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(RECOMMENDED CITATION)

A COMPARISON OF STAKEHOLDERS' VIEWS ON SCIENCE EDUCATION IN ROMANIA AND GERMANY: RESULTS FROM THE INTERNATIONAL PROFILES CURRICULAR DELPHI STUDY ON SCIENCE EDUCATION

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ABSTRACT. Within the framework of the FP7 funded European Project entitled "*PROFILES - Professional Reflection Oriented Focus on Inquiry-based Learning and Education through Science*", 22 partner institutions from 21 countries are involved in making efforts to disseminate a modern understanding of scientific literacy and facilitate an uptake of inquiry-based science education (IBSE). Embedded in this project is the International PROFILES Curricular Delphi Study on Science Education, which aims at identifying desirable aspects and shortcomings of modern science education with respect to scientific literacy.

In the International PROFILES Curricular Delphi Study on Science Education, different stakeholders' views on desirable aspects of scientific literacy based science education are by means of the Delphi method collected in three consecutive rounds by the PROFILES partners in 21 different countries. As relevant stakeholders involved with science and science education, these studies include students, pre- and in-service science teachers, science education researchers and scientists.

In the first round, the stakeholder's views in each country were collected in individual statements and through qualitative analyses classified into category systems. In this contribution, the results of the first round from Germany and Romania are compared. The comparison shows that despite cultural differences and different educational systems, similar tendencies can be found in the stakeholders' views in the two countries.

Keywords: *Science Education, Delphi study, PROFILES project.*

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ZUSAMMENFASUNG. Im Rahmen des Europäischen PROFILES Projekts sind 22 Partnerinstitutionen aus 21 Ländern beteiligt, ein modernes Verständnis naturwissenschaftlicher Grundbildung (scientific literacy) zu erarbeiten und eine Implementation von inquiry-based science education (IBSE) zu fördern, was auf Deutsch in etwa mit forschend-entwickelndem Lernen übersetzt werden kann. Eingebettet in dieses Projekt ist die Internationale PROFILES curriculare Delphi-Studie Naturwissenschaften, die auf die Ermittlung wünschenswertes Aspekte und Mängel der im gegenwärtigen modernen naturwissenschaftlichen Unterricht in Bezug auf naturwissenschaftliche Grundbildung abzielt.

In der Studie werden die Ansichten verschiedener Interessenvertreter (stakeholder) zu wünschenswerten Aspekte naturwissenschaftlicher Grundbildung in drei aufeinander folgenden Runden von den PROFILES Partnerinstitutionen in 21 verschiedenen Ländern mithilfe der Delphi-Methode erfasst. Als relevante Interessengruppen bezüglich naturwissenschaftlicher Bildung werden sowohl Schüler, Lehramtsstudenten, Referendare, und Lehrer mit naturwissenschaftlichen Fächern als auch in der Naturwissenschaftsdidaktik tätige Personen und Naturwissenschaftler mit einbezogen.

In der ersten Runde wurden die Ansichten der beteiligten Interessenvertreter in den verschiedenen Ländern jeweils in Textform erhoben. Durch qualitative Inhaltsanalyse wurden die Aussagen anschließend in Kategoriensysteme überführt. In diesem Beitrag werden die Ergebnisse der ersten Runde aus Deutschland und Rumänien miteinander verglichen. Aus dem Vergleich geht hervor, dass trotz unterschiedlicher Bildungssysteme und kultureller Unterschiede ähnliche Tendenzen in den Schwerpunkten der Interessenvertreter in den beiden Ländern erkennbar sind.

Schlüsselwörter: Bildungwissenschaften, Delphi Studium, PROFILES Projeckt.

Introduction

As is well known that in the last years a clear decrease of young students' interest for science lessons has been noticed, the actual actors involved in science education must find solutions for raising the children's interest in learning activities related to this area. In this sense, some reports suggest that inquiry activities lead to promising results, with visible positive impact in students' attitudes (Chang & Mao, 1999; Shymanski, Yore & Anderson, 2004). On the other hand, besides getting more interest in science, inquiry activities are found to stimulate interest that is more sustainable after the moment of intervention (Gibson & Chase, 2002).

The IBSE paradigm - *Inquiry Based Science Education* - represents an approach which is focused on student inquiry as the driving force for learning, the teaching process being organized around questions and problems, in a highly student-centered inquiry process. The IBSE methodology proposes that students learn through and about scientific inquiry rather than by teachers presenting scientific content knowledge (PROFILES Consortium, 2010).

In this respect, one of the main objectives of the PROFILES project (http://www.profiles-project.eu) is to promote IBSE through raising the self-efficacy of science teachers to take ownership of more effective ways of teaching students, supported by stakeholders (PROFILES Consortium, 2010). Thus, the PROFILES partnership (represented by 22 institutions from 20 countries) agreed to conduct a curricular Delphi Study (Bolte, 2008; Häußler, Frey, Hoffmann, Rost & Spada, 1980; Mayer, 1992) with the aim *to involve various stakeholders in reflecting on contents and aims of science education as well as in outlining aspects and approaches of modern science education.*

Description of the procedure

In light of previous curricular Delphi Studies in Science, the PROFILES Curricular Delphi Study on Science Education was divided into three rounds (Bolte & Schulte, 2011):

(a) *Round I* - gave the opportunity to participants for expressing their opinions related to *aspects of contemporary and pedagogically desired science education* in open-text responses to three open questions regarding *motives, situations* and *contexts***,** as well as *fields*, *aspects* and *qualifications*.
(b) *Round II* - provided the participants with the necessary information concerning the defined categories of the first round and asked the participants *to prioritize the given categorie*s as well as to assess *to what extent the aspects expressed by the categories are realized in practice*
(c) *Round III* - provided the participants with *concepts of desirable science education empirically identified on the basis of the second round and again asked them for weighted assessment* (similar to the second round).

The target group who took part in the Delphi Study was selected in order to *cover significant parts of German & Romanian societies*, *emphasizing mainly on the stakeholders directly involved with curricular aspects of science education* (Bolte, 2003; Gorghiu et al., 2013). That is the reason for selecting participants involved in different scientific and educational fields. In this respect, the structure of the target group consisted of the following sub-groups:

(a) *students / young students* - 16-18 years old;
(b) *pre-service teachers* (university students involved in Science programmes) and *trainee science teachers* (young teachers);
(c) *Science teachers* and *trainee science teachers* (experienced teachers);
(d) *educators, didacticians* and *in-service teacher educators* (in chemistry, physics, biology, geography and general science areas);
(e) *scientists* (chemists, physicists, biologists);
(f) *education politicians* (spokespersons for education policy),
(g) *people who are not directly involved with Sciences* (university students, teachers, parents, humanists) – just in Romania.

In this paper, specific results obtained in the 1st round of Curricular Delphi Study on Science Education, performed by *Freie Universitat Berlin* (Germany) and *Valahia University Targoviste* (Romania) PROFILES teams are presented. Each participant from the selected target group was requested to fill in maximum *10 form sheets,* in which he/she could formulate statements in such way that *each answer contains three formal components* (Bolte & Schulte, 2011):

(a) *statements about situations, contexts or motives where scientific literacy is useful* ("which situations and motives can be taken as a reason and in which context should science-related themes be put in order to stimulate and further scientific educational processes?");
(b) *statements about fields of science that are considered significant and which the individual should have dealt with* ("which science-related contents, methods and themes should a (scientifically) educated person have dealt with intensively?");
(c) *statements about the qualifications that must be attained* ("which form of availability, skills, and attitudes should the individual attain regarding contents, methods and themes
(d) that are considered as educationally relevant?").

An overview of the procedure of data analysis in the first round of the Curricular Delphi Study on Science Education is illustrated in Figure 1 (Bolte, 2003).

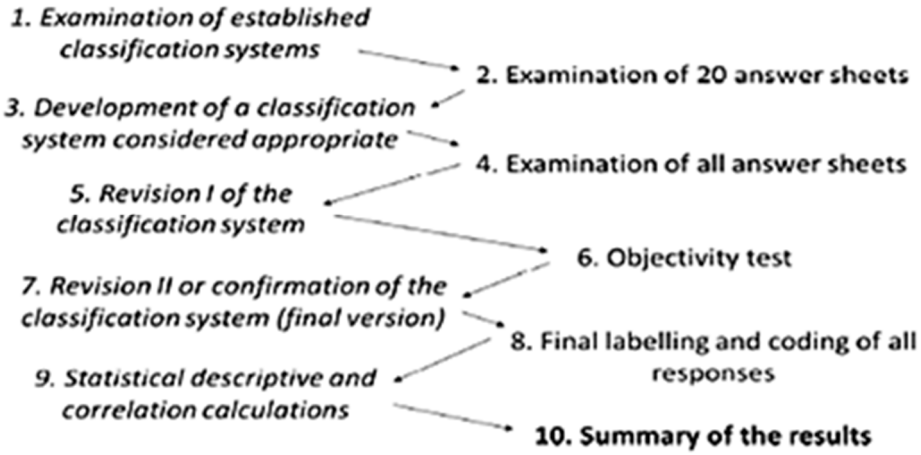


Figure 1. Mutual coordination of constructive development phases and empirical work phases (Bolte, 2003)

As recommended, *a classification system was chosen* based on *a set of categories on the basis of which all the statements can be assigned, grouped and systematized*.

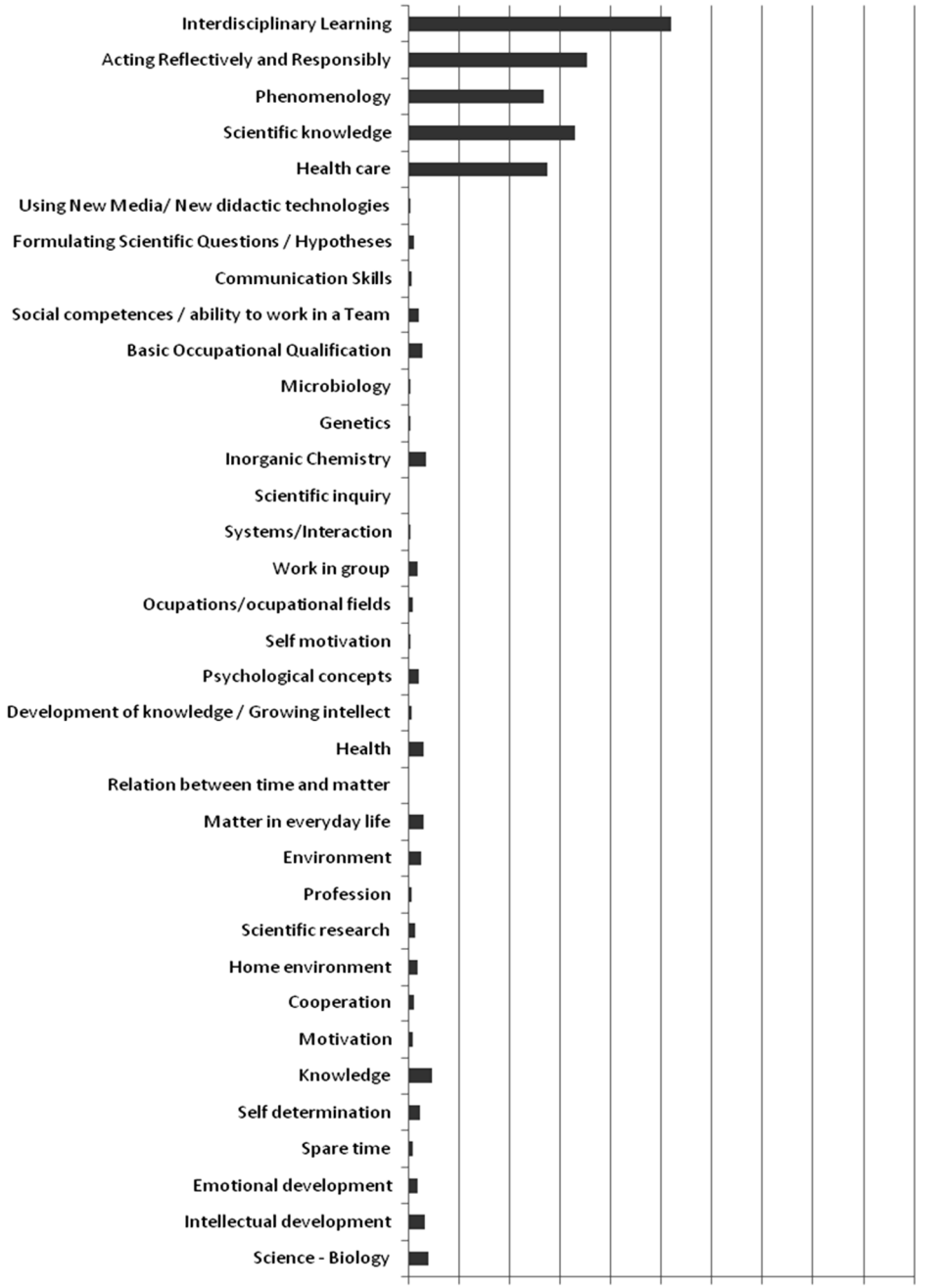
The *set of categories* was subdivided into *three parts* (I: *situations, contexts and motives*, II: *fields* and III: *qualifications*), but also a *subdivision of part II* (*field*) into *part IIa* (*basic concepts and topics*) and *part IIb* (*scientific fields and perspectives*), as well as a *subdivision of part III* (*qualifications*) into *part IIIa* (*qualifications/attitudes/skills*) and *part IIIb* (*methodical aspects related to qualifications*) were introduced.

Results and discussion

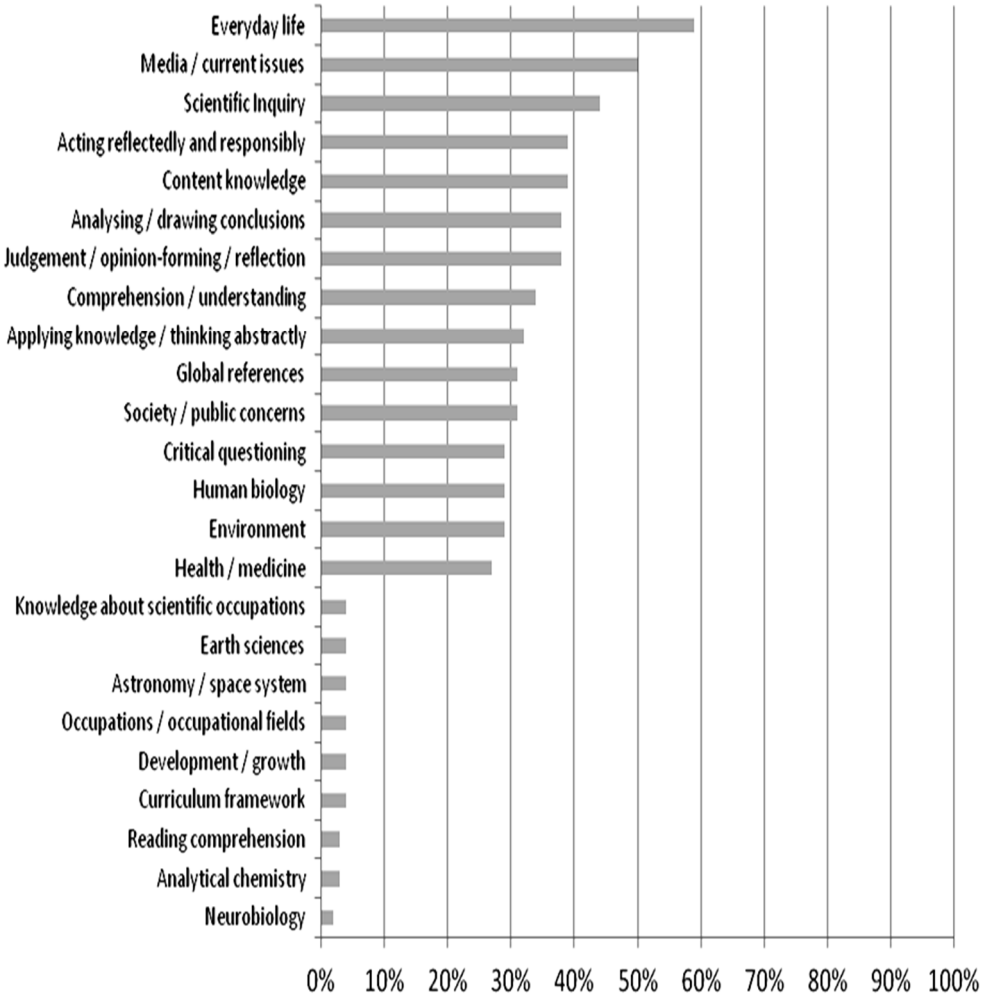
The following results are structured according to the different parts of the classification system, focusing on the results regarding the whole sample as well as regarding the different sample groups. Frequencies of the stipulated categories by the different target groups are illustrated, but the overall analyses is based on the *categories which were mentioned rarely* (*≤ 5%*) or *often* (*≥ 25%*) - figures 2-6.

In the participants' statements from Romania an important orientation was directed on the following categories: **"Health care"** (part I), **"Scientific knowledge"** and **"Phenomenology"** (part IIa), **"Environmental Chemistry"** (part IIb), **"Acting reflectively and responsibly"** (part IIIa) and finally, **"Interdisciplinary Learning"** (part IIIb). In particular, the group of students mentioned **"Self motivation"**, **"Social competences / Ability to work in a team"** and **"Spare time"** (over 40%), the group of teachers and trainee teachers emphasized **"Doing research"**, **"Microbiology"** and **"Genetics"** (over 50%), the group of educators, didacticians and in-service teacher educators expressed **"Civic education"**, **"Nature"** and **"Environment"** (over 30%), the group of scientists mentioned **"Cooperative ways of learning"** and **"Self determination"** (over 50%), as main categories. As an observation, even it is not illustrated in the following diagrams, it is important to mention that just the group of education politicians provided statements allocated to the category **"Scientific Inquiry"** (rated as 100%) and just the group of people who are not directly involved with sciences provided statements allocated to the categories **"Using New Media/New didactic technologies"** and "**Systems / Interaction"** (both being rated as 100%).

In Germany, according to the participants' statements, an especially strong focus was set on aspects related to the categories **"Media / current issues"** and **"Everyday life"** (part I*) as well as* on **"Scientific inquiry"** (part IIa*),* **"Human biology"** *and* **"Electrodynamics"** (part IIb), *and on* **"Rational thinking / analyzing / drawing conclusions"**, **"(Specialized) Knowledge"** and **"Acting reflectively and responsibly"** (part III). In particular, the group of Students mentioned **"Everyday life"**, **"Content knowledge"** and **"Scientific inquiry"** (over 40%), the group of teachers and trainee teachers stipulated **"Everyday life"**, **"Scientific inquiry"** and **"Media / current issues"** (over 45%), the group of educators, didacticians and in-service teacher educators expressed **"Everyday life"**, **"Judgment / opinion-forming / reflection"** and **"Acting reflectively and responsibly"** (over 60%), the group of scientists mentioned **"Analyzing / drawing conclusions"**, **"Media / current issues"** and **"Everyday life"** (over 40%), as main categories.

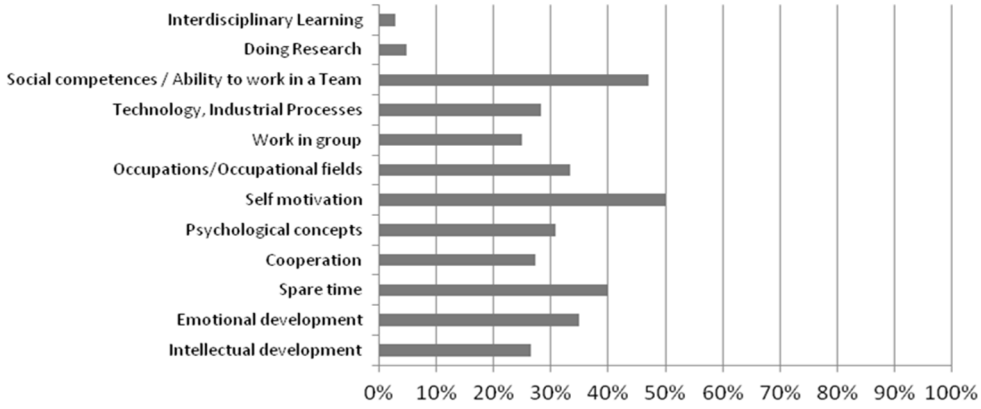

Interdisciplinary Learning
Acting Reflectively and Responsibly
Phenomenology
Scientific knowledge
Health care
Using New Media/ New didactic technologies
Formulating Scientific Questions / Hypotheses
Communication Skills
Social competences / ability to work in a Team
Basic Occupational Qualification
Microbiology
Genetics
Inorganic Chemistry
Scientific inquiry
Systems/Interaction
Work in group
Ocupations/ocupational fields
Self motivation
Psychological concepts
Development of knowledge / Growing intellect
Health
Relation between time and matter
Matter in everyday life
Environment
Profession
Scientific research
Home environment
Cooperation
Motivation
Knowledge
Self determination
Spare time
Emotional development
Intellectual development
Science - Biology
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

(a)

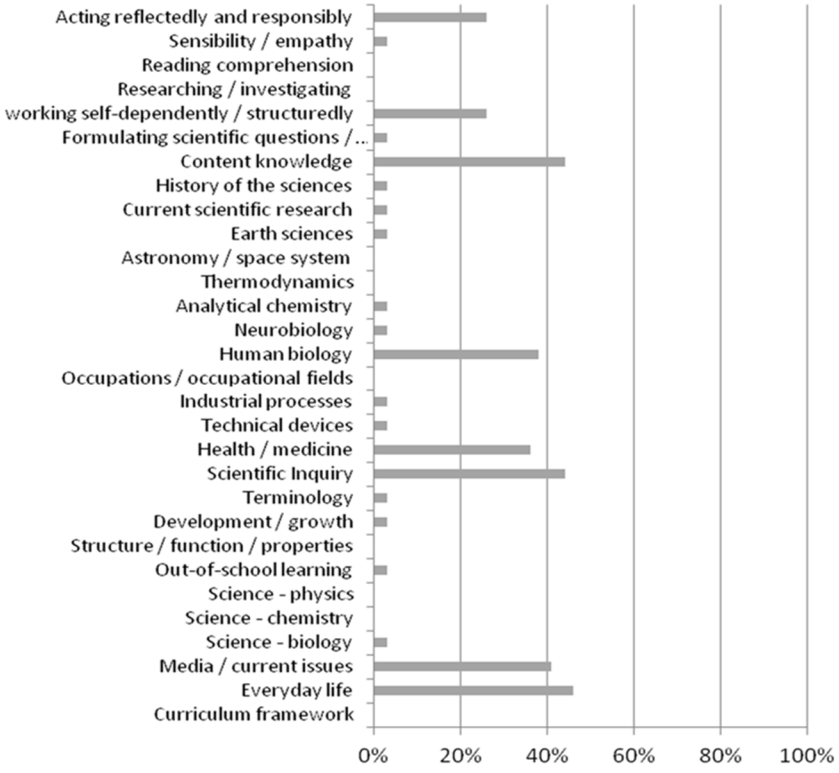


(b)

Figure 2. Overview of the categories that were mentioned rarely (≤ 5%) or often (≥ 25%) - Mean percentages regarding the *whole Sample Group* – (a) Romania; (b) Germany



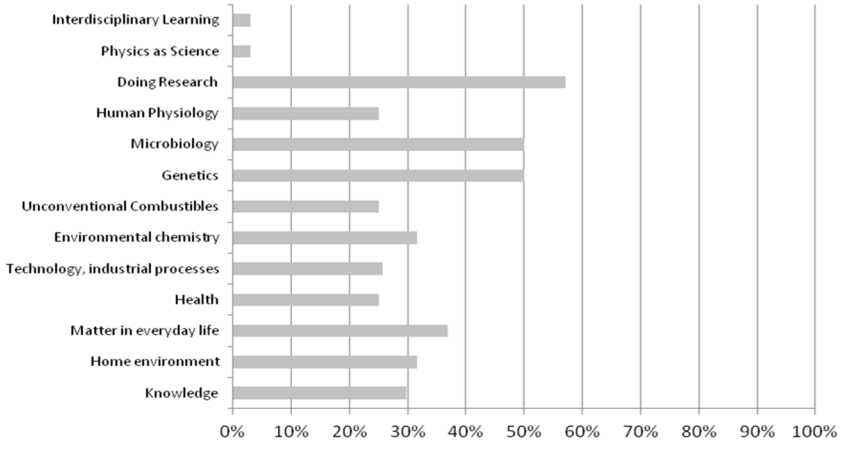
(a)



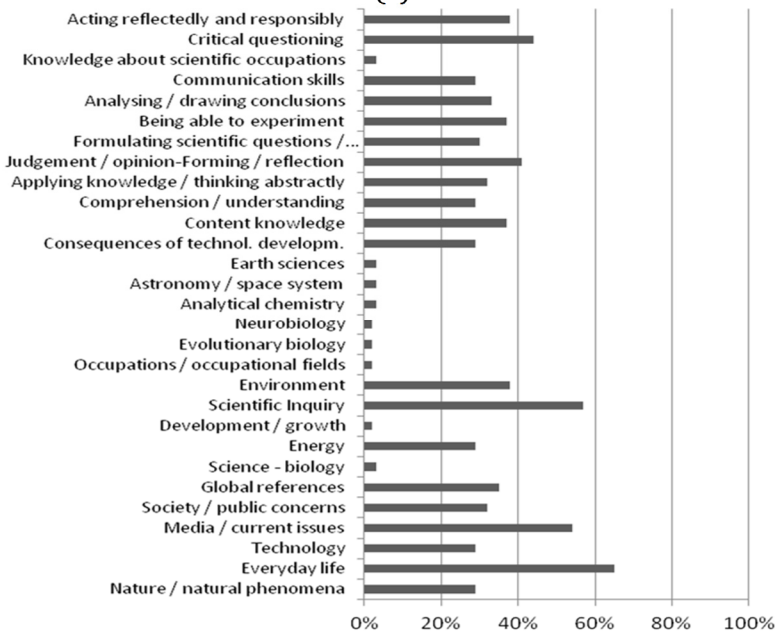
(b)

Figure 3. Overview of the categories that were mentioned rarely (≤ 5%) or often (≥ 25%) - Mean percentages regarding the *Group of Students (Pupils)* – (a) Romania; (b) Germany

A differentiated view on the category frequencies of the different subsamples shows that *the different groups feature different focuses and thus deviate in several cases from each other regarding the relative frequency of mentioning the different categories*.



(a)



(b)

Figure 4. Overview of the categories that were mentioned rarely (≤ 5%) or often (≥ 25%) - Mean percentages regarding the *Group of Teachers & Trainee Teachers* – (a) Romania; (b) Germany

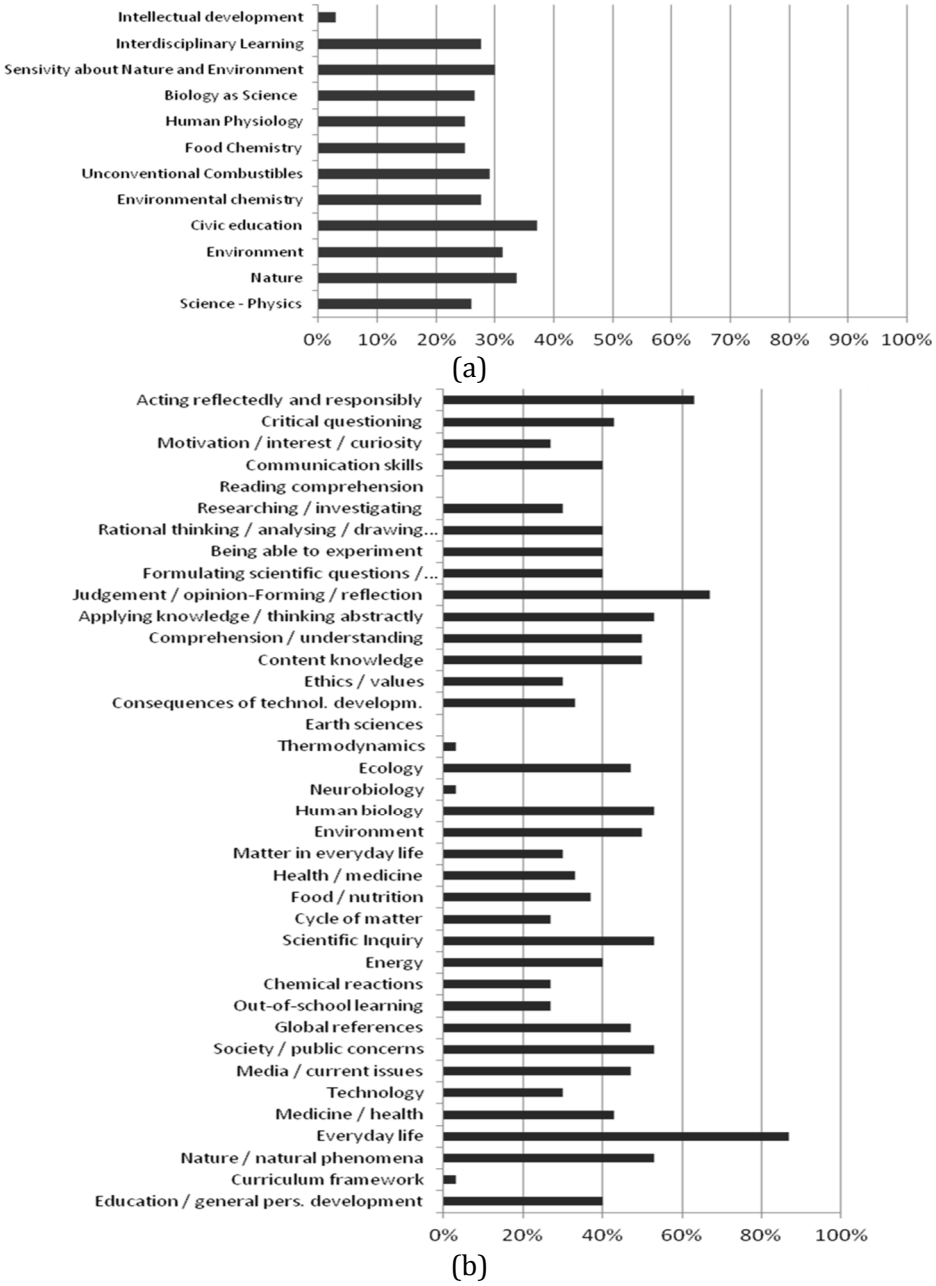
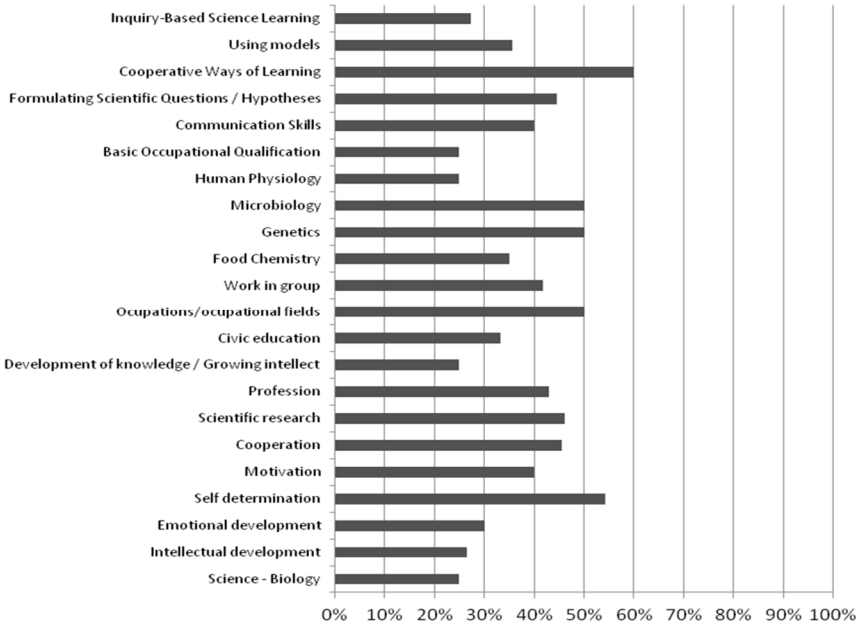
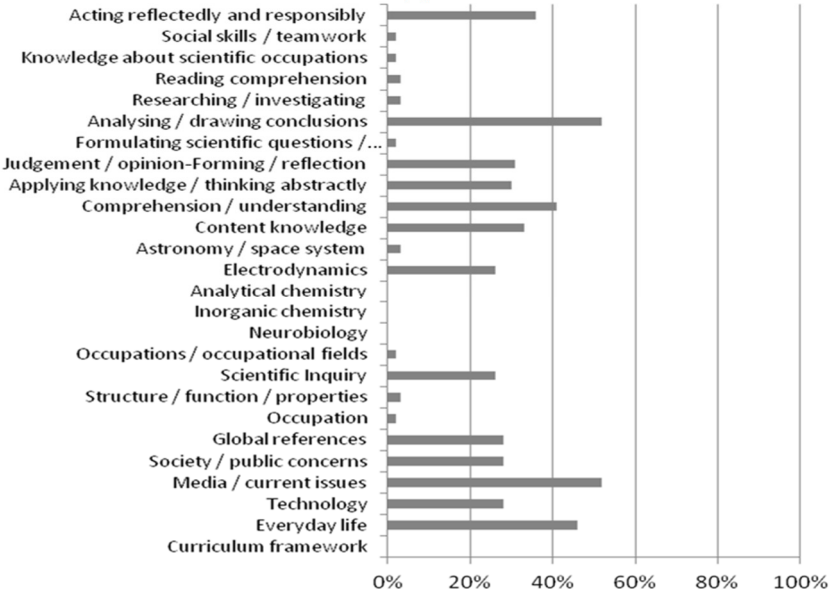


Figure 5. Overview of the categories that were mentioned rarely (≤ 5%) or often (≥ 25%) - Mean percentages regarding the *Group of Educators, Didactics & In-service Teacher Educators* – (a) Romania; (b) Germany



(a)



(b)

Figure 6. Overview of the categories that were mentioned rarely (≤ 5%) or often (≥ 25%) - Mean percentages regarding the *Group of Scientists* – (a) Romania; (b) Germany

Conclusions

The results obtained in the first round of the PROFILES Curricular Delphi Study on Science Education reveal first insights into stakeholders' views about desirable aspects of scientific literacy based science education. The comparison between the first round results from Germany and Romania shows that stakeholders in both countries share several similar emphases about meaningful science education. In particular, common accentuations include aspects related to the connection of science and everyday life and current issues, elements related to the promotion of scientific inquiry, as well as aspects referring to more overarching aims of education. The question whether those aspects only rarely referred to by the participants in both countries are actually considered as less important for science education or whether they are less mentioned because they are not very much present in current science education cannot be answered on the basis of the results of the first round but is investigated in the course of the second round. Further analyses will show how far similarities between German and Romanian stakeholders are maintained.

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