
STUDENTS' POSITIONS IN PHYSICS EDUCATION. A GENDERED PERSPECTIVE

Gertraud Benke, Helga Stadler
IFF, Wien, Universität Wien

ABSTRACT

In this paper we present first findings from a study on gender differences in physics education based on a questionnaire addressing four different areas: 1. Attitude and interest, 2. Epistemology, 3. Knowledge of basic physics, 4. Awareness of gender differences in physics. We discuss the interplay of interest, epistemological stances, ways of conceiving physics and gender. Contrary to our expectations, we did not find clear relations between gender and epistemological stances as well as between gender and conceiving physics. Instead we found class effects (self-selection in tracks), and answers on open-ended questions hint at an intricate relationship between understanding and (gendered) interest patterns.

1. PROBLEM STATEMENTS

Girls are only moderately interested in physics. This is repeatedly found not only in studies asking for students' interests (e.g. Hoffman et al. 1998) but is also reflected in students' choice of college program as well as their later profession. Studies show that girls and women lack self-esteem with respect to physics in comparison with their male peers. On top of that they show a poorer performance in physics assessments (TIMSS Studies, Stadler, 1999).

In our previous research (Stadler, Benke, Duit, 2001; Stadler, Duit, Benke, 2000), we developed the hypothesis that (most) girls and (most) boys approach physics differently, that they employ different comprehension strategies. Boys tend to believe that they understand something, if they can position the new "concept" within their overall understanding of physics, i.e. relate it to other (physical) concepts. In contrast, girls try to understand physical notions relating them back to elements and configurations of elements in everyday life.

In our present research, we include additional student properties, and try to map out the relation of these properties to gender and the overall contribution of these factors for engagement in and understanding of physics. Thus, we raise the following general question:

How does an individual's identity influence their participation in school physics? In this, we see the following aspects as crucial elements of an individuals' identity construction. (In attribution theory terms, these three aspects address stable intrinsic properties of a person which co-determine their actual behavior):

- A person's relation to knowledge (the epistemological stance, as originally put forward by Belenky et al. 1986) – this describes the level of empowerment in dealing with given information – may I question it, do I have to accept it, etc. An important part of a person's relation to knowledge is also determined by the person's conception of knowledge (i.e. what constitutes "proper" knowledge in physics).
 - A person's self-perception of interests. In our research, again and again we found students expressing a relation between "understanding" something and being interested in something. If they cannot "figure it out" (being active/empowered), they state they lose their interest. In other words, we see "interest" as a comprehensive category capturing "motivation".
 - A person's gender identity (and the relation to the perceived gender roles). In that, we are guided by concrete interactions and conversations with girls in addition to several accounts in the literature on gender differences (e.g. Boaler, 1997). Based on these accounts, we expect that girls and boys differ with respect to their consciously expressed description of what it means to understand something (in physics). Furthermore, we hypothesize that their notion of understanding will have implications for their engagement in and with physics.
- Using this framework, we are addressing the following concrete research questions:
- What is the distribution of epistemological stances, ways of conceiving of physics, self-perception of interests, and the perception of gendered interests for the classes analyzed?
 - Do we find gender differences in these areas?
 - Is there a relation between interest in physics and epistemological stances?

Study design

Questionnaire, interview, and video-data were collected in three classes of high-school students (age 15/16) taking their first year of advanced physics. Our results are predominantly based on the analysis of (two sets of) 48 questionnaires administered in the three classes (with a total of 25 boys and 23 girls). The classes differed in their natural science orientation: two classes were from a humanities tracked program, one from a natural science tracked program. The questionnaires were distributed before and after a unit on the earth's movement. The unit itself was videotaped, and will be analyzed in further research. Additionally, one month after the unit in-depth-interviews were done with a small number of the students.

The questionnaire poses questions in four different areas: 1. Students' interests and attitude towards physics, 2. students' knowledge of gravitation (which allows us to discern their use of argumentative patterns in physics), 3. students' epistemological position, and 4. students' perception of gender differences with respect to physics.

The majority of questions were open ended; a subsection of questions concerning students' interest and gender stereotypes contained rating scales. The questionnaires were handed out by the physics teacher as a homework assignment. Answers were overall surprisingly detailed.

For further analysis, answers were read carefully, clustered into categories derived from the data (Strauss, 1987), and subjected to descriptive statistics.

2. RESULTS

In the following, we will discuss our findings concerning students' interests, students' implicit self-positioning with respect to knowledge, students' ways of thinking about physics and interactions between these areas for both girls and boys.

Students' Interests

In the questionnaire, students were asked to name up to three of their favorite and of their least favored subjects. For each of the subjects, we calculated the overall frequency (of being liked and being disliked), and looked at affinities between subjects. We then clustered the natural sciences (physics, chemistry – but not biology, which seems to be a category of its own) and mathematics, and compared the frequency over all classes with interest in the language arts. We found the frequently reported gender breakdown with girl preferring language arts, and boys opting for natural sciences. However, when looking at each class individually, girls in the science track tended to be overall more interested in mathematics and science than the boys. Girls in the humanities track on the other hand were more interested in language arts than the boys of their classes and the boys overall.

Besides asking students to name subjects, we also asked them to rate their own as well as boys and girls general interest in particular topics in physics (“How to construct a car”, “to understand how glasses work” etc.). In our analysis, we compared for each class the (average) interest girls/boys professed for themselves in the particular topic with the interest that was attributed to girls/boys by their own and the other (gender) group. Utilizing t-tests (based on the whole population, calculated separately for each topic), we found that both boys and girl exaggerate the actually existing differences: Boys believe girls overall to be less interested in the various topics than they (girls) actually are, and girls believe boys to be more interested than they (boys) are. Overall, the difference between the (actually expressed) interests of girls and boys is significantly smaller (frequently there is no statistically significant difference between the actual interests of boys and girls) than the difference attributed to the genders by either gender (that is the difference girls (boys) attribute to “the interest of girls in general” and “boys in general”). Frequency tabulations for each of the classes are congruent with the general picture.

Students' self-positioning with respect to knowing and knowledge

To determine students' epistemological attitudes, we asked the following questions (among others):

1. How do you know whether something is true or not [post test addition: “in physics”]?
2. Are all opinions [post test: “in physics”] equally good, or are some answers better than others?
3. Based on Belenky et al.'s (1996) typology, we categorized the answers into the following types:

Science Education Research in the Knowledge-Based
Society

Psillos, D.; Kariotoglou, P.; Tselfes, V.; Hatzikraniotis, E.;
Fassoulopoulos, G.; Kallery, M. (Eds.)

2003, XI, 481 p., Hardcover

ISBN: 978-1-4020-1412-3