



STUDENTS' INTERESTS AND INTERDISCIPLINARY INSTRUCTION IN MATHEMATICS AND SCIENCE

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Research:

- Relations between mathematics and science in upper secondary education
- Interest research
- Technology and modern science in secondary education

1982-1997 Teacher at Danish upper secondary school

Favorite soccer teams:

- Celtic and Liverpool



John Dewey (1913): Interest and effort in education

Interests are the most important motivational factors in learning and development

Interest is conceptualized as a relational construct between a person and an object. An interest represents a more or less enduring specific relationship between a person and an object of interest in her or his life-space (Krapp, Hidi, Renninger (1992): *Interest, Learning and Development*)

James Wertsch (1998) in *Mind as Action* distinguishes between mastery and appropriation of a cultural tool. Interest as a powerful mediator between mastery and appropriation?



Students' interest in science



Die IPN-Interessestudien Physik The Relevance of Science Education

Focus on lower secondary school based on the assumption that students have developed relatively stable individual interest profiles during lower secondary school

Focus on students' interests in domains that belong to academically defined curricula with focus on a single subject, for instance physics or mathematics



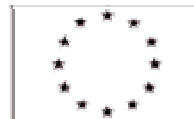


- Interesse og fagoverskridende undervisning i naturvidenskab
- Interesse und fächerübergreifender Unterricht in den Naturwissenschaften

PARTNERS:

- IPN – Institute for science education
- University of Southern Denmark
- CVU Sønderjylland (Teacher college)
- 6 upper secondary schools in the Region of Southern Denmark and Schleswig-Holstein in Germany
- Companies

INTERREG III A



FYNSAMT • K.E.R.N.
Sønderjyllands Amt - Schleswig



The IFUN-project

Focus on upper secondary education – expansion of previous interest research

Focus on the interplay between the subjects of mathematics, physics, chemistry and biology – relations between mathematics and the subjects of natural science

Focus on the subjects in interdisciplinary settings – cultural, historic, societal and application aspects of the subjects

Analysis and action





The interdisciplinary perspective

- **Active and student-centered activities centered on applications of mathematics and science in real world settings as a way to facilitate increased interests in the subjects – application is interdisciplinary**
- **Prepare future citizen for future life:**
 - Physicist, biologists, economists etc. are involved in the study of complex systems – a proper image of the current activities of mathematics and science is interdisciplinary
 - Competencies to cope with our complex world – some specific competencies can be acquired better in interdisciplinary domains of mathematics and science than in others
- **The 2005 reform of the Danish Gymnasium**
 - Emphasis on an interaction between subjects (qualifications and competences as opposed to subjects)



Research questions

Which variables influence the development and promotion of upper secondary students' interest in interdisciplinary domains of mathematics and science?

Which curricular and instructional methods help promote upper secondary students' interest in interdisciplinary domains of mathematics and science?

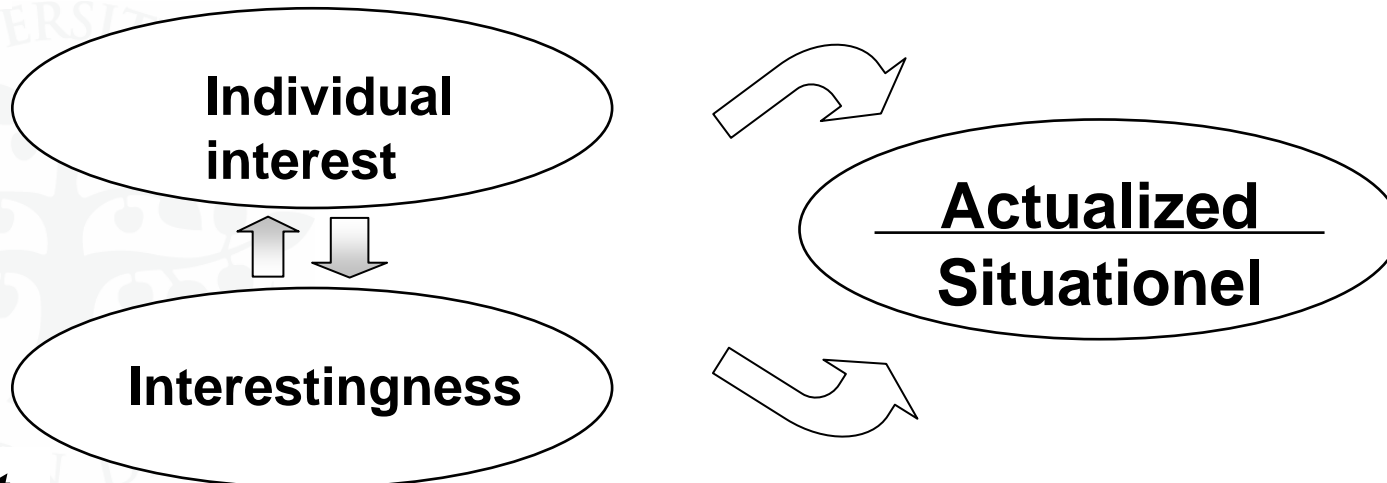




Individual and situational interest

- (1) interest as a characteristic of the person (individual interest)
- (2) interest as a characteristic of the learning environment (interestingness)
- (3) interest as a psychological state (actualized individual interest/situational interest)

Person



Context



From situational to individual interest

- **The conceptual differentiation between situational and individual interests entails a focus on the process by which externally stimulated situational interest is stabilized and maintained and finally becomes integrated into a person's self as a individual interest**

- **Situational interest is multifaceted**
 1. Catch: First occurrence of situational interest
 2. Hold: Stable situational interest
 3. Individual interest



Framework: 3 dimensions

Content context: The student's interest in a particular interdisciplinary domain of science and mathematics

Learning setting: The characteristics of a specific learning setting that causes a situational interest in the topic and promote and support a shift from catching interest to holding interest

Identity: The student's affiliation with and valuation of mathematics and science



IFUN – two phases

- **The first phase of the study is designed to provide a stimulus for interesting interdisciplinary instruction in mathematics and science. The aim of this is to give empirical evidence on what interdisciplinary topics students are interested in learning about**

- **In the second phase an intervention project will be initiated based on the insight gained in the first phase. The intention is to develop, implement and evaluate a didactic concept for interdisciplinary instructional units in mathematics and science**



Research approach

Interactive research and design – a syncretic combination of research, development, and practice (Greeno 1998)

Phase 1: Self-reports from students

- A 143-item questionnaire that takes up one class period is given to 500 grade 11 students from Danish upper secondary school
- Interviews of 15 grade 11 students from Danish upper secondary school

Phase 2: Design of interest based learning environments

- Seminars where researchers and teachers collaborate to produce meaningful change in the classroom practice
- Design and implementation of interdisciplinary instructional sequences in six German and Danish grade 10/11 classes
- Empirical evidence by a two questionnaires (pre and post) and videostudy



IFUN questionnaire

143-items address seven main domains

- 1. Science and mathematics in basic school (Folkeskolen) and general upper secondary school (Gymnasium)**
- 2. The individual student's learning style**
- 3. The subjects physics, mathematics, chemistry and biology**
- 4. Making instruction in mathematics and science more interesting**
- 5. Justifications for physics, mathematics, chemistry and biology in upper secondary education**
- 6. Mathematics and science outside school**
- 7. Mathematics, science and the individual student's future**



Tendencies, questionnaire (N =75)

- Mathematics is among the three most interesting and important subjects at lower and upper secondary school
- Interest in mathematics does not change from lower to upper secondary school
- Interest in physics and chemistry does change from lower to upper secondary school. Physics is either interesting or not interesting!
- There is no significant change in general interest in mathematics and science from lower to upper secondary school



Tendencies, questionnaire (N =75)

Did your interest for physics change during the last two months (if yes how and why):

- *I am more interested now because I understand physics better*
- *We got a new teacher in physics, and now I am more interested*





Tendencies, questionnaire (N =75)

- The subjects – especially mathematics – are relevant for the students
- The subjects – especially biology – have impact on the students view of the future of the globe
- An overwhelming majority of the students thinks that their interest in mathematics and science will increase if interdisciplinary domains associated with the applied, environmental, technological, career opportunities and socio-scientific content is included in the teaching of the subjects
- Use of modern technology in teaching mathematics and science does not have a significant impact on the students' interests
- There is not a significant number of students who thinks that the justification for mathematics and science in the educational system is the importance for the Danish competitive capacity



Tendencies, questionnaire (N =75)

- An overwhelming majority of the students do not have leisure activities related to mathematics and science
- There is not a significant number of students who thinks that the subjects develop creativity
- A significant number of students find that it is important for their learning of a topic to practice application through exercises and laboratory work
- The importance of mathematics and science for the students' future is related to career
- Several students hope that mathematics and science will contribute to a better future, e.g. by developing a cure for AIDS



Tendencies, interviews (N = 5)

Mathematics is important for tertiary education

I cannot give an example of a profession where mathematics is important – in a bank maybe!!

I am not interested in physics. Our teacher writes a lot of silly and unintelligible symbols on the blackboard

I often discuss mathematics and science with my brother/sister, who is a grade 13 student

Real interdisciplinary instruction in mathematics and physics is a rarity, and I think it a pity





IFUN Status

Phase 1 terminates in April 2006 – analysis of questionnaires is published

Phase 2 is initiated in April with a seminar for researchers, teachers and representatives from companies. Planning of intervention in 2006/07 – 6-8 interdisciplinary instruction sequences. Framework – Svein Sjøberg's 3 dimensions for science and mathematics education (i) The products of science (ii) The processes of science (iii) The role of science in society