



HAL
open science

Research on Interest in Science: Theories, Methods and Findings

Andreas Krapp, Manfred Prenzel

► **To cite this version:**

Andreas Krapp, Manfred Prenzel. Research on Interest in Science: Theories, Methods and Findings. International Journal of Science Education, 2011, 33 (01), pp.27-50. 10.1080/09500693.2010.518645 . hal-00658698

HAL Id: hal-00658698

<https://hal.science/hal-00658698>

Submitted on 11 Jan 2012

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Research on Interest in Science: Theories, Methods and Findings

Journal:	<i>International Journal of Science Education</i>
Manuscript ID:	TSED-2010-0327-A
Manuscript Type:	Special Issue Research Paper
Keywords :	attitudes, interest in science, large-scale surveys
Keywords (user):	motivation, research methods

SCHOLARONE™
Manuscripts

Research on Interest in Science: Theories, Methods and Findings

Abstract

This article presents an overview of interest research and describes the theoretical and methodological background for the assessment of interest in science in large-scale assessments like the “Programme for International Student Assessment” (PISA). The paper starts with a short retrospective on the history of interest, bringing out theoretical roots that help to understand recent discussions on interest in science education. As interest is a widely used concept with manifold facets, it is essential to discuss different ways of modelling the relationship between a person and a comprehensive object like Science with all of its different aspects, including wide ranges of content as well as contexts. Models that can be used for describing the content structure of science interest and the process of interest development are presented. Based on an overview of typical methods for assessing interests, exemplary findings on students’ interest in science are presented which play an important role in the current scientific debate. Finally, challenges for future research on interest in science education are discussed.

1
2
3 What prompts people to spend their lifetime examining scientific phenomena?

4
5 Researchers' typical answer to this question is: We want to understand the objects we
6
7
8 examine, we want to know how things work--it interests us. This interest in knowledge is the
9
10 driving force behind research.
11

12
13 What prompts young people to engage with scientific questions and to want to find
14
15 things out about science and technology? As grown-up scientists were once children, perhaps
16
17 it is the case that they have been driven by a specific cognitive interest since they were young.
18
19 One could also assume that some people simply stand out by the special interest they have--in
20
21 science, for example--and that this is how future scientists are formed.
22
23

24
25 Unfortunately, however, the actual facts are much more complex, and when things get
26
27 complicated, what is needed is research that also looks into the phenomenon of interest. Why
28
29 do complications that require scientific clarification occur? For example, a large number of
30
31 scientists are required, but only a few people in the adolescent generation are so interested in
32
33 this area that they aim at a professional qualification and career in this field (European
34
35 Commission, 2004, 2006; Organisation for Economic Co-operation and Development
36
37 [OECD], 2008). How can this be explained? Are there perhaps competing interests or other
38
39 motives which influence decisions about further study and future careers? A further
40
41 complication is related to the fact that although children and young people's interest can
42
43 motivate them to explore certain things, they may thereby ignore everything which has
44
45 already been discovered by other people before them. Thus, it is also important to engage with
46
47 others' knowledge and to more or less systematically learn from others. What effect does this
48
49 have on interest? And what is the effect of the way in which access to science is mediated?
50
51
52

53
54 It seems to be the case that young children are interested in all sorts of things, so how
55
56 do selection processes take place, how are interests channelled? What is the role of ability and
57
58 successful engagements leading to a noticeable learning progress? How can interest in science
59
60 be awakened and maintained in general? After all, nowadays, it is not only a question of

1
2
3 gaining new blood in the field of science. Science concerns everybody--in both everyday and
4
5 professional life (Bybee, 1997; Fensham, 1985; Millar & Osborne, 1998). We constantly have
6
7 to make decisions which can only be considered to be reasonable if they take scientific
8
9 evidence into account. But how can basic scientific knowledge be acquired--both in and out of
10
11 school--and how does one keep up with new developments, for example, after leaving school?
12
13 Is interest the motivation that steers lifelong development?
14
15

16
17 This brief outline of the problem reveals typical questions for research on interest in
18
19 science and shows that several disciplines are required. Science education alongside
20
21 educational psychology and educational research can contribute to a better understanding of
22
23 how interest in science is developed, how it expands or disappears and how it can be
24
25 promoted.
26
27

28
29 In this overview, we will therefore present relevant theories and findings from these
30
31 fields. In order to classify the research approaches, it is helpful to first take a look at the
32
33 history of interest research. Against this background, theoretical models will then be
34
35 presented with which the interest construct can be specified and empirically surveyed, and its
36
37 development reconstructed. We will devote a separate section to the methods used in interest
38
39 research. From the viewpoint of science education, theoretical models which clarify the
40
41 conditions behind interest development are particularly important. Therefore, exemplary
42
43 research approaches and findings on research on interest in science which play an important
44
45 role in the current scientific debate will be the focus.
46
47
48
49

50 **Historical Review**

51
52 The importance which the concept of interest can have in educational contexts was
53
54 highlighted by great scholars centuries ago, e.g. Johann Amos Comenius (1592-1670) or Jean
55
56 Jacques Rousseau (1712–1778). It was Johann Friedrich Herbart (1776–1841) who for the
57
58 first time developed a general theory of education in which interest played a central role. He
59
60 emphasised that interest must not only be regarded as a desirable motivational condition of

1
2
3 learning but also as an important goal or outcome of education.
4

5 Herbart's ideas were adopted by authors at the turn of the twentieth century, for
6
7 example by William James (1842–1910) and John Dewey (1859–1952). In particular,
8
9 Dewey's book *Interest and Effort in Education* (Dewey, 1913) influenced further research.
10
11

12 At the beginning of the twentieth century, the interest concept was used in different
13
14 fields of educational and psychological research aiming at a better understanding of learning
15
16 conditions or decisions about educational or vocational careers. The increasingly divergent
17
18 use of the term 'interest' in different contexts of an emerging empirical research, however,
19
20 promoted the development of new theoretical approaches and psychological constructs. Thus,
21
22 research on phenomena of interest in the middle of the twentieth century focused on attention
23
24 (Deutsch & Deutsch, 1963), curiosity (Berlyne, 1960) or intrinsic motivation (Hunt, 1965).
25
26 Only the area of vocational psychology has maintained interest as an established theoretical
27
28 construct (e.g. Strong, 1943).
29
30
31
32
33

34 In the last decades of the twentieth century, various areas of research witnessed a
35
36 renaissance of the interest construct. This was due to the recognition that the concepts and
37
38 theories developed in the specialised fields of motivation research do not adequately account
39
40 for important phenomena that were addressed in earlier theories on interest such as the
41
42 content specificity of learning motivation (Krapp, Hidi, & Renninger, 1992; Schiefele, 1978).
43
44 The renaissance of interest theories was also supported by constructivist thinking emphasising
45
46 a new understanding of the subject in interaction with the physical, social and cultural
47
48 environment.
49
50
51

52 Because of its focus on specific content (objects, domains) the concept of interest
53
54 seemed to be appropriate to understand tendencies of students or adults to engage in certain
55
56 themes or contexts--or to withdraw from them. It was reasonable that studies on attitudes
57
58 towards science and technology took up the concept of interest (Gardner, 1975; Ormerod &
59
60 Duckworth, 1975), examining the 'swing from science' in the 1970s. The starting point for

1
2
3 these discussions was formed by empirical findings about the increasingly critical attitude of
4 the population towards science and technology and the related disappearing interest in these
5 subjects in secondary and tertiary education (Gardner, 1975, 1985). Rather influential was a
6 study commissioned by the Department of Education and Science in England (UK) on the
7 'flow of students of science and technology in higher education' (Dainton, 1968). In many
8 countries, research projects were initiated in order to examine the decline of interest and
9 science-related attitudes more closely and to explore effective measures on how to work
10 against this.
11
12
13
14
15
16
17
18
19
20
21

22 During these decades science education discovered the concept of interest, and
23 manifold research initiatives were started in collaboration with neighbouring disciplines (e.g.
24 educational psychology, sociology). The findings of these research approaches have been
25 discussed at international conferences since the 1980s (Hoffmann, Krapp, Renninger, &
26 Baumert, 1998b; Lehrke, Hoffmann, & Gardner, 1985; Lie, 1983). In the 1990s, the
27 international and interdisciplinary exchange (Hoffmann et al., 1998b; Osborne, Simon, &
28 Collins, 2003; Renninger, Hidi, & Krapp, 1992) and the discussion about consequences
29 concerning necessary reforms of the educational system (Bennett, 2001; OECD, 2006b;
30 Osborne & Dillon, 2008; Roberts, 2002) was increasingly intensified.
31
32
33
34
35
36
37
38
39
40
41
42

43 During the past two decades research in different areas of science education has
44 substantially contributed to the informed discussion about the role of interest in learning and
45 human development in modern societies. The recognition of interest as a component of
46 scientific literacy in the framework for PISA 2006 provides an opportunity to broaden our
47 knowledge in this area.
48
49
50
51
52
53
54

55 **Theoretical Foundations**

56
57 The interest concept is used in different ways in the literature on science education.
58 This is partially due to the fact that the authors orient themselves towards different theoretical
59 models and research paradigms.
60

The Meaning of Interest

There are numerous publications on the meaning of the interest construct in everyday and scientific language use (e.g. Berlyne, 1949; Silvia, 2006; White, 1967). General agreement can be found with regard to the central characteristics of the interest construct, for example that it is a multidimensional construct whose operational-definition requires both cognitive and emotional categories (Gardner, 1996; Hidi, Renninger, & Krapp, 2004; Schiefele, 2009). Interest is sometimes characterised as an 'affective variable' (Rennie & Punch, 1991; Steinkamp & Maehr, 1983). However, it is important to note that interest cannot be equated with 'enjoyment while learning'. Enjoyment can occur for many reasons, and interest is only one of these.

The decisive criterion of the interest construct which enables it to be clearly distinguished from several neighbouring motivational concepts is its content specificity. An interest is always directed towards an object, activity, field of knowledge or goal: 'One cannot simply have an interest: one must be interested in something' (Gardner, 1996, p. 6).

There are different views about the relationship between the concepts of attitude and interest. Some authors suggest using both concepts synonymously (Schreiner, 2006; Schreiner & Sjøberg, 2004). Other authors (e.g. Osborne et al., 2003) see attitude as the superordinate concept and interpret interest as a specific form of attitude, characterised by a certain object area. Gardner (1996, 1998) and other authors, however, point out that both concepts can be clearly distinguished from one another. A decisive difference arises with respect to the evaluation criteria that are the focus. General, nonpersonal evaluation viewpoints are decisive for an attitude towards a particular object, whereas the subjective value attached to the knowledge about this object is important for interest. These two evaluation aspects are independent of each other. It is, for example, possible to have a pronouncedly negative attitude towards an issue (e.g. racism), yet have a strong and enduring interest to understand this topic.

Theoretical Considerations on Specifying the Interest Construct

In recent theories, interest is mostly understood as a phenomenon that emerges from an individual's interaction with his or her environment (Hidi & Renninger, 2006; Silvia, 2006). This postulate is also the starting point of an educational theory of interest (Prenzel, 1992; Schiefele, Krapp, Prenzel, Heiland, & Kasten, 1983), also called 'person-object theory of interest' (Krapp, 2002a, b). According to this theory interests evolve out of manifold relationships between persons and objects in social and institutional settings. An interest represents a specific and distinguished relationship between a person and an object. An object can refer to concrete things, a topic, a subject-matter or an abstract idea, i.e. a certain part of the cognitively represented environment. A person will develop an interest for some of these objects for a shorter or longer period of time.

The interest relation to an object is characterised by certain cognitive and affective components (Hidi et al., 2004). The most important characteristics refer to an individual's values and feelings (Schiefele, 2009). Any interest has the quality of personal significance, and it is associated with positive experiential states. Thus, interest-based interactions with the environment provide optimal experiential modes that combine positive cognitive qualities (e.g. thoughts on meaningful goals) and positive affective qualities. Given optimal conditions, flow may be experienced during interest-based activities (Csikszentmihalyi, 1975, 1990).

A further essential feature of interest is its intrinsic character. Interest-based activities meet the criterion of 'self-intentionality', which means that an interest-related goal is compatible with one's preferred values and ideals. In general, an interest is associated with a pronounced readiness to acquire new domain-specific knowledge (a cognitive-epistemic component). As a result highly interested students are characterised by a comparably differentiated knowledge structure in the corresponding object area. The same is true of metacognitive knowledge. Those who are highly interested are well aware of what else there

1
2
3 is to know and to explore in ‘the zone of proximal development’ (Prenzel, 1988, 1992;
4
5 Vygotsky, 1978).
6
7

8 The emergence and impact of interest can be examined on different levels of analysis.
9
10 On the first level, interest refers to the dispositional (or ‘habitual’) motivational structure of an
11 individual. Here, interest is interpreted as a relatively stable tendency to occupy oneself with
12 an object of interest. On this level, one usually speaks of individual interest. On the second
13 level, interest refers to current engagements. It describes a state or an ongoing process during
14 an actual interest-based activity. This is the case when we observe the learning behaviour of a
15 student and characterise his or her motivational state as ‘being interested’. This psychological
16 state involves focused attention, increased cognitive functioning, persistence and affective
17 involvement. An actually ‘operating’ interest can either be caused by an already existing
18 dispositional (individual) interest or by the special conditions of a teaching or learning or
19 work situation (interestingness). An interest that is primarily caused by external factors is
20 called a situational interest (Hidi, 1990). It may be transitory or may provide the basis of a
21 longer-lasting interest (Hidi & Renninger, 2006; Krapp, 2002b).
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37

38 **Concepts and Models for Describing the Content Structure of Interest**

39
40
41 An important aspect of the interest construct is its domain specificity. The object or
42 content area of an interest can either be characterised in a general way by referring to a broad
43 area of knowledge or possibilities of interaction with the environment (e.g. a scientific
44 discipline), or by describing specific topics, activities, etc. in which a person is actually
45 interested.
46
47
48
49
50
51

52
53 A well-known theoretical concept that describes interest orientations at a very high
54 level of generality is Holland’s RIASEC-typology comprising six personality types (Realistic,
55 Investigative, Artistic, Social, Enterprising and Conventional). Each type represents a
56 complex cluster of attitudes, self-beliefs, values and interests (Holland, 1997). Science
57 interests most likely occur when an individual’s personality structure represents the
58
59
60

1
2
3 investigative type. Holland's model provides a theoretical basis for measuring general interest
4 orientations which are presumed to remain stable over a period of time and can therefore be
5 used to explain or predict students' school subject preferences and choices (Elsworth, Harvey-
6 Beavis, Ainley, & Fabris, 1999), expected success in higher education or vocational decisions
7 and career satisfaction (Silvia, 2006).

8
9
10
11
12
13
14
15 The level of generality in Holland's model seems to be too broad for attempts to
16 describe the interest of students in national or international assessments (like PISA). It can be
17 expected that an 'investigative' or 'realistic' personality type tends to be more interested in
18 science than a 'social' or 'artistic' type; however, the categories of this typology do not allow
19 students' interests to be differentiated in an educationally meaningful way.

20
21
22
23
24
25
26
27 Interests in science can be defined at a more generalised or a more concrete level. In
28 the first case, the content area of science interest would comprise the whole body of science-
29 related subjects and topics of which a person is aware. In the second case, one would take into
30 account that an individual's science interest can be limited to a particular school subject (e.g.
31 biology, but not physics or chemistry) or to particular topics and activities within a subject
32 domain (e.g. acquiring knowledge about the structure of the human brain; playing a musical
33 instrument), a discipline (e.g. physiology) or a research field (e.g. ocean research).

34
35
36
37
38
39
40
41
42
43 In order to distinguish between different kinds of science interests, it is obvious to
44 refer to the structure of school subjects because these mainly provide the opportunities to get
45 in touch with sciences systematically. In fact, there are students who are highly interested in
46 one subject (e.g. biology), but not in other science subjects such as chemistry or physics.

47
48
49
50
51
52
53 From a theoretical perspective, this level of differentiation for characterising the
54 content structure of students' interest in science remains too rough and beyond the
55 classifications at hand, e.g. from Science Education. In addition to a differentiation of
56 contents and themes, others aspects like contexts or areas of application can help to describe
57 profiles of interest in science (see below).

1
2
3 Gardner and Tamir (1989) have proposed a multidimensional concept for describing
4 interest in biology. Another example of a theoretically and empirically well-founded
5 topological model was developed at the Leibniz Institute for Science Education (IPN) in order
6 to assess the interest of students in physics (Haeussler, 1987; Haeussler & Hofmann, 2000).
7
8 The model differentiates between three main dimensions of interest: (a) interest in a particular
9 topic of physics; (b) interest in a particular context in which a physical topic is presented; and
10 (c) interest in the particular activity a student is allowed to engage in in conjunction with that
11 topic. Each of the three dimensions (topics, contexts, activities) is further broken down into
12 subcategories resulting in a relatively complex overall model with eight content categories,
13 seven context areas and four kinds of activities. This model has been used as a theoretical
14 basis for the repeated measurement of students' interest in physics in a longitudinal study (see
15 below). The idea to reconstruct students' science interest on the basis of a multidimensional
16 topological model has been partly realised in PISA 2006 with the innovative methodical
17 concept of contextualised items (McCrae, 2009; OECD, 2006a).

36 **Theoretical Models for Reconstructing the Process of Interest Development**

37
38 Large-scale assessments like PISA 2006 are limited to cross-sectional data which
39 cannot be used for analysing developmental trends or the validation of developmental
40 hypotheses. Nevertheless, developmental concepts and models are relevant for the
41 interpretation of findings (e.g. differences between subpopulations) and for a discussion of
42 interpretations that have to be drawn from these results.

43
44 Two kinds of developmental questions are of special importance: Is it possible to
45 identify typical stages in the development of interest in science? And how can the mostly
46 negative developmental trends of the average science interest in student populations be
47 explained?
48
49

50
51 **Models about typical stages of interest development.** Travers (1978), Gottfredson
52 (1981), Todt and Schreiber (1998) and other authors have postulated a regular sequence of
53
54
55
56
57
58
59
60

1
2
3 developmental stages from childhood to late adolescence. According to these theories one can
4
5 assume a longer-lasting developmental period from preschool to primary school age in which
6
7 all children are interested in all kinds of natural phenomena. Even very young children tend to
8
9 observe their environment in a systematic manner; they enjoy new experiences, and are ready
10
11 to learn more about natural phenomena with which they are confronted. From primary to
12
13 secondary school, interest will be shaped: Children develop preferences for certain areas (e.g.
14
15 animate nature, technology) and perceive their strengths and weaknesses in accordance with
16
17 their experiences in science lessons in school. A critical phase for the development of science
18
19 interest is adolescence, when students start to clarify their personal aims and ambitions
20
21
22 (identity).
23
24
25

26
27 A second approach to describing interest development is based on the aforementioned
28
29 distinction between situational and individual interest. During the life course, a person is
30
31 interested in many things. Interests which are induced from outside are often kept 'alive' for
32
33 only a short period of time. This holds especially true for subject areas that are first accessible
34
35 in school, such as chemistry or physics. Nevertheless, it is possible that under certain
36
37 conditions, a longer-lasting interest may grow out of a situational interest created by the
38
39 interesting 'composition' of a teaching situation.
40
41
42

43
44 Krapp (2002b) has proposed to reconstruct this developmental shift on the basis of a
45
46 model which represents three prototypical stages of interest development: (a) an emerging
47
48 situational interest awakened or triggered by external stimuli for the first time; (b) a stabilised
49
50 situational interest that lasts during a certain (limited) learning phase; and (c) an individual
51
52 interest that represents a relatively enduring predisposition to engage in a certain object area
53
54 of interest. The first occurrence of a situational interest is primarily a matter of the specific
55
56 motivational quality of a learning situation or learning task, which is usually described as
57
58 interestingness. With respect to educational aims the next two stages of interest development
59
60 are of central importance. They include two qualitatively different steps of interest

1
2
3 development: first, the shift from the transitional state of actual attraction or curiosity to a
4
5 more stable motivational state which is a necessary condition for effective learning, and
6
7
8 second, the shift from a rather stabilised situational interest to a more or less enduring
9
10 individual interest.

11
12 In their 'four-phase model of interest', Hidi and Renninger (2006) also distinguish
13
14 between two levels (or phases) of situational interest (triggered and maintained situational
15
16 interest). This model is characterised by a further plausible distinction between an 'emerging'
17
18 and a 'well-developed' individual interest. Although the whole (intra-individual) process of
19
20 interest development must of course be interpreted as a continuum, it is theoretically
21
22 meaningful to postulate typical stages or phases because they provide a practically useful
23
24 heuristic that helps teachers to analyse and evaluate students' actual or desired motivational
25
26 status.
27
28
29
30

31 **Theoretical interpretations of observed developmental trends.** Survey data
32
33 gathered in student populations are mostly used to identify general developmental trends or
34
35 trajectories that represent changes of aggregated interest scores in a certain domain or subject
36
37 area over a period of time. Clearly negative trends can often be found with respect to interest
38
39 in science (and related attitudes)--especially for the subject areas of physics and chemistry
40
41 (Baumert & Köller, 1998; Daniels, 2008; Gottfried, Fleming, & Gottfried, 2001; Osborne et
42
43 al., 2003; see below).
44
45
46
47

48 A number of explanations have been offered in the literature. Three explanatory
49
50 approaches are of special importance for our discussion. The first approach supposes that the
51
52 development of science interest is primarily dependent on the quality and type of instruction.
53
54 There are numerous hypotheses about the emergence, promotion or hindrance of school-
55
56 related interests which concern, amongst others, the school's organisation, the curriculum or
57
58 the degree to which the general environment in the schools fit the students' actual needs and
59
60 desires (Eccles & Midgley, 1989).

1
2
3 A second explanatory approach is based on findings and theories from the field of
4 developmental psychology. It is postulated, for example, that students in adolescence tend to
5 give priority to the coping with new developmental tasks and are no longer ready to invest all
6 of their energy in academic learning (Andermann & Maehr, 1994; Hofer, 2010 in press).
7
8
9

10
11
12 A third kind of explanation, the so-called differentiation hypothesis, assumes that the
13 decline of the average science interest during adolescence stems primarily from the fact that
14 young people, when searching for their own identity, subject their abilities and interests to a
15 critical evaluation. All interests which do not seem to be compatible with the ideal self-
16 concept are devalued and excluded from the student's personally important interest pattern
17 (Todt, Drewes & Heils, 1994, Travers, 1978). From this perspective, the negative
18 development trend in the student population, is thus first and foremost an inevitable
19 consequence of the normal differentiation of interest which occurs in adolescence (Daniels,
20 2008)
21
22
23
24
25
26
27
28
29
30
31
32

33 34 **Methods for Assessing Interests in Science**

35
36 The research strategies and measuring methods implemented in empirical studies vary
37 depending on the research questions being pursued. In this section, we will give a short
38 overview of typical measuring procedures. A more detailed description of the PISA 2006
39 interest assessment can be found in OECD (2006a, 2009b).
40
41
42
43
44

45
46 Most research approaches use questionnaires or rating scales to measure certain
47 aspects of the interest construct. Often-used measures refer to students' perceived
48 interestingness of school subjects or students' general interest in science. An important, but
49 only seldom-realised methodical approach attempts to reconstruct the topological structure of
50 science interest in a particular domain (e.g. physics). Furthermore, there are methods which
51 do not aim at measuring science interest directly but provide information about variables that
52 are in a theoretically convincing way associated with science interest. In PISA 2006, for
53 example, the following measures belong to this category: enjoyment of science, personal
54
55
56
57
58
59
60

1
2
3 value of science, science-related activities, future-oriented motivation to learn science and
4
5 expectations for a scientific career at age 30.
6
7

8 **Methods for Surveying Interest in School Subjects and Scientific Domains**

9

10 In survey studies, interest is often measured on the basis of simple rating scales or
11 short questionnaires in which the subjects are requested to estimate the perceived
12 interestingness of a subject or to assess their personal interest in this subject area. It is,
13 however, often doubtful which aspect of interest is indicated in the students' answers to these
14 questions. Haeussler and Hoffmann (2000) suggest making a distinction between 'domain
15 interest' and 'subject interest'. In the first case, a student is primarily interested in the contents
16 of a domain that are taught in the lessons of a particular school subject (e.g. knowledge about
17 the functions of the human brain). In the second case, the students' expressions of interest are
18 related to the school subject according to how it is being taught in school at that point in time.
19 As a rule, students' generalised evaluations of the 'interestingness' of school subjects are not
20 only (or primarily) determined by the kind of knowledge they expect to acquire in the lessons
21 (domain interest) but also by other aspects such as the expected (extrinsic) outcome of
22 learning, the perceived difficulty or prejudices towards the 'typical' teachers' of these
23 subjects. Thus, there can be a wide divergence between students' estimates of domain and
24 subject interest.
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

45 The construction of a theoretically satisfactory interest measure requires a
46 specification of the interest construct or a particular aspect of this construct that is used as a
47 basis for operationalisation. If the aim is, for example, to measure students' domain interest
48 under consideration of the above-mentioned definition criteria explicated in the person-object-
49 theory of interest, the items of a questionnaire would have to take into account
50 cognitive/epistemic ('wanting to know more'), emotional ('enjoy') and value-related
51 ('considered to be important') facets of the interest construct. An instrument that has been
52 developed on the basis of this theoretical concept is the Study Interest Questionnaire (SIQ;
53
54
55
56
57
58
59
60

1
2
3 Schiefele, Krapp, Wild, & Winteler, 1993) which may be applied to all kinds of subjects
4
5 taught at secondary school or university, including scientific domains.
6
7

8 In PISA 2006, students' general interest in science is measured in the student
9
10 questionnaire (Q21) by eight multiple-choice items asking students how much interest they
11
12 have in learning about the following broad science topics: physics, chemistry, biology of
13
14 plants, human biology, astronomy, geology, the ways scientists design experiments and what
15
16 is required for scientific explanations. The degree of interest is indicated by the categories
17
18 high, medium, low, and no interest. Thus, the data from the student questionnaire do not
19
20 specify the theoretically postulated cognitive and affective subcategories of the interest
21
22 construct (see above).
23
24
25

26 27 **Methods for Assessing the Topological Structure of a Domain Interest**

28
29 Science interest is measured in a rather general way in other research approaches as
30
31 well. Scores derived from statements in questionnaires or rating scales are used as an
32
33 empirical indicator of the 'amount' or 'degree' of interest in a particular subject or domain.
34
35 This methodical approach does not take into account that students' interest is not equally high
36
37 for all topics or activities related to a particular subject or domain. In order to reconstruct the
38
39 content structure of science interest more precisely, a multidimensional concept of interest
40
41 measurement is required (Gardner, 1996). One of the most differentiated instruments of this
42
43 kind was developed within the framework of a longitudinal study on interest in physics
44
45 (Haeussler, 1987; Haeussler & Hoffmann, 2000). As mentioned above, the construction of the
46
47 questionnaire was based on a three-dimensional model. Each of the three dimensions (topics,
48
49 contexts, activities) was further broken down into subcategories which resulted in a relatively
50
51 complex overall model with eight content categories, seven context areas and four kinds of
52
53 activities. The questionnaire consists of a total of 88 items. The hypothetical structure of
54
55 interest in physics could essentially be confirmed in factor analyses carried out with the data
56
57 from cross-sectional and longitudinal studies.
58
59
60

1
2
3 The international comparative study titled ‘The Relevance of Science Education’
4 (ROSE) on the attitudes and interest of secondary-level students in the area of science and
5 technology (Schreiner & Sjøberg, 2004; see below) is also based on a multidimensional
6 instrument which takes both a series of scientific subject areas and a large number of contexts
7 into consideration. The questionnaire consists of 250 items which are answered on a four-
8 point Likert scale. The questionnaire has been implemented in 40 countries up until now
9 (Osborne & Dillon, 2008; Schreiner & Sjøberg, 2004). In both cases the specific subareas of
10 students’ science interest in a particular domain are being measured retrospectively. Students
11 are asked about their interest in a situation in which they are not directly involved with
12 specific tasks or topics.
13
14
15
16
17
18
19
20
21
22
23
24
25

26
27 In this respect PISA 2006 has implemented a new and innovative measurement
28 procedure, the so called ‘embedded’ approach for the assessment of students’ ‘interest in
29 learning science topics’ (McCrae, 2009; OECD, 2006a; see Carstensen, Drechsel, & Prenzel,
30 this volume). Eighteen out of 37 science units included a set of three items assessing students’
31 topic-specific interest in science. As the stimulus text (including pictures or graphs) of the
32 cognitive task introduced the students to a specific context as well as a specific content area,
33 the added interest items were related to concrete instances of context and content. In this
34 sense, the interest assessment was contextualised in a way similar to the IPN interest study.
35
36
37
38
39
40
41
42
43
44
45

46 The main focus of this interest measure was on the cognitive (epistemic) component of
47 science interest. The embedded items requested students to estimate their interest with respect
48 to the categories ‘knowing more’, ‘learning more’, and ‘understanding better’. Other
49 theoretically postulated characteristics referring to feeling- and value-related valences (see
50 above) are not taken into account in this measurement procedure.
51
52
53
54
55
56

57 **Further Methods for Assessing Interest**

58
59 In survey studies such as PISA only a limited range of interest measures is applicable.
60 The following hints may give an impression about methods used in other important research

1
2
3 approaches about the role of interest in teaching and learning.
4

5 Research approaches that aim at analysing the conditions or effects of interest-based
6 learning at the level of states and processes have to deal with the problem that observations or
7 inquiries may interfere with the subjective experiences of the person involved. An approach
8 frequently taken is the use of questionnaires or rating scales which are administered after a
9 teaching-learning episode. As with all retrospective methods, it has to be taken into account
10 that the interviewees normally will not be able to remember exactly the actual quality of their
11 experience during the interest-related activity and that the results will thus be distorted. A
12 decisive factor for such distortions is the amount of time elapsing between the activity and the
13 administration of a questionnaire. However, retrospective estimations of motivational
14 conditions which are carried out at the end of lessons have by all means been proven
15 empirically sound and reliable in science education (e.g. Seidel, Prenzel, & Kobarg, 2005).
16 This is especially the case when students retrospectively assess the frequency of concrete
17 experiences (e.g. 'During the last lesson ... I would have liked to find out more about the
18 topic').
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37

38 There are several ways to measure interest-related processes during a learning activity.
39 In experiments designed to analyse the role of topic in text-based learning, Schiefele (1996)
40 asked students to make ratings of subjective experience dimensions at nominated points
41 during a reading task. Working from a different theoretical perspective but again focusing on
42 experiential states during learning activities, Shernoff, Csikszentmihalyi, Schneider and
43 Shernoff (2003) have used the Experience-Sampling Method (ESM) to explore empirical
44 relationships between concentration, situational interest, enjoyment and the flow experience.
45 ESM is based on the principle of time samples: In natural or experimental situations subjects
46 are asked to work on a few questions or rating scales (e.g. about their current activities or the
47 quality of their feelings) in close time proximity to a randomly assigned signal (Larson &
48 Csikszentmihalyi, 1983).
49
50
51
52
53
54
55
56
57
58
59
60

1
2
3 A similar method to measure experiential states associated with interest-based learning
4
5 has been adopted by Ainley, Hidi and Berndorff (2002). In experimental studies about how
6
7 individual and context factors contribute to topic interest and text learning, traditional self-
8
9 report measures were combined with a novel interactive computerised method of recording
10
11 cognitive and affective reactions to science and popular culture texts, monitoring their
12
13 development in real time. Following participants' signalling of how interesting they expected
14
15 the texts on certain topics to be, each text was presented in a form that recorded students'
16
17 choices, affective responses and persistence with each text. Tracking these behavioural
18
19 variables enables the examination of psychological processes that may mediate between
20
21 arousal of interest and learning outcomes (Ainley & Hidi, 2002).
22
23
24
25
26

27 In research approaches which aim at a detailed analysis of intra-individual
28
29 development processes, qualitative methods such as observations in natural settings, open-
30
31 ended interviews, group discussions or content analyses of diaries and other documents which
32
33 contain information about interest-related activities are being carried out. Browne and Ross
34
35 (1991), for example, made naturalistic observations yielding evidence about kindergarten
36
37 children's early science interests.
38
39
40

41 Important aspects of science interest can sometimes be revealed by using indirect
42
43 measures. Typical examples are procedures for assessing the relative weight of science
44
45 interest in student populations or estimations of students' general attitudes towards particular
46
47 subjects on the basis of data from official statistics (e.g. choice of courses in secondary school
48
49 or majors in further education; Osborne et al., 2003).
50
51
52

53 A new possibility for analysing interest in certain populations is provided by
54
55 databanks which can be used via the Internet. Baram-Tsabari and colleagues, for example,
56
57 have carried out content analysis assessments of queries submitted to 'Ask-A-Scientist' sites
58
59 in Israel, as well as of databanks of the Internet search engine Google which are accessible to
60
the public in order to survey the content and focus of adolescents' interest in the area of

1
2
3 science and technology (Baram-Tsabari & Segev, 2009; Baram-Tsabari, Sethi, Bry, &
4
5 Yarden, 2006).

8 **Research Approaches and Relevant Findings on Students' Interest in Science**

9
10 As interests in science are explored not only in science education but also in other
11
12 disciplines (e.g. educational science, psychology, sociology), it is still a challenge to
13
14 summarise the current state of research across topics and disciplines. In the following, we
15
16 would like to give an impression of typical research approaches and findings by looking at
17
18 some examples from central research questions that can be raised in any area of interest
19
20 research and which are also relevant for the discussion of the findings presented in the
21
22 following chapters of this special issue.
23
24
25

26 **How Domain Specific Are Interests in Science?**

27
28 Interest is a multidimensional construct that can be analysed and operationalised at
29
30 different levels of generality and under consideration of different structural components of the
31
32 interest concept. To which degree can we expect these components to be correlated? In
33
34 everyday thinking it is often assumed that a general interest in science exists. Those who are
35
36 highly interested in science (and technology) enjoy learning about any science-related topics
37
38 and also like working with it outside of school.
39
40
41
42

43
44 Empirical research, however, provides evidence that this is a much too simplistic
45
46 interpretation. In survey studies that use rather general indicators of both, interest in a school
47
48 subject and enjoyment of learning mostly significant correlation are reported (Schutz &
49
50 Pekrun, 2007). This also holds true for PISA 2006 (Ainley & Ainley, this volume). In his
51
52 summary of psychological research about the interrelation of interest and emotion, Silvia
53
54 comes to the conclusion 'that interest and enjoyment are distinct positive emotions' (Silvia,
55
56 2006, p. 29). When interest in science is explored in a differentiated manner, i.e. according to
57
58 subject areas or specific topics, intra-individual as well as inter-individual distinctions are
59
60 found (Haeussler Hoffmann, Langeheine, Rost, & Sievers, 1998; Ormerod & Duckworth,

1
2
3 1975; Osborne et al., 2003).

4
5 It has also been shown that subject interest or the relative popularity of a school
6
7 subject does not facilitate a reliable statement about the corresponding domain interest, i.e.
8
9 that part of interest which is concerned with the content questions and problems of a scientific
10
11 domain or discipline. Although a relatively high correlation was found between domain and
12
13 subject interest ($r=0.57$) in the total sample of the Kiel study on interest in physics, this
14
15 correlation varies considerably between the groups of students at different grade levels
16
17 (Haeussler & Hoffmann, 2000; Hoffmann, Haeussler, & Lehrke, 1998). The same is true for
18
19 the connection between domain and subject interest on the one hand, and corresponding
20
21 interests in leisure time or professional interests on the other hand. Even within a certain
22
23 scientific interest (e.g. in biology or physics), considerable differences have been found
24
25 between the interest of individual students and student groups in the specific subject areas or
26
27 topics of this subject.
28
29
30
31
32

33 **How High Are Students' Interests in Science Compared to Other Subjects?**

34
35 Many empirical studies examine this question. Even though the details of the findings
36
37 do not always concur, overall, they clearly indicate substantial differences between students'
38
39 reported interest in school subjects, which are often operationalised by comparative ratings of
40
41 experienced or expected interestingness. While the subjects Physics and Chemistry, which are
42
43 considered to be relatively difficult by the majority of students at the secondary level, are
44
45 relatively unpopular and are rated as an interesting school subject comparatively seldom
46
47 (Gardner, 1998; Hoffmann et al., 1998a), the subject biology has much higher scores when it
48
49 comes to ratings of popularity and interest (Osborne et al., 2003; Tamir & Gardner, 1989).
50
51 This is similar for the very heterogeneous school subject Geography (Geo Science; Trend,
52
53 2005). On the other hand, scientific topics and science subjects are very popular with
54
55 elementary school students (Martin, Mullis, & Foy, 2008).
56
57
58
59
60

Subject-specific interest varies depending on how subtopics or the specific subject

1
2
3 areas of a subject are personally perceived. For example, in physics, topics which have a
4 practical or social reference are rated as much more interesting than the general scientific
5 principles of this subject (Haeussler & Hoffmann, 2000; Lavonen, Byman, Uitto, Juuti, &
6
7
8
9
10 Meisalo, 2008).

11 12 **What is Known About Differences Between Subgroups?**

13
14
15 Surveys about the general level of interest (or other indicators of positive attitudes
16 toward science) often try to identify substantial differences between particular subgroups of
17 students that can be separated according to relevant educational or sociological variables such
18 as gender, cultural background, geographic region, socioeconomic status of the families, etc.
19
20 The PISA 2006 database also allows for exploring these kinds of questions (OECD, 2007).
21
22
23
24

25
26
27 Gender differences in scientific interest depend to a large degree on the domains.

28
29 While interest in biology or the life sciences is just as pronounced in girls as in boys, if not
30 more so, a different picture can be seen for the so-called 'hard' sciences. Physics and
31 chemistry are subject areas in which girls usually show less interest than boys. The indications
32 that girls turn away from the 'hard' sciences more so than boys over the course of their
33 schooling are empirically well documented (Haeussler & Hoffmann, 2000; Jones, Howe, &
34 Rua, 2000; Labudde, Herzog, Neuenschwander, Enrico, & Gerber, 2000).
35
36
37
38
39
40
41
42

43
44 Differences between what boys and girls consider to be interesting were also reported
45 in ROSE (Osborne & Dillon, 2008; Schreiner & Sjøberg, 2004; Sjøberg & Schreiner, 2005)
46 and in analyses based on PISA 2006 data (e.g. OECD, 2007).
47
48
49

50
51 Constructs such as self-concept and self-efficacy (Reis & Park, 2001; Zimmerman,
52 2000) play an important role in the explanation of gender-specific differences in interest in
53 science. Gender-specific differences are mostly larger for self-concept than for self-efficacy
54 (OECD, 2007), although high-performing girls also tend to underestimate their own ability
55 compared to similarly high-performing boys.
56
57
58
59
60

Programmes for strengthening girls' scientific interests thus often aim at the self-

1
2
3 concept of girls, and attempt to strengthen this with suitable tasks and feedback procedures
4
5 (Haeussler & Hoffmann, 2002). Another successful strategy is a more careful recognition of
6
7 girls' topic interests in both science curricula and instruction. It has also been shown that a
8
9 temporary separation of girls from boys in science classrooms can strengthen girls' self-
10
11 concept and interest. Other theoretical approaches suggest that the image of science and the
12
13 interpretation of this image by peers play an important role in girls' decision to turn away
14
15 from science and technology in adolescence (Kessels, Rau, & Hannover, 2006). Here, too, it
16
17 was possible to show that measures which change the students' image of science and
18
19 technology promote girls' interest (Kessels & Hannover, 2007).
20
21
22
23
24

25 In the more recent international comparative studies of the
26
27 <http://www.iea.nl/> International Association for the Evaluation of Educational Achievement
28
29 (IEA) and the Organisation for Economic Co-operation and Development (OECD), it can be
30
31 seen that the differences between girls and boys both in the area of performance and that of
32
33 interest are now only very small (Martin et al., 2008; OECD, 2007, 2009a). Overall, the effect
34
35 strengths are low even when significant differences are observed. Similarly, no indications
36
37 were found that boys and girls systematically differ in their expectations of having a future
38
39 career which is related to science (and technology). The data gained in PISA 2006 seem to
40
41 support this positive trend. Looking at all countries together (OECD, 2007), over two-thirds
42
43 of students stated that they consider science to be important and useful, that they want to be
44
45 good in science lessons and that they enjoy learning new things in these lessons. About 21%
46
47 of students say that they will make science a central issue in their life; about 37% imagine
48
49 working in a science-related career. Thus, a thoroughly positive picture of young people's
50
51 appreciation of science emerges worldwide. However, if one looks at the results of interest
52
53 surveys at a country level, a noteworthy tendency can be observed: The interest in science is
54
55 higher in less industrialised countries than in countries with advanced technological
56
57 development. A similar picture can be seen in the Trends in International Mathematics and
58
59
60

1
2
3 Science Study (TIMSS) (Martin et al., 2008) and also in the ROSE study (Osborne & Dillon,
4
5 2008; Sjøberg & Schreiner, 2005).

8 **What Effect Does Interest Have on Learning in School and Educational Success?**

9
10 Research approaches that deal with this question interpret interest as an independent
11
12 variable that can be used to predict the amount or the quality of learning motivation, students'
13
14 usage of learning strategies or academic achievement and other educationally relevant
15
16 outcome variables (e.g. selection of an educational program or a professional career in a
17
18 science domain).
19
20

21
22 Numerous studies have dealt with the correlation between interest, school grades and
23
24 other indicators of school success in science and other subjects. The results have been
25
26 summed up and reported in meta-analyses, amongst others, which consider indicators of
27
28 interest alongside other affective and motivational factors (e.g. Willson, 1983). Schiefele,
29
30 Krapp and Winteler (1992) carried out a meta-analysis of findings on the relationship between
31
32 subject matter interest and academic achievement. Across all subjects and school levels, they
33
34 calculated a mean correlation of $r=0.30$. The school subject is an important moderator:
35
36 Relatively high correlations were found for physics, science and mathematics. In the IPN
37
38 study on interest in physics mentioned above, the subject interest in physics correlated with
39
40 the corresponding school grade by $r=-0.38$ (Hoffmann et al., 1998a, p. 113). Sex-specific
41
42 differences were not established. However, there are also studies in which no significant
43
44 connection could be found between interest and school performance if the influence of other
45
46 potential predictors is controlled (Köller, Baumert, & Schnabel, 2001). In PISA, weak
47
48 correlations can also be observed between different measures of interest and performance
49
50 (OECD, 2007). The relevance of interest for lifelong learning and choice of studies, however,
51
52 does not depend on a high correlation between interest and performance. Both interest and
53
54 performance are important educational aims. A low correlation can also indicate that students
55
56 with a high cognitive potential for science do not pursue careers as scientists or engineers
57
58
59
60

1
2
3 because they lost their interest during school.
4

5 **How Does Interest Change Over the Course of Schooling and How Can the**
6 **Development of Interest be Explained?**
7
8

9
10 Although PISA 2006 does not provide data for exploring these kinds of developmental
11 questions, we want to point in this concluding section to some exemplary findings in this area
12 of interest research because they have a central position in the discussion about science
13 interest (OECD 2006b; Osborne & Dillon, 2008; Roberts, 2002).
14
15

16
17
18 In the past years, educational interest research has looked, amongst other things, at the
19 questions of whether there are general development trends, how these trends can be explained
20 and how they can be influenced with suitable educational measures. The change in science-
21 related interests over the course of schooling has been surveyed with different methods in
22 many countries (Baumert & Köller, 1998; Daniels, 2008; Gardner, 1985; Osborne et al.,
23 2003). Surveys at the secondary level are generally concerned with specific subjects or
24 subject areas. Taken together, the data provide evidence that many students tend to lose their
25 interest in science over the course of time. The ‘hard’ disciplines of physics and chemistry are
26 particularly affected by this negative development. Biology is less affected, although
27 considerable slumps can also be seen here at secondary level (Osborne et al., 2003). This
28 decline is more pronounced in girls than in boys (Haeussler & Hoffmann, 1998).
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44

45 The theoretical and practical relevance of such general development trends is often
46 misjudged. They only provide information about changes in the average interest of a student
47 population and cannot easily be used to describe or predict the most probable course of an
48 individual’s interest development in this domain. This is due to the fact that the trend analyses
49 are based on aggregated data and thus do not provide an insight into the course of interest
50 development in specific subpopulations or particular subject areas of physics which deviate
51 from this data. In fact, more exact analyses of the data available from longitudinal studies
52 show that, realistically, very different developmental curves must be expected and that it is
53
54
55
56
57
58
59
60

1
2
3 not in any way justifiable to postulate a generally negative developmental trend in the domain
4
5 of science interests.
6

7
8 This can be demonstrated with the example of the Kiel study on interest in physics,
9
10 which combined a cross-sectional with a longitudinal study and accompanied more than 4000
11
12 students over a time span of six years (Grades 5 to 10; Haeussler et al., 1998; Haeussler &
13
14 Hoffmann, 2000). It was shown that the development of domain interest in different subject
15
16 areas (e.g. optical instruments, electricity and electronics, radioactivity) sometimes differs
17
18 considerably from the development of global domain interest (which is aggregated across all
19
20 sub-aspects). Furthermore, the findings indicate that there are only a relatively small number
21
22 of subject areas in which the interest of girls and boys differs largely (e.g. electricity and
23
24 electronics); in contrast, in the majority of specific factual interests, no serious gender-specific
25
26 differences can be identified. Domain interest remains largely constant over time in six areas.
27
28 In fact, interest in discussions on and evaluations of physics topics increases from the 9th to
29
30 the 10th grade. Furthermore, the analyses show that the developmental curves depend largely
31
32 on the way in which physics knowledge is integrated into a context. If physics instruction is
33
34 mainly aimed at presenting scientific natural laws and reconstructing mathematically, then the
35
36 majority of students--both boys and girls--lose interest in physics. In contrast, if physics
37
38 knowledge is taught in such a way that students can recognise a direct connection to practical
39
40 life situations in which they are personally interested, then there are good chances that their
41
42 interest will remain stable or even increase.
43
44
45
46
47
48
49

50
51 The findings from these more differentiated analyses are striking in that they show that
52
53 both the interest level and the course of interest development in science subjects depend
54
55 strongly on the perceived attractiveness of the prevalent curriculum's lesson content on the
56
57 one hand, and on the other hand, on the manner in which scientific knowledge is presented
58
59 and taught. Against the background of these results, strong doubts are cast on the validity of
60
the statement that interest in science generally sinks dramatically at secondary level, which

1
2
3 can be found frequently in scientific literature.
4

5 6 **Future Prospects**

7
8 Interest is a central concept in science education. Schools must aim to promote interest
9
10 in science and technology. On the one hand, this means supporting students' open-
11
12 mindedness towards science and technology. On the other hand, school makes a contribution
13
14 towards clarifying interests. School helps students to discover which areas and topics they are
15
16 enthusiastic about, which they would like to work on themselves, and in which they would
17
18 like to get more involved--both in education and future professional life. In view of the high
19
20 demand for new blood in science and technology, schools--as well as research institutes--have
21
22 the task of making the importance of science and technology visible, as well as the intrinsic
23
24 incentives and epistemic challenges of working in these areas.
25
26
27

28
29 Interest is also a key concept for science education in another respect: The interest that
30
31 students effectively bring with them to school and further develop there is a decisive
32
33 condition for instruction. It is the school's task to pick up the interest which the students bring
34
35 with them, i.e. to establish connections between it and the curricular requirements. These
36
37 interests can relate to context, content and activities. Thus, an elaborate conception of interest
38
39 and a diagnostic way of looking at things are important aspects of science teachers'
40
41 competency.
42
43
44

45
46 To a certain extent, the interests which students bring with them correspond to the
47
48 'trait' aspect of interest. In instruction, however, it is important to foster the 'state' aspect, i.e.
49
50 situational interest. The repeated experience of situational interest in connection with
51
52 scientific and technological topics, discursive models, experiments and their preparation and
53
54 argumentative representation is the precondition for the development of a more stable interest
55
56 which significantly influences the choice of courses, third level areas of study or careers.
57
58

59
60 Interest as a requirement of science education, as well as a means and aim of science
education is thus, long after Herbart's theory, still a serious challenge for our educational

1
2
3 institutions. As we have shown in this contribution, the theoretical conceptions of interest, its
4
5 structure and the psychological functions on which it is based have been further differentiated
6
7 since Herbart. In particular, they have been defined more precisely by empirical research in
8
9 the last 50 years. As interest research also always has to consider the objects of interest (and
10
11 their content), it relies on interdisciplinary approaches and cooperation. Accordingly, over the
12
13 last decades, most advances in the examination of interest in science and technology can be
14
15 found in the overlapping areas of science education, education and educational psychology.
16
17
18 However, much more research remains to be done in these areas. What is particularly
19
20 important here is to examine the conditions in science instruction, as well as in out-of-school
21
22 environments, that support cognitive learning gains and performance, as well as those that
23
24 stimulate and further develop interest in science and technology (Seidel & Shavelson, 2007).
25
26
27
28

29
30 Nowadays, international large-scale assessments provide a decisive impulse for the
31
32 attention which the interest construct receives, as well as for further research on interests.
33
34 Comparative studies which deal with science and mathematics have asked students about their
35
36 attitudes towards science right from the beginning. However, the 'interest construct' was only
37
38 considered indirectly, e.g. by surveying emotional aspects (enjoying science, having fun with
39
40 science) or the value attached to individual school subjects or object areas. Sometimes,
41
42 students were simply asked whether they were interested in science. Considering the
43
44 differentiated and theoretically well-founded interest conceptions which were already
45
46 available in educational psychology and science education at that point in time, these
47
48 empirical approaches fell far short of the possibilities. Ultimately, this severely limited
49
50 empirical survey clearly underestimated the significance of the interest construct (as a
51
52 relevant aim of schools!). This situation was obviously changed by PISA 2006: In the
53
54 survey's framework, interest in science was considered to be an important aspect of scientific
55
56 literacy. At the same time, an attempt was made to relate the interest concept to a structuring
57
58 of science which systematically differentiated between contexts, content areas and
59
60

1
2
3 competencies. As a consequence of these considerations, an attempt was made to obtain a
4
5 more differentiated picture by embedding an interest survey in the assessment. This approach
6
7 can be understood as a first attempt by large-scale assessments to measure interest in a more
8
9 differentiated way. This attempt had to be realised under the conditions of the very limited
10
11 timescales of such surveys. Several contributions in this special issue provide an impression
12
13 of the findings which have been gained with this approach.
14
15

16
17 It can be hoped that a starting point and a sustainable impulse for further efforts in the
18
19 consideration of interest in large-scale assessments has thus been provided which will also
20
21 have an influence on other areas (such as assessments concerning educational standards or the
22
23 development of assessments for individual diagnostics). The development of computer-based
24
25 assessments which provide exceptional possibilities for surveying facets of interest in more
26
27 authentic situations would seem to be one particularly suitable approach. However, the
28
29 development of such instruments also means a serious challenge for interest research.
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

References

- Ainley, M., & Hidi, S. (2002). Dynamic measures for studying interest and learning. In P. R. Pintrich & M. L. Maehr (Eds.) *Advances in motivation and achievement: New directions in measures and methods* (Vol. 12; pp. 43-76). Amsterdam: JAI Press.
- Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning and the psychological processes that mediate their relationship. *Journal of Educational Psychology, 94*, 545-561.
- Anderman, E. M., & Maehr, M. L. (1994). Motivation and schooling in the middle grades. *Review of Educational Research, 64*, 267-309.
- Baram-Tsabari, A., & Segev, E. (2009). Exploring new web-based tools to identify public interest in science. *Public Understanding of Science*. Advance online publication. doi: 10.1177/0963662509346496
- Baram-Tsabari, A., Sethi, R. J., Bry, L., & Yarden, A. (2006). Using questions sent to an Ask-A-Scientist site to identify children's interests in science. *Science Education, 90*(6), 1050-1072.
- Baumert, J., & Köller, O. (1998). Interest research concerning secondary level I: An overview. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.) *Interest and learning. Proceedings of the Seeon-conference on interest and gender* (pp. 241-256). Kiel, Germany: Institut fuer die Paedagogik der Naturwissenschaften (IPN).
- Bennett, J. (2001). Science with attitude: The perennial problem of pupils' responses to science. *School Science Review, 82*(300), 59-70.
- Berlyne, D. E. (1949). Interest as a psychological concept. *The British Journal of Psychology, 39*, 184-195.
- Berlyne, D. E. (1960). *Conflict, arousal and curiosity*. New York: Grove Press.

- 1
2
3 Browne, N., & Ross, C. (1991). Girls stuff, boys stuff: Young children talking and playing. In
4
5 N. Browne (Ed.), *Science and technology in the early years* (pp. 37-51). Buckingham,
6
7 UK: Open University Press.
8
9
10 Bybee, R. W. (1997). Towards an understanding of scientific literacy. In W. Graeber & C.
11
12 Bolte (Eds.), *Scientific literacy--An international symposium* (pp. 37-68). Kiel,
13
14 Germany: Institut fuer die Paedagogik der Naturwissenschaften (IPN).
15
16
17 Csikszentmihalyi, M. (1975). *Beyond boredom and anxiety. The experience of play in work*
18
19 *and games*. San Francisco: Jossey-Bass.
20
21
22 Csikszentmihalyi, M. (1990). *Flow. The psychology of optimal experience*. New York: Harper
23
24 & Row.
25
26
27 Dainton, F. S. (1968). *The Dainton report: An inquiry into the flow of candidates into science*
28
29 *and technology*. London: HMSO.
30
31
32 Daniels, Z. (2008). *Entwicklung schulischer Interessen im Jugendalter*. (Development of
33
34 student interest on secondary level) Muenster, Germany: Waxmann.
35
36
37 Deutsch, J. A., & Deutsch, D. (1963). Attention: Some theoretical considerations.
38
39 *Psychological Review*, 70, 80-90.
40
41
42 Dewey, J. (1913). *Interest and effort in education*. Cambridge, MA: Riverside Press.
43
44
45 Eccles, J. S., & Midgley, C. (1989). Stage/environment fit: Developmentally appropriate
46
47 classrooms for early adolescents. In R. E. Ames, & C. Ames (Eds.), *Research on*
48
49 *motivation in education* (Vol. 3, pp. 139-186). New York: Academic.
50
51
52 Elsworth, G., Harvey-Beavis, A., Ainley, J., & Fabris, S. (1999). Generic interests and school
53
54 subject choice. *Educational Research and Evaluation*, 5(3), 290-318.
55
56
57 European Commission (Ed.). (2004). *Europe needs more scientists!* Brussels: European
58
59 Commission, Directorate-General for Research, High Level Group on Human
60
Resources for Science and Technology in Europe. Retrieved from
http://europa.eu.int/comm/research/conferences/2004/sciprof/pdf/final_en.pdf

- 1
2
3 European Commission (Ed.). (2006). *Science education now: A renewed pedagogy for the*
4
5 *future of Europe*. Brussels: European Commission Directorate-General for Research.
6
7 Retrieved from <http://ec.europa.eu/research/science->
8
9 [society/document_library/pdf_06/report-rocard-on-science-education_en.pdf](http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf)
10
11
12 Fensham, P. J. (1985). Science for all. *Journal of Curriculum Studies*, 17(4), 415-435.
13
14 Gardner, P. L. (1975). Attitude to science: A review. *Studies in Science Education*, 2, 1-41.
15
16 Gardner, P. L. (1985). Students' interest in science and technology: An international
17
18 overview. In M. Lehrke, L. Hoffmann, & P. L. Gardner (Eds.), *Interests in science and*
19
20 *technology education* (pp. 15-34). Kiel, Germany: Institut fuer die Paedagogik der
21
22 Naturwissenschaften (IPN).
23
24
25
26 Gardner, P. L. (1996, June). Students' interests in science and technology: Gender, age and
27
28 other factors. Paper written for the International Conference on Interest and Gender:
29
30 Issues of Development and Change in Learning, Seeon, Germany.
31
32
33 Gardner, P. L. (1998). The development of males' and females' interest in science and
34
35 technology. In L. Hoffmann, A. Krapp, K. A. Renninger, & J. Baumert (Eds.), *Interest*
36
37 *and learning. Proceedings of the Seeon-conference on interest and gender* (pp. 41-57).
38
39 Kiel, Germany: Institut fuer die Paedagogik der Naturwissenschaften (IPN).
40
41
42
43 Gardner, P. L. & Tamir, P. (1989). Interest in biology. Part I: A multidimensional construct.
44
45 *Journal of Research in Science Teaching*, 26, 409-423.
46
47
48 Gottfredson, L. S. (1981). Circumscription and compromise: A developmental theory of
49
50 occupational aspirations. *Journal of Counseling Psychology*, 28(6), 545-579.
51
52
53 Gottfried, A. E., Fleming, J. S., & Gottfried, A. W. (2001). Continuity of academic intrinsic
54
55 motivation from childhood through late adolescence: A longitudinal study. *Journal of*
56
57 *Educational Psychology*, 93, 3-13.
58
59
60

- 1
2
3 Haeussler, P. (1987). Measuring students' interest in physics--Design and results of a cross-
4
5 sectional study in the Federal Republic of Germany. *International Journal of Science*
6
7 *Education*, 9(1), 79-92.
- 8
9
10 Haeussler, P., & Hoffmann, L. (1998). Qualitative differences in student's interest in physics
11
12 and the dependence on gender and age. In L. Hoffmann, A. Krapp, K. A. Renninger, &
13
14 J. Baumert (Eds.), *Interest and learning. Proceedings of the Seon-conference on*
15
16 *interest and gender* (pp. 280-289). Kiel, Germany: Institut fuer die Paedagogik der
17
18 Naturwissenschaften (IPN).
- 19
20
21
22 Haeussler, P., Hoffmann, L. (2000). A curricular frame for physics education: Development,
23
24 comparison with students' interests, and impact on students' achievement and self-
25
26 concept. *Science Education*, 84, 689-705.
- 27
28
29 Haeussler, P., & Hoffmann, L. (2002). An intervention study to enhance girls' interest, self-
30
31 concept, and achievement in physics classes. *Journal of Research in Science Teaching*,
32
33 39(9), 870-888.
- 34
35
36 Haeussler, P., Hoffmann, L., Langeheine, R., Rost, J., & Sievers, K. (1998). A typology of
37
38 students interest in physics and the distribution of gender and age within each type.
39
40 *International Journal of Science Education*, 20(2), 223-238.
- 41
42
43 Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of*
44
45 *Educational Research*, 60, 549-571.
- 46
47
48 Hidi, S., & Renninger, A. (2006). The four-phase model of interest development. *Educational*
49
50 *Psychologist*, 41, 111-127.
- 51
52
53 Hidi, S., Renninger, K. A., & Krapp, A. (2004). Interest, a motivational construct that
54
55 combines affective and cognitive functioning. In D. Dai & R. Sternberg (Eds.),
56
57 *Motivation, emotion and cognition: Integrative perspectives on intellectual functioning*
58
59 *and development* (pp. 89-115). Mahwah, NJ: Erlbaum.
- 60

- 1
2
3 Hofer, M. (in press). Adolescents' development of individual interests: A product of multiple
4 goal regulation? *Educational Psychologist*, 45(3).
5
6
7
8 Hoffmann, L., Haeussler, P., & Lehrke, M. (1998a). *Die IPN-Interessenstudie Physik*. (The
9 IPN study on students' interest in science). Kiel, Germany: Institut fuer die Paedagogik
10 der Naturwissenschaften (IPN).
11
12
13 Hoffmann, L., Krapp, A., Renninger, A., & Baumert, J. (Eds.). (1998b). *Interest and learning.*
14
15 *Proceedings of the Seeon-conference on interest and gender*. Kiel, Germany: Institut
16 fuer die Paedagogik der Naturwissenschaften (IPN).
17
18
19
20
21
22 Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and*
23 *work environments* (3rd ed.). Odessa, FL: Psychological Assessment Resources.
24
25
26
27 Hunt, J. M. (1965). Intrinsic motivation and its role in psychological development. In D.
28 Levine (Ed.), *Nebraska symposium on motivation* (pp. 189-282). Lincoln: Nebraska
29 University Press.
30
31
32
33
34 Jones, M. G., Howe, A., & Rua, M. J. (2000). Gender differences in students' experiences,
35 interests, and attitudes toward science and scientists. *Science Education*, 84, 180-192.
36
37
38
39 Kessels, U., & Hannover, B. (2007). How the image of math and science affects the
40 development of academic interests. In M. Prenzel (Ed.) *Studies on the educational*
41 *quality of schools. The final report on the DFG Priority Programme* (pp. 283-297).
42 Muenster, Germany: Waxmann.
43
44
45
46
47
48 Kessels, U., Rau, M., & Hannover, B. (2006). What goes well with physics? Measuring and
49 altering the image of science. *British Journal of Educational Psychology*, 76, 761-780.
50
51
52
53 Köller, O., Baumert, J., & Schnabel, K. (2001). Does interest matter? The relationship
54 between academic interest and achievement in mathematics. *Journal for Research in*
55 *Mathematics Education*, 32, 448-470.
56
57
58
59
60

- 1
2
3 Krapp, A. (2002a). An educational-psychological theory of interest and its relation to self-
4
5 determination theory. In E. Deci & R. Ryan (Eds.), *The handbook of self-determination*
6
7 *research* (pp. 405-427). Rochester, NY: University of Rochester Press.
8
9
- 10 Krapp, A. (2002b). Structural and dynamic aspects of interest development: Theoretical
11
12 considerations from an ontogenetic perspective. *Learning and Instruction*, 12, 383-409.
13
14
- 15 Krapp, A., Hidi, S., & Renninger, K. A. (1992). Interest, learning and development. In K. A.
16
17 Renninger, S. Hidi, & A. Krapp (Eds.), *The role of interest in learning and development*
18
19 (pp. 3-25). Hillsdale, NJ: Erlbaum.
20
21
- 22 Labudde, P., Herzog, W., Neuenschwander, M. P., Enrico, V., & Gerber, C. (2000). Girls and
23
24 physics: Teaching and learning strategies tested by classroom interventions in grade 11.
25
26 *International Journal of Science Education*, 20, 143-157.
27
28
- 29 Larson, R., & Csikszentmihalyi, M. (1983). The experience sampling method. *New Directions*
30
31 *for Methodology of Social and Behavioral Science*, 15, 41-56.
32
33
- 34 Lavonen, J., Byman, R., Uitto, A., Juuti, K., & Meisalo, V. (2008). Students' interest and
35
36 experiences in physics and chemistry related themes: Reflections based on a ROSE-
37
38 survey in Finland. *Themes in Science and Technology Education*, 1(1), 7-36.
39
40
- 41 Lehrke, M., Hoffmann, L., & Gardner, P. L. (Eds.). (1985). *Interests in science and*
42
43 *technology education*. Kiel, Germany: Institut fuer die Paedagogik der
44
45 Naturwissenschaften (IPN).
46
47
- 48 Lie, S. (Ed.). (1983). *Girls and science and technology. Contributions to the second*
49
50 *International GASAT conference*. Oslo, Norway: University of Oslo, Institute of
51
52 Physics.
53
54
- 55 Martin, M. O., Mullis, I. V. S., & Foy, P. (with Olson, J. F., Erberber, E., Preuschoff, C., &
56
57 Galia, J.). (2008). *TIMSS 2007 international mathematics report: Findings from IEA's*
58
59 *trends in international mathematics and science study at the fourth and eighth grade*.
60
Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

- 1
2
3 McCrae, B. J. (2009). What science do students want to learn? In R. Bybee & B. McCrae
4
5 (Eds.), *PISA Science 2006: Implications for science teachers and teaching* (pp. 149-
6
7 162). Arlington, VA: NSTA Press.
8
9
10 Millar, R., & Osborne, J. (Eds.). (1998). *Beyond 2000: Science education for the future*.
11
12 London: King's College.
13
14
15 Organisation for Economic Co-operation and Development. (2006a). *Assessing scientific,*
16
17 *reading and mathematical literacy. A framework for PISA 2006*. Paris: OECD.
18
19
20 Organisation for Economic Co-operation and Development. (2006b). *Evolution of student*
21
22 *interest in science and technology studies: Policy report*. Paris: OECD Global Science
23
24 Forum.
25
26
27 Organisation for Economic Co-operation and Development. (2007). *PISA 2006. Science*
28
29 *competencies for tomorrow's world*. Paris: OECD.
30
31
32 Organisation for Economic Co-operation and Development. (2008). *Encouraging student*
33
34 *interest in science and technology studies*. Paris: OECD.
35
36
37 Organisation for Economic Co-operation and Development. (2009a). *Equally prepared for*
38
39 *life? How 15-year-old boys and girls perform in school*. Paris: OECD.
40
41
42 Organisation for Economic Co-operation and Development. (2009b). *PISA 2006. Technical*
43
44 *report*. Paris: OECD.
45
46
47 Ormerod, M. B., & Duckworth, D. (1975). *Pupils' attitudes to science*. Windsor, UK:
48
49 National Foundation for Educational Research.
50
51
52 Osborne, J., & Dillon, J. (2008). *Science education in Europe: Critical reflections. A report to*
53
54 *the Nuffield Foundation*. London: King's College.
55
56
57 Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the
58
59 literature and its implications. *International Journal of Science Education*, 25, 1049-
60 1079.

- 1
2
3 Prenzel, M. (1988). *Die Wirkungsweise von Interesse. Ein paedagogisch-psychologisches*
4
5 *Erklaerungsmodell.* (The effect of interest: Explanations from educational psychology).
6
7 Opladen, Germany: Westdeutscher Verlag.
8
9
- 10 Prenzel, M. (1992). Selective persistence of interest. In K. A. Renninger, S. Hidi, & A. Krapp
11
12 (Eds.), *The role of interest in learning and development* (pp. 71-98). Hillsdale, NJ:
13
14 Erlbaum.
15
16
- 17 Reis, S. M., & Park, S. (2001). Gender differences in high-achieving students in math and
18
19 science. *Journal for the Education of the Gifted*, 25(1), 52-73.
20
21
- 22 Rennie, L. J., & Punch, K. F. (1991). The relationship between affect and achievement in
23
24 science. *Journal of Research in Science Teaching*, 28(2), 193-209.
25
26
- 27 Renninger, K. A., Hidi, S., & Krapp, A. (Eds.). (1992). *The role of interest in learning and*
28
29 *development.* Hillsdale, NJ: Erlbaum.
30
31
- 32 Roberts, G. (2002). *SET for success: The supply of people with science, technology,*
33
34 *engineering and mathematics skills.* London: HMSO.
35
36
- 37 Schiefele, H. (1978). *Lernmotivation und Motivlernen* (Motivation to learn and the learning
38
39 motives) (2nd ed.). Munich, Germany: Ehrenwirth.
40
41
- 42 Schiefele, H., Krapp, A., Prenzel, M., Heiland, A., & Kasten, H. (1983). *Principles of an*
43
44 *educational theory of interest.* Paper presented at the 7th Meeting of the International
45
46 Society for the Study of Behavioral Development, Munich, Germany.
47
48
- 49 Schiefele, U. (1996). Topic interest, text representation, and quality of experience.
50
51 *Contemporary Educational Psychology*, 21, 3-18.
52
53
- 54 Schiefele, U. (2009). Situational and individual interest. In K. R. Wentzel, & A. Wigfield
55
56 (Eds.), *Handbook of motivation at school.* Mahwah, NJ: Erlbaum.
57
58
- 59 Schiefele, U., Krapp, A., Wild, K. -P., & Winteler, A. (1993). Der 'Fragebogen zum
60
Studieninteresse' (FSI). (The 'questionnaire on study interest'). *Diagnostica*, 39, 335-
351.

- 1
2
3 Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic
4
5 achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi, & A. Krapp
6
7 (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ:
8
9 Erlbaum.
- 10
11
12 Schreiner, C. (2006). *Exploring a ROSE-garden: Norwegian youth's orientations towards*
13
14 *science - seen as signs of late modern identities*. Oslo: Unipub.
- 15
16
17 Schreiner, C., & Sjøberg, S. (2004). Sowing the seeds of ROSE. Background, rationale,
18
19 questionnaire development and data collection for ROSE (the Relevance of Science
20
21 Education) - A comparative study of students' views of science and science education.
22
23 *Acta Didactica, 4*, Oslo, Dept. of Teacher Education and School Development,
24
25 University of Oslo.
- 26
27
28
29 Schutz, P. A., & Pekrun, R. (Eds.). (2007). *Emotion in education*. San Diego, CA: Academic
30
31 Press.
- 32
33
34 Seidel, T., Prenzel, M., & Kobarg, M. (2005). *How to run a video study. Technical report of*
35
36 *the IPN Video Study*. Muenster, Germany: Waxmann.
- 37
38
39 Seidel, T., & Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The
40
41 role of theory and research design in disentangling meta-analysis research. *Review of*
42
43 *Educational Research, 77*, 454-499.
- 44
45
46 Shernoff, D. J., Csikszentmihalyi, M, Schneider, B., & Shernoff, E. S. (2003). Student
47
48 engagement in high school classrooms from the perspective of flow theory. *School*
49
50 *Psychology Quarterly, 18*(2), 158-176.
- 51
52
53 Silvia, P. J. (2006). *Exploring the psychology of interest*. New York: Oxford University Press.
- 54
55
56 Sjøberg, S., & Schreiner, C. (2005). How do learners in different cultures relate to science and
57
58 technology? Results and perspectives from the project ROSE (the Relevance of Science
59
60 Education). *Asia-Pacific Forum on Science Learning and Teaching, 6*, 1-16.

- 1
2
3 Steinkamp, M. W., & Maehr, M. L. (1983). Affect, ability, and science achievement: A
4
5 quantitative synthesis of correlational research. *Review of Educational Research*, 53,
6
7 369-396.
8
9
- 10 Strong, E. K. (1943). *Vocational interests of men and women*. Palo Alto, CA: Stanford
11
12 University Press.
13
14
- 15 Tamir, P., & Gardner, P. (1989). The structure of interest in high school biology. *Research in*
16
17 *Science & Technological Education*, 7, 113-140.
18
19
- 20 Todt, E., Drewes, R., & Heils, S. (1994). The development of interests during adolescence:
21
22 Social context, individual differences, and individual significance. In R. K. Silbereisen
23
24 & E. Todt (Eds.), *Adolescence in context: The interplay of family, school, peers and*
25
26 *word in adjustment* (pp. 82-95). New York: Springer.
27
28
- 29 Todt, E., & Schreiber, S. (1998). Development of interests. In L. Hoffmann, A. Krapp, K. A.
30
31 Renninger, & J. Baumert (Eds.) *Interest and learning. Proceedings of the Seon-*
32
33 *conference on interest and gender* (pp. 25-40). Kiel, Germany: Institut fuer die
34
35 Paedagogik der Naturwissenschaften (IPN).
36
37
- 38 Travers, R. M. W. (1978). *Children's interests*. Kalamazoo, MI: Michigan University, College
39
40 of Education.
41
42
- 43 Trend, R. (2005). Individual, situational and topic interest in geosciences among 11- and 12-
44
45 year-old children. *Research Papers in Education*, 20(3), 271-302.
46
47
- 48 Vygotsky, L. (1978). *Mind and society*. Cambridge, MA: Harvard University Press.
49
50
- 51 White, A. R. W. (1967). *The philosophy of mind*. New York: Random House.
52
53
- 54 Willson, V. L. (1983). A meta-analysis of the relationship between science achievement and
55
56 science attitude. Kindergarten through college. *Journal of Research in Science*
57
58 *Teaching*, 20(9), 839-850.
59
60
- Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary*
Educational Psychology, 25(1), 82-91.