
WEIZMANN_Israel	33	35	25	23	116
UNI-KLU_Austria	27	48	20	20	115
CUT_Cyprus	141	32	15	4	192
MU_Czech Republik	138	30	28	25	221
UEF_Finland	76	67	23	22	188
UCC_Ireland	53	74	21	25	173
UNIVPM_Italy	2	82	0	42	126
LU_Latvia	30	35	22	20	107
UMCS_Poland	30	41	21	25	117
UPORTO_Portugal	9	38	2	0	49
VUT_Romania	21	43	22	20	106
UL_Slovenia	26	39	20	24	109
UVA_Spain	61	22	22	21	126
FHNW_Switzerland	42	38	23	0	103
DEU_Turkey	29	50	26	21	126
UniHB_Germany	27	26	25	14	92
Total	**831**	**847**	**350**	**424**	**2452**

Sample and Responses Round 1 FUB

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Sample Round 1 (FUB) (July 2012)		**Number of participants**		**Number of statements**	**Average number of statements per person**
Students		39		415	11
Teachers	Education Students	32	63	1147	18
	Trainee teachers	5			
	Teachers	18			
	Teacher Educators	8			
Education Researchers		30		828	28
Scientists		61		769	13
Total		**193**		**3159**	**16**

Results Round 1 FUB – Qualitative Analysis

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Inter-rater agreement following $q = \frac{2N_+}{2N_+ + N_-}$

I: situations, contexts, motives	IIa: concepts and topics	IIb: fields and perspectives	III: qualification	IV: methodical aspects
q_I = .78	q_{IIa} = .82	q_{IIb} = .70	q_{III} = .74	q_{IV} = .76
q_t = .77				

Results of the inter-rater agreement of two different coders after coding 20 questionnaires

Results Round 1 FUB – Qualitative Analysis

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Classification System with 88 Categories – FUB

Motives, Situations or Contexts: 18 Categories related to

- individual education (3)
- external motives (2)
- individual (everyday related) contexts (7)
- scientific contexts (4)
- situations (2)

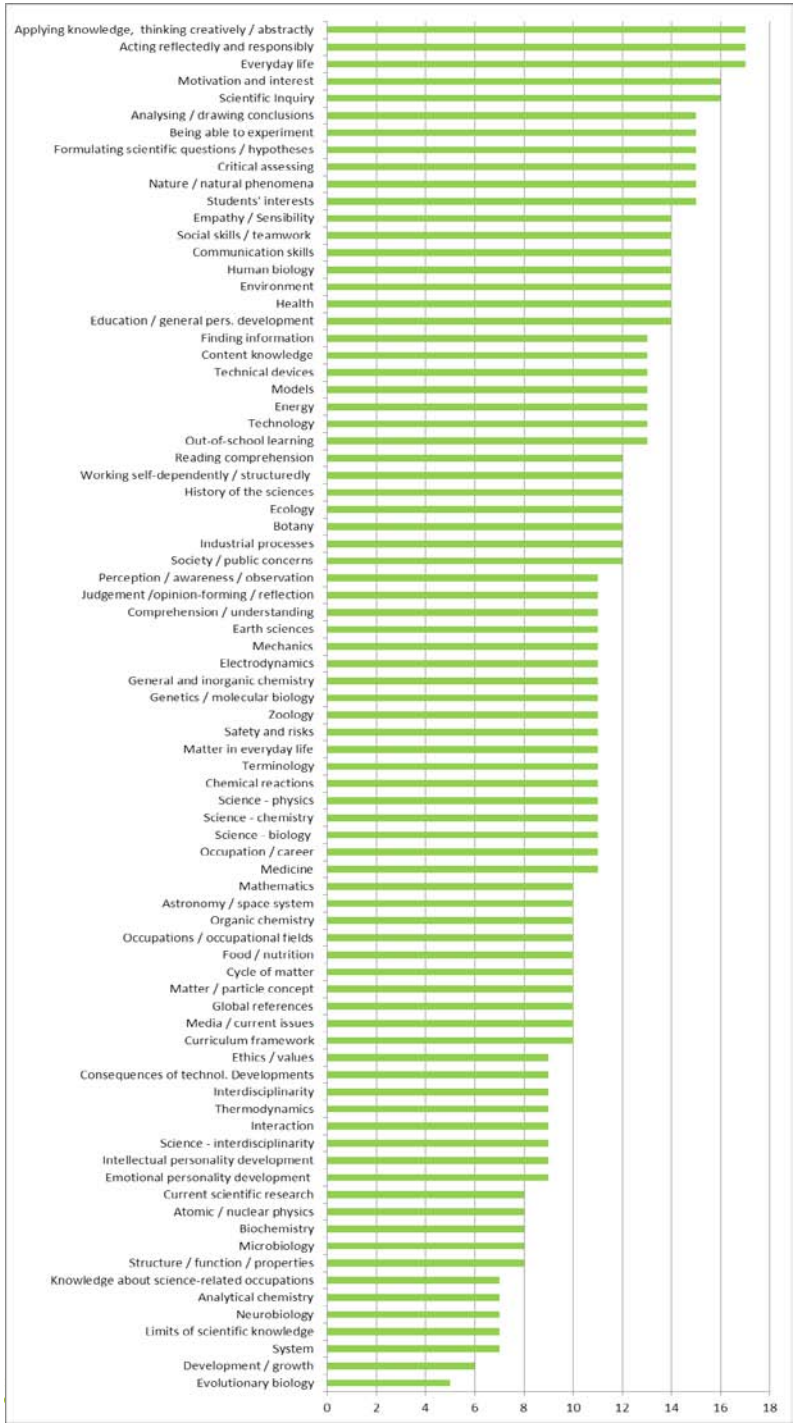
Concepts / Topics and Fields / Perspectives: 44 (20+24) Categories related to

- basic concepts of science (11)
- topics of science with reference to everyday life (9)
- perspectives of the sciences (16)
- perspectives from which science as well as everyday life related facts can be considered (8)

Qualifications: 18 Categories related to

- everyday life-related (sc.) competencies (11)
- scientific and inquiry-related competencies (4)
- Attitudes (3)

Methodical aspects: 8 Categories



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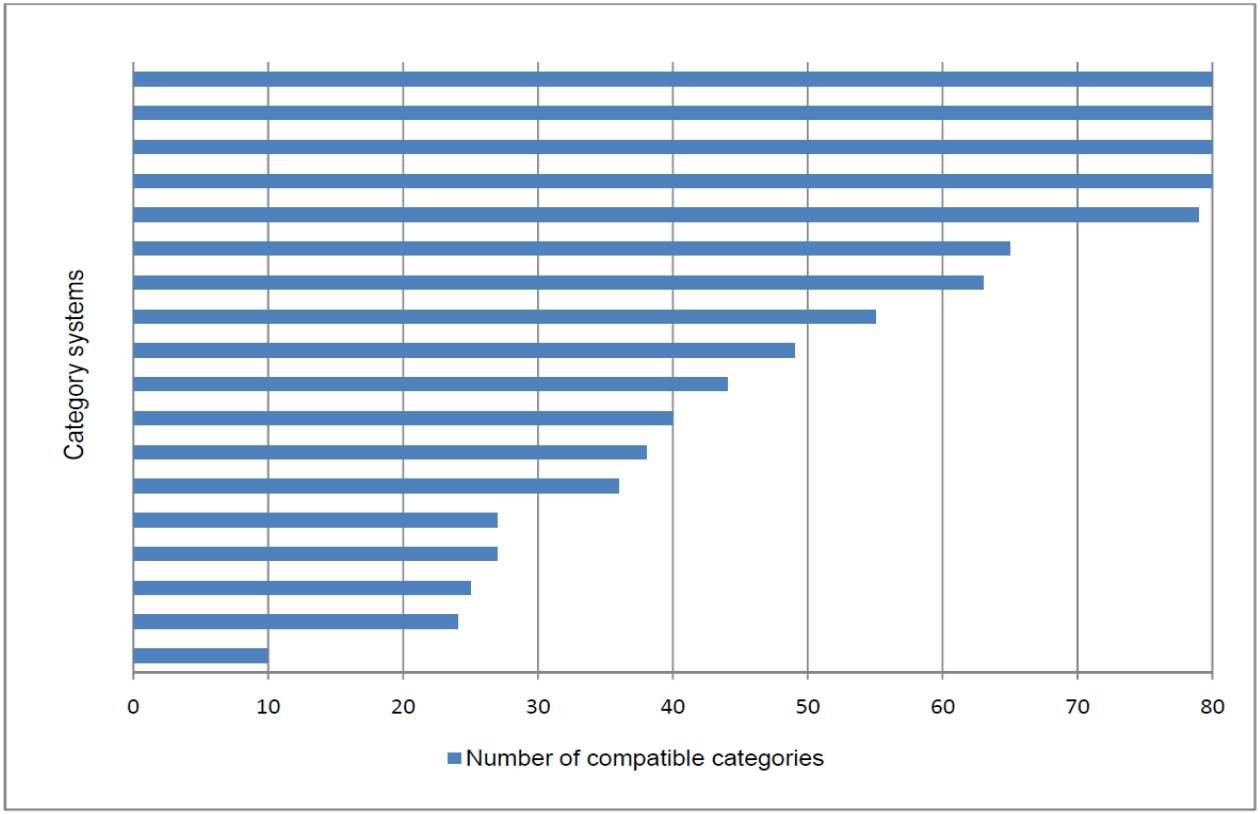
Results Round 1 PROFILES-wide – Qualitative Analyses :

- 18 category systemes, ranging from category systems with 26 categories to category systems with 133 categories
- 60 (out of 80) categories are in each case shared by at least 10 category systems

Fig.: Number of category systems containing a particular category

Results Round 1 PROFILES-wide – Qualitative Analysis

Compatibility of the category systems (N=18) among each other



→ 8 category systems are compatible in a number of at least 50 categories

Results Round 1 FUB – Quantitative Analysis

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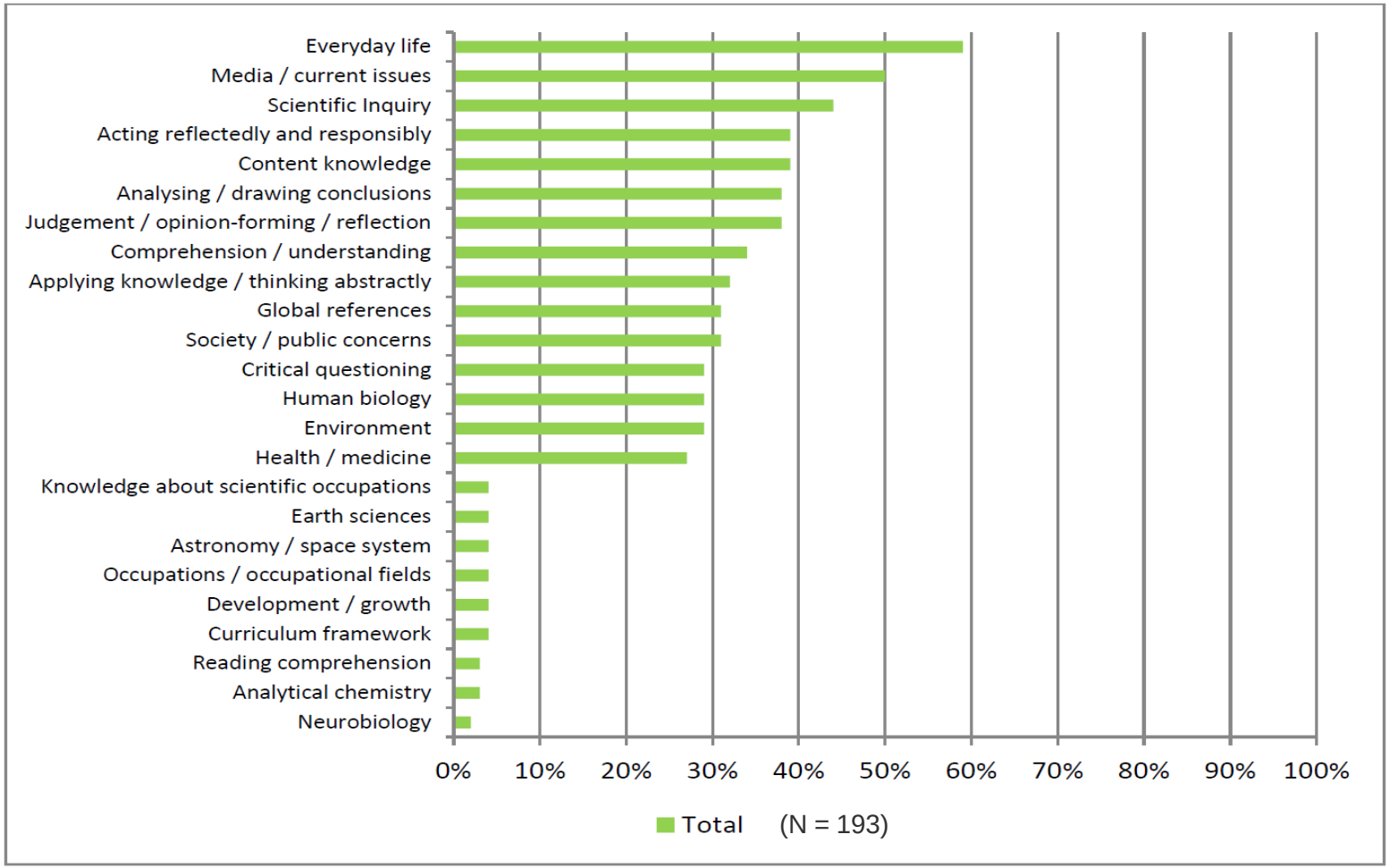
Frequencies of the total sample – categories mentioned often and rarely



→ 15 categories were mentioned particularly often (>25%)
→ 9 categories were mentioned particularly rarely (<5%)

Results Round 1 FUB – Quantitative Analysis

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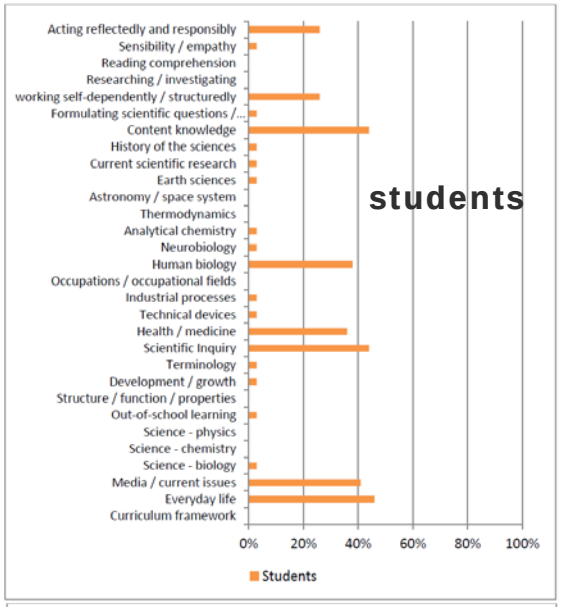
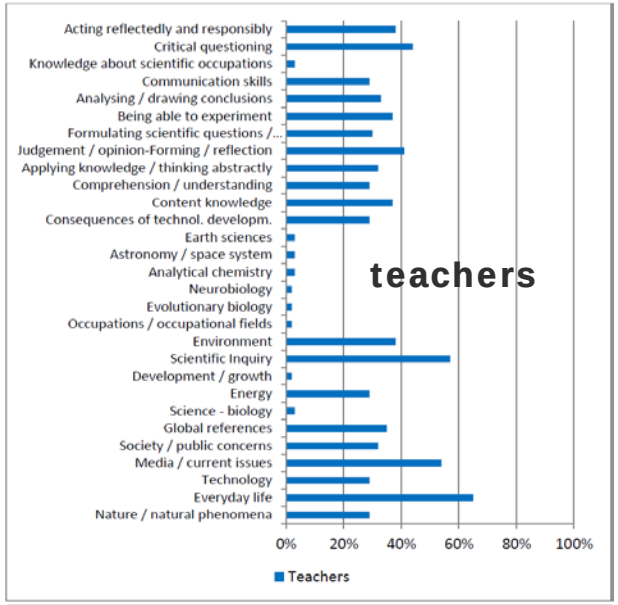
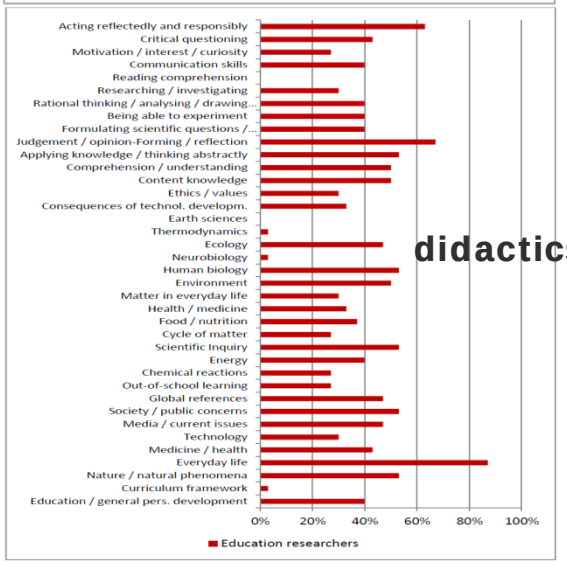
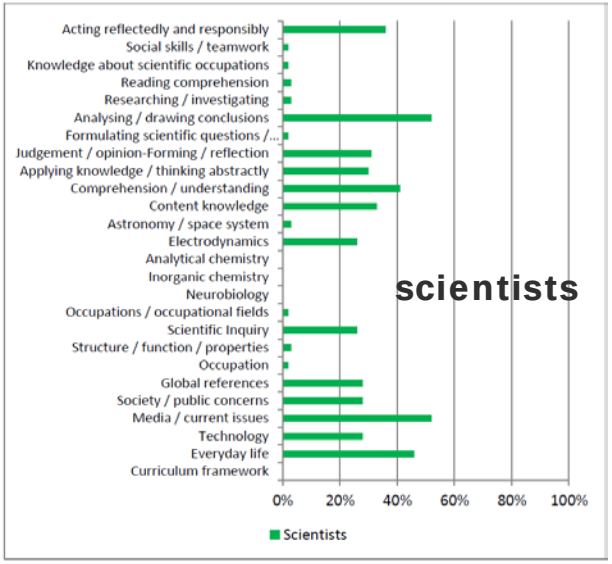




Answering patterns – frequencies of the 4 sample groups





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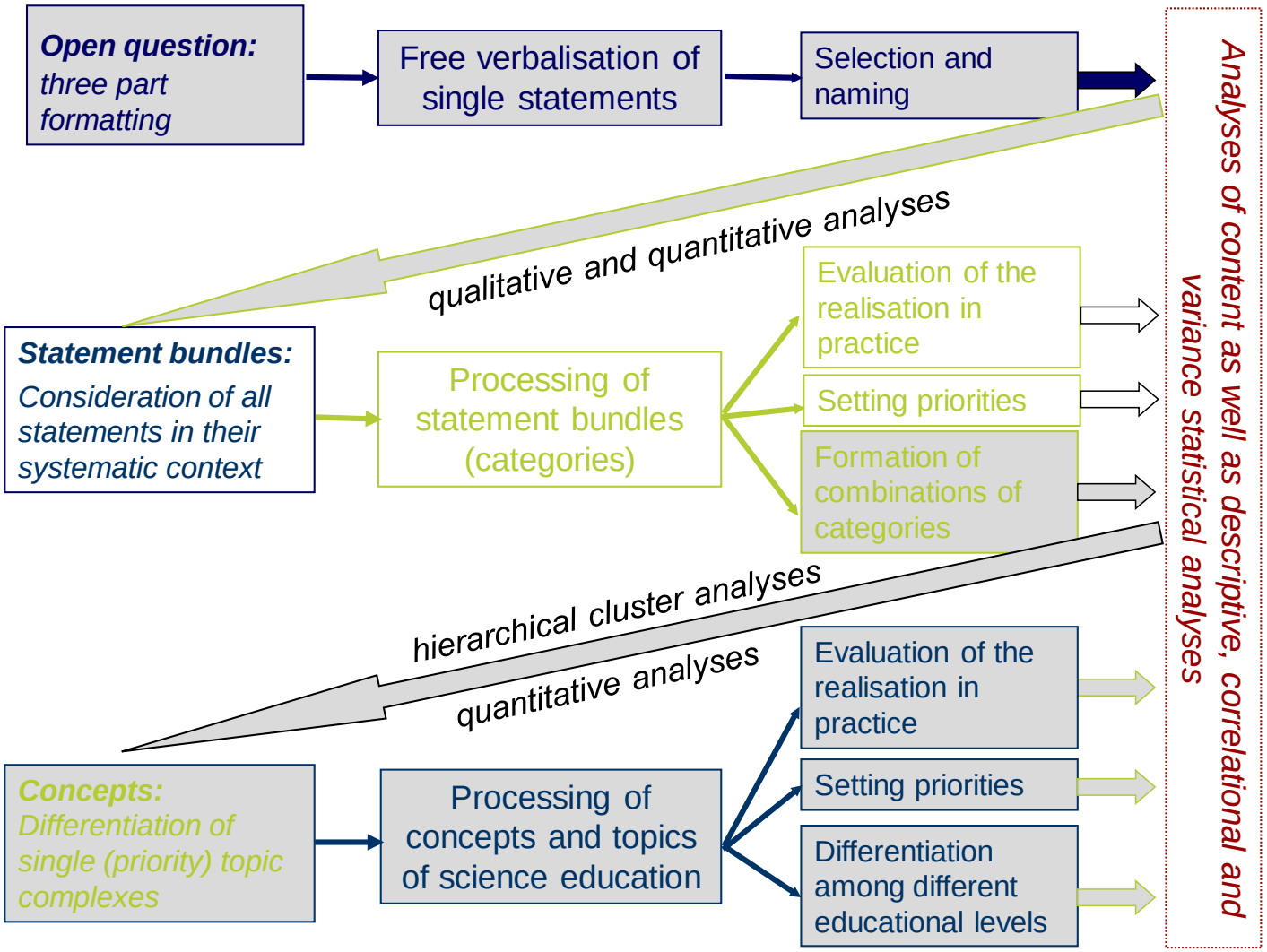
Round 2


Open question:
three part formatting
Free verbalisation of single statements
Selection and naming
qualitative and quantitative analyses
Statement bundles:
Consideration of all statements in their systematic context
Processing of statement bundles (categories)
Evaluation of the realisation in practice
Setting priorities
Formation of combinations of categories
hierarchical cluster analyses
quantitative analyses
Concepts:
Differentiation of single (priority) topic complexes
Processing of concepts and topics of science education
Evaluation of the realisation in practice
Setting priorities
Differentiation among different educational levels
Analyses of content as well as descriptive, correlational and variance statistical analyses

Sample Round 2 FUB

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Sample structure		Round 1		Round 2		Round 3 (still in progress, data status 9/2012)	
Students		39		34		28	
Teachers	Education Students	32	63	29	50	10	27
	Trainee teachers	5		4		4	
	Teachers	18		16		13	
	Teacher Educators	8		1		0	
Education Researchers		30		29		13	
Scientists		61		41		22	
Total		**193**		**154**		**90**	

Results Round 2 FUB – Priority

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	P_t	Priority
Top Ten	5,3	Comprehension / understanding
	5,2	Analysing / drawing conclusions
	5,1	Applying knowledge / creative and abstract thinking
	5,1	Judgement / opinion-forming / reflection
	5,1	Critical assessment
	5,1	Nature / natural phenomena
	5,1	Acting reflectedly and responsibly
	5,0	working self-dependently / structuredly / precisely
	5,0	Motivation and interest
	5,0	Perception / awareness / observation
	⋮	
Low Five	3,6	Industrial processes
	3,4	History of the sciences
	3,3	Astronomy / space system
	3,1	Learning in mixed-aged classes
	2,9	Role play

Sample: N=154

Results Round 2 FUB – Priority and Practice

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	P_t	Priority	R_t	Practice
Top Ten	5,3	Comprehension / understanding	4,8	Curriculum framework
	5,2	Analysing / drawing conclusions	4,3	Content knowledge
	5,1	Applying knowledge / creative and abstract thinking	4,2	Chemical reactions
	5,1	Judgement / opinion-forming / reflection	4,1	General and inorganic chemistry
	5,1	Critical assessment	4,0	Terminology
	5,1	Nature / natural phenomena	4,0	Science – biology
	5,1	Acting reflectedly and responsibly	4,0	Environment
	5,0	working self-dependently / structuredly / precisely	4,0	Science – chemistry
	5,0	Motivation and interest	4,0	Structure / function / properties
	5,0	Perception / awareness / observation	3,9	Matter / particle concept
	…		…	
Low Five	3,6	Industrial processes	2,3	Emotional personality development
	3,4	History of the sciences	2,3	Learning in mixed-aged classes
	3,3	Astronomy / space system	2,3	Current scientific research
	3,1	Learning in mixed-aged classes	2,3	Astronomy / space system
	2,9	Role play	2,2	Role play

Sample: N=154

Results Round 2 FUB – Priority-Practice-Differences

	D_t	Priority-Practice-Difference
Top Ten	2,4	Critical assessment
	2,3	Judgement / opinion-forming / reflection
	2,2	Acting reflectedly and responsibly
	2,1	Current scientific research
	2,1	Motivation and interest
	2,1	Students‘ interests
	2,0	Ethics / values
	2,0	Consequences of technological developments
	2,0	Applying knowledge / creative and abstract thinking
	1,9	Interdisciplinarity
	…	
Low Five	0,3	Terminology
	0,3	Botany
	0,3	General and inorganic chemistry
	0,3	Chemical reactions
	0,2	Zoology

Sample: N=154

Discussion and Outlook

- Priorities: Although gradual differences, almost all aspects considered as relevant
- Emphases on overarching aims of science education as in PROFILES
- Gap between priority and practice
- According to the FUB Delphi sample…
  - modern science education should facilitate...
    - comprehension, analysing and drawing conclusions
    - applying knowledge
    - critical assessment, judgement abilitites and acting reflectedly
    - working structuredly and self-dependently
    - interest and motivation
    - perceiving and observing
  - the must urgent need for action is in …
    - considering technological developments and discussing them against different ethical concepts
    - references to current scientific research
    - taking up interdisciplinary topics
- PROFILES wide comparison points to national differences as well as to considerable overlaps
- More differentiated results are expected within the further progress of round 2 and within round 3

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Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science

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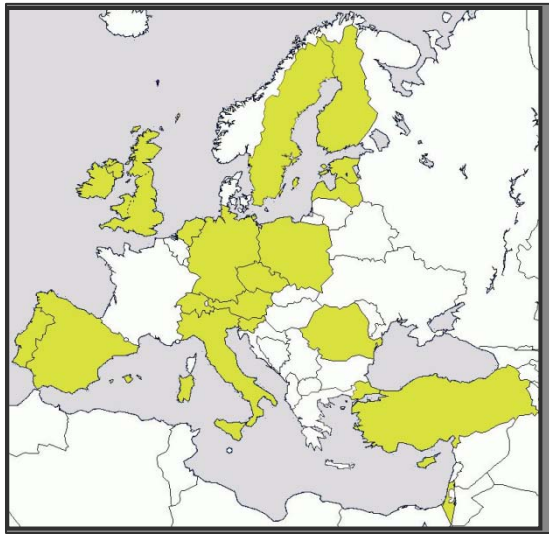

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Berlin, September 2012

SEVENTH FRAMEWORK PROGRAMME

References

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Introduction to WP3: Stakeholder involvement and interaction

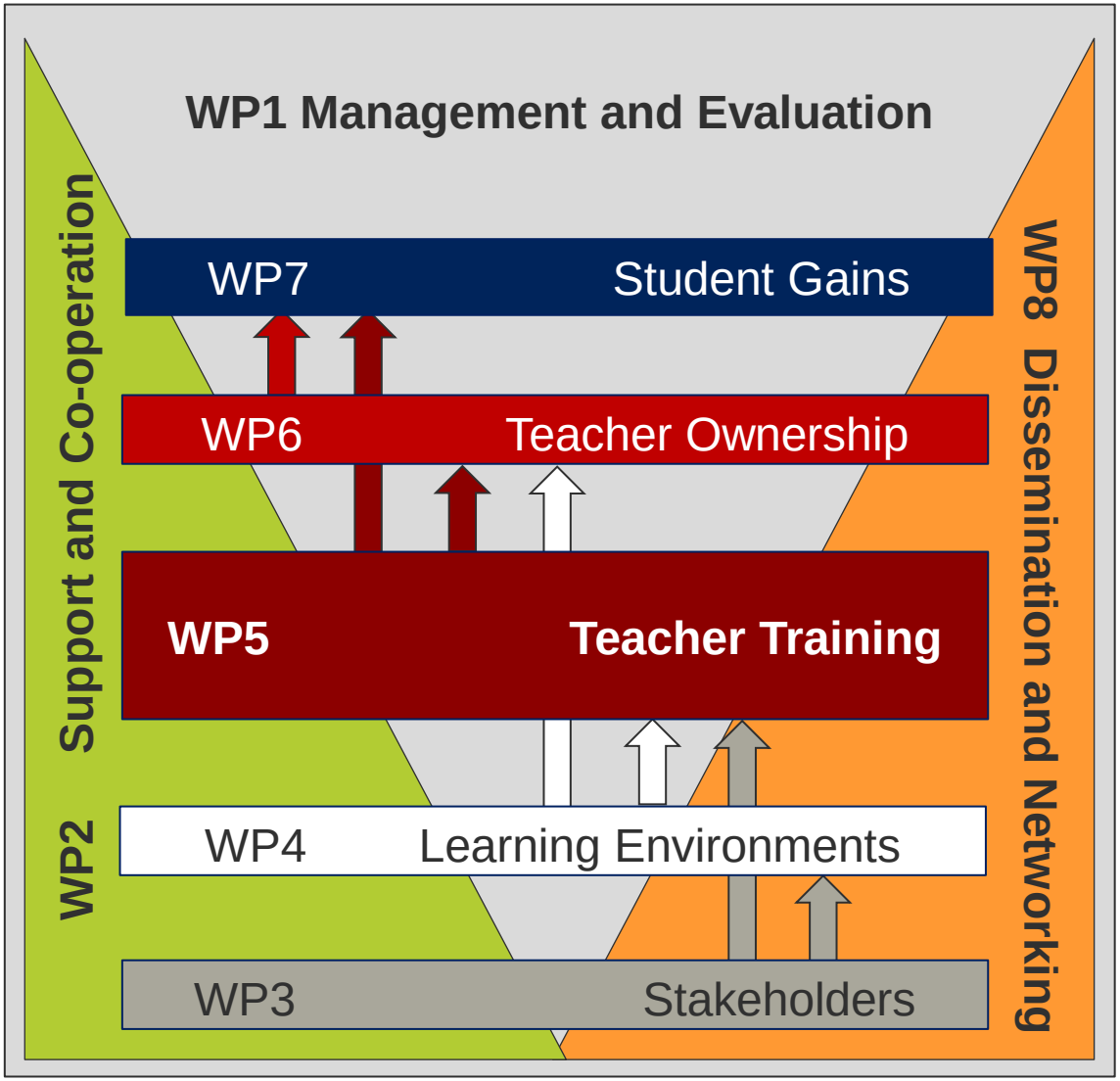

Fig.: Representation of the components showing interdependencies

PROFILES DoW (2010, 59)

Three-part Question Format

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	I: Situations/contexts/motives	II: field	III: qualification
01 FUB_Germany			
02 UTARTU_Estonia			
03 WEIZMANN_Israel			
04 UNI-KLU_Austria			
05 CUT_Cyprus			
06 MU_Czech Republik			
07 UEF_Finland			
08 UCC_Ireland			
09 UNIVPM_Italy			
10 LU_Latvia			
12 UMCS_Poland			
13 UPORTO_Portugal			
14 VUT_Romania			
15 UL_Slovenia			
16 UVA_Spain	closed questions		
17 FHNW_Switzerland			
18 DEU_Turkey			
20 UniHB_Germany			
21 ICASE_UK			

Category systems

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	I: situations/ contexts/motives	IIa: (basic) concepts and topics	IIb: fields and perspectives	III: qualifications	Total
FUB_Germany	18	20	24	18	80
UTARTU_Estonia	0	0	0	26	26
WEIZMANN_Israel	18	20	25	22	85
UNI-KLU_Austria	17	31		22	70
CUT_Cyprus	22	19		11	52
MU_Czech Republik	11	13	18	23	65
UEF_Finland	19	14	18	20	71
UCC_Ireland	60	32		41	133
UNIVPM_Italy	20	17	15	17	69
LU_Latvia	11	19		8	38
UMCS_Poland	32	24	22	33	111
UPORTO_Portugal	7	9	0	11	27
VUT_Romania	16	16	13	9	54
UL_Slovenia	34	12	15	24	85
UVA_Spain	18	20	24	18	80
FHNW_Switzerland	17	16	15	16	64
DEU_Turkey	19	37	10	42	108
UoB_Germany	18	20	24	18	80

Samples Round 2

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	students	teachers	ed.researchers	scientists	others	total
01 FUB_Germany	34	50	29	41	0	154
02 UTARTU_Estonia						0
03 WEIZMANN_Israel	30	25	17	10	0	82
04 UNI-KLU_Austria	0	14	17	10	0	41
05 CUT_Cyprus	49	17	11	1	18	96
06 MU_Czech Republik	56	30	28	25	0	139
07 UEF_Finland	30	32	22	15	0	99
08 UCC_Ireland	52	74	21	26	0	173
09 UNIVPM_Italy						0
10 LU_Latvia	27	35	21	20	14	117
12 UMCS_Poland						0
13 UPORTO_Portugal	20	32	1	1	0	54
14 VUT_Romania	21	43	22	20	25	131
15 UL_Slovenia						0
16 UVA_Spain	27	17	12	9	0	65
18 FHNW_Switzerland	17	27	25	0	0	69
19 DEU_Turkey						0
21 UniHB_Germany	6	26	9	13		54
Total	369	422	235	191	57	1274