Background, Framework and Purpose

Sweden has experienced a downward trend during the last decade for what concerns the results on international assessments in Science Education, for instance at TIMSS Advanced 2008 and PISA during the period of 2000-2006. This trend was also confirmed on PISA 2009 (Skolverket, 2010) where the Swedish students obtained a significantly lower score than in the 2006 measurement. On a general level, different reasons for the decline are suggested, such as the decentralization of the educational system in the mid 1990's, changes of teaching methods towards more individual classroom work or tendencies of increased differentiation within schools for homogenous teaching groups in terms of performance (Skolverket, 2010, p. 132). However, a concern to analyze and understand the decreasing trend in science resulted in the approval of research funds from the Swedish Research Council to the research project *Perspectives on large scale studies* (PELS) in 2009. The aim of the project is to conduct quantitative and qualitative re-analyses on the existing data and to collect alternative or new data related to the studies. As an example of alternative data, we will in this paper, focus on a situation where students are engaged in solving PISA items.

According to OECD, the major objective of PISA is to assess knowledge and skills "deemed to be essential for future life" (OECD, 2006, p. 11). However, it is important to keep in mind that the conclusions about to what extent the students actually succeed to reach this aim derived from their individual answers on specific items, in form of written statements, in a rather artificial test situation, separated from the ordinary educational situation in the science classroom. The question is, to what extent the data from these kind of situations actually may represent the students' knowledge in and about science needed for future life? Additionally, most PISA items consist of multiple choice questions or open questions in which the answers given usually are extremely short in form of 2-3 words or half sentences. One example of this is the item where, "toxic emissions" might be the answer to the question "From where do the sulphur oxides and the nitrogen oxides of the air originate?". The question is how such imprints actually may describe the students' knowledge in chemistry or what kind of considerations has lead to this answer?

In order to increase the possibility to interpret and understand PISA results, we argue, further investigation must be conducted in regard of how 15-year old students in Sweden engage in and understand this type of questions that are posed in PISA. The aim of our current research is therefore to explicate the problem solving situation, the difficulties and opportunities the students confront within the context of PISA tests. One way to approach students' experiences of PISA and the items is to observe how they solve the problems when having the opportunity to work collaboratively in small groups. Through the students' conversations we can observe how they engage in and talk about the items and problems they are asked to solve. In this way the conversations between the students becomes explicit reflections of their understanding of the scientific content, but also reflections of their interaction with the context provided by the items, as well as with the wording and the format of the test. An important point here is that the main aim is *not* to assess the students as individuals but instead to focus on *how* the students interact with the items. The purpose of this approach is to explore how students understand, engage in, make meaning of, reason and find an answer to items and to discuss the validity of PISA tests and other large scale studies.

Rationale

The main rationale of this study is the will to increase the understanding of the results from large scale studies such as PISA through departing from a sociocultural understanding on action and knowledge. In this approach human knowledge is seen as socially construed and should be not be regarded as a individual property but rather as an human action; the action of

knowing (Wells, 1999). This idea has important implications on what is possible to study, as is not the knowledge *within* the persons observed, but rather the knowing they *express or not express in action* that are in focus. Knowing and human mental processes are in this way seen as *situated* within cultural, historical, social and institutional settings (Säljö, 2000) and the outcome of the tests is also determined by the context. According to Vygotsky (1978) knowing means to master different tools and signs offered or needed in a specific situation. In an assessment situation, it may for example be the mastery of symbols and words of the scientific language, how to read a diagram or how to search relevant information on the Internet. As suggested by Roth (1998, p. 166) results on tests can, in this view, be regarded as a *situated achievement* rather than the outcome of stable structures and specific problem solving skills.

In this perspective it has also been suggested that the development of new media has new and important implications on how humans act in and experience the environment (Jenkins, 2006). For a young generation, participating cultures on the Internet and the opportunity of "googling" needed facts, are changing the standards for *what and how* knowledge is acquired (Selander, 2008). He argues that "it seems obvious that our current society is in a stage of change that requires a new understanding of knowledge, learning and identity formation". In our study, some students have been given access to a computer in order to observe how this tool may mediate actions and construe knowledge in this particular setting.

Research Questions in this study is:
How do students engage in and talk about PISA items and tests when they have the opportunity to work collaboratively in small groups? How do the students master symbols and words presented in PISA items and how do they make meaning of them?

Method
In total, 71 Swedish 9th graders from a compulsory school, divided into 21 groups of 2-4 students, participated in our study. All work was audio- and video recorded and the material totally consists of 16 hours of group discussions about PISA items. Six groups had access to a computer, connected to Internet, while completing the task with the purpose to study if the students were capable of searching for clues that could lead them to an answer. In all, the students answered eleven questions from three released PISA items (Acid Rain [S485], Green House Effect [S114] and Sunscreen [S447]). The groups were asked to have a "think aloud" discussion about how they could solve the problems and then to agree on one common written answer per group. The written responses were also collected and represent the contextual data for the analysis of the students' interactions.

In the phase of the preliminary analysis, the purpose has been to describe how the students interact vis-à-vis the PISA items and what the written answers may represent in relation to this interaction. In the analysis, the data material is scanned for *critical incidents* (Jakobsson, 2001) regarding the research questions, situations of *exploratory talk* (Barnes, 1998), *gaps of interaction* (Wickman, 2004) and situations of *resistance* (Wertsch, 1998). These kinds of situations have been transcribed, analyzed and categorized. However, further analyzes will be conducted in order to increase the validity of the study and to expand the conclusions from the study. For example, the students' use of computers still remains to be analyzed.

Results
The preliminary results concern the following aspects of the PISA test: *sense-making of items, translation mistakes, wording/formulations* and *engagement/motivation.*

***Sense-making of items*:** An example of this is the subtitle of the item Green House Effect: "Fact or myth?" This question was actually not a part of the assessment. Simultaneously,

several students used considerable time to examine the text, evaluating whether the content was related to facts or myths. In this way, they lost almost ten minutes of valuable testing time.

***Translation mistakes*:** Many students stacked to several Swedish translations which were either identified as incorrect or uncommon in Swedish.

***Wording/Formulations*:** The mastery of words and symbols in the test was crucial for getting the point of the items posed, to be able to discuss, solve and to find an answer. The definition and meaning of scientific concepts and words, as for example "factor", "reference" and "substance", caused troubles for many of the students. Also formulations like "Denote such a factor as designated by Jenny" (S114Q04) or "Suggest another way of reducing the effects of sunburn of the skin that researchers should investigate" (S447Q06) met great resistance from the students, who often reacted by mocking or rejecting any effort to discuss or to find an answer to the question.

***Engagement/Motivation*:** In some of the conversations the students expressed an obvious lack of interest, motivation or relevance of engaging in the problem solving activity. Explicit examples of this could be situations where the students use the ironic and common Swedish youth expression "orka" (literally meaning *have the energy to*) which may be interpreted as "who cares?" or "who wants to be engaged?". Further analyses will be conducted in order to understand the relation between the motivation and the scientific context.

Conclusions and implications so far

To explore and analyze how groups of students understand, engage in, make meaning of, negotiate, discuss, conclude and find answers on PISA items have led to conclusions to question the relevance of and the language used in some PISA tasks. Additionally, some implications directed to the PISA community will be addressed concerning translation and the use of "real life or future contexts". The results also may have important implications regarding the interpretation on the national level of the PISA test. Our result also clearly indicates that the students' written answers not only reflect their scientific knowledge, competencies and skills. Their answers also seem to be affected by attitudes towards science as it is presented in PISA items, by the lack of familiarity with uncommon words and expressions used in the test, by translation mistakes and by a lack of intersubjectivity between the students and the constructer of the test concerning what counts as important or the meaning of an item.

Bibliography

Barnes, D. (2008). Exploratory talk for learning. In N. Mercer & S. Hodgkinson (Eds.), Exploring Talk in School. (pp. 1-15). London: Sage Publications Ltd.

Jakobsson, A. (2001). Elevers interaktiva lärande vid problemlösning i grupp [Students interactive learning in problem solving]. Thesis from School of teacher education, University College of Malmö, Sweden.

Jenkins. H. (2006). Culture convergence: Where old and new media collide. Cambridge, US: MIT Press.

OECD. (2006). Assessing scientific, reading and mathematical literacy. A framework for PISA 2006.

Roth, W-M. (1998). Situated cognition and assessment of competence in science. Evaluation and Programming Planning, 21, 155-169.

Säljö, R. (2000). Lärande I praktiken: Ett sociokulturellt perspektiv. Stockholm: Prisma.

Selander, S. (2008). Designs for learning and the formation and transformation of knowledge in an era of globalization. Studies of Philosophy and Education, 27(4), 267-283.

Skolverket (2010). Rustad att möta framtiden? PISA 2009 om 15-åringars läsförståelse och kunskaper i matematik och naturvetenskap.[Swedish National Report on PISA 2009]. Stockolm.

Vygotsky, L.S. (1978). Mind in society: the development of higher psychological processes. Cambridge, Mass.: Harvard U.P.

Wells, G. (1999). Dialogic Inquiry. New York: Cambridge University Press.

Wertsch, J.V. (1998). Mind as action. New York: Oxford University Press.

Wickman, P.O. (2004). The practical epistemologies of the classroom: a study of laboratory work. Science Education. 88, 325-344.