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Oral session F

Hyper-constructivism in teaching physics: Defining social competences

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Abstract

The European Union standardized university teaching by introducing so called European Credits Transfer System, that define clear requirements in curricula: knowledge, abilities and social competences. Universities (and also schools) try to “mimic” these requirements, by fuzzy-expression like “student knows”, “student is able”. This approach is deleterious: social competence could be a lever to make physics – useful and interesting. Following these requirements substantial change in teaching is needed: from what the *lecturer finds* important to what is necessary for students, as *social competences*. This should increase *usefulness* of Physics as a tool and method for professional lives.

Didactics of Physics made recently a significant step forward: in raising the self-consistence of physical concepts [1], in including feedbacks between contents and didactics [2], in relating mathematical formula to the external world [3], and in introducing constructivist approach into teaching [4]. In the same time EU and OECD educational requirements continue to change. The recent OECD system for university teaching (AHELO) monitors: - critical thinking, - analytical reasoning, - problem-solving, - written communication. Physics would be a model science to fulfill these requirements – a kind of *forma mentis*. But then pupils say that physics is difficult, not-involving, too much formal. Educated persons, appreciating astronomy, mathematics, biology, refrain from physics. How to add, to excellent *input* promises of physics methodology also the *successful* output for professional carriers? Defining possible social competences, gained with learning physics is necessary. This competence must go beyond the banal: “student understands the importance of physics for everyday life”.

We present results based on two, blended methodologies: neo-realism and hyper-constructivism [5]. The hyper-constructivist recipe [6] stays in constructing pupils’ knowledge by the teacher, but *discussing*, not rejecting their previous knowledge. Pupils must be convinced, by the executed line of collective reasoning and by the ad-hoc experiments, that their pre-thinking was wrong (if it were wrong, obviously). Example of such reasoning on concepts of energy and gravitation were given before [6]. Here we concentrate on social competences that are developed, to some extent, as by-products of hyper-constructivist lessons. We give examples of hyper-constructivist reasoning on acoustics, optics, and electrostatics.

Social competences, that can be developed, include: - interdisciplinary professional capacities, - assuring pupils in their own experimental abilities, - teaching how to formulate *important* questions, - and indicating *approximate* solutions. In electrostatics, concepts of voltage, current and power do not require mathematical definitions, as pupils find them written on electrodomestic appliances in any German supermarket. A social competence can be, double-folded: - the total power consumption must be calculated before the use of appliances; - electrostatic voltages are risky for electronic equipment. Interdisciplinary links include the electrical field vector as gradient of the potential, the voltage identical to equal-height contour lines in geography, that correspond also to the shape of so called geoid [7]. Atomic levels in helium and in so-called energy-saving lamps introduce subjects of perception of colors and aesthetics, in general. Mechanics, with toy carts sliding along Galileo’s plane is an ideal introduction to procedures of planning experiments. Toys flutes, with three overtones depending on the power of blowing air, introduce the subject of sound perception. More examples will be given at GIREP Congress.

Keywords

hyper-constructivism, social competences, didactic of physics

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Professionalization through practical training. Application of pedagogical content knowledge within the physics-teaching-learning lab of the University Wuerzburg

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Abstract

During the last decade the need and the demand for more practical training during the pre-service teacher education became more and more important topics in Germany. The University of Wuerzburg tried to improve the science pre-service teacher education and to increase the practical training by founding the Mind Centre in 2009. Heart of the Mind Centre is the teaching-learning-labs (TLL) where the possibility of connecting school, pre-service teacher education and research is realised.

The TLL-seminar is obligatory placed in the schedule at the sixth term. It is divided in a preparation period and a practical training. During the preparation period the pre-service teachers set up different experimental stations with materials for a certain curriculum-applied physics unit (e.g. optics, energy). Beside the pre-service teachers plan the supervision of students at their experimental stations. Following this, there occur three to four implementations with a couple of school-classes, visiting the lab at different times. Subsequent to every implementation the pre-service teachers get feedback from the peer-group and experienced experts. So the pre-service teachers get the chance to change and enhance their stations before the next implementation.

The professional teaching competence is a good predictor for student performance and can't be imparted enough during teacher education. Besides content knowledge (CK) and pedagogical knowledge (PK), the PCK is one of the three dimensions of the professional teaching competence. As Shulman (1987) and Magnusson (1999) mentioned, PCK is the knowledge that helps teachers to structure, to explain, to describe and to link scientific contents. These abilities are the differences between an expert and a teacher. Neumann and Kröger (2013) tried to invent a model to further examine the PCK by using Magnusson's description. Their model contains three dimensions: the physics content, the state of knowledge and the PCK-facets. The four PCK-facets again are divided into assessment, instructional strategies, curriculum and student cognitions.

Object of the examination is the application of pedagogical content knowledge (PCK). At first we like to know, if the PCK of the pre-service teachers increases due to the TLL-seminar. In addition the survey focuses on the knowledge pre-service teachers use while creating their experimental stations and the implementation with school-classes.

A mixed-method-approach is used to survey the application of PCK. The quantitative part is based on the project KiL by the IPN Kiel and the DIAGNOSER project by the National Science Foundation and the University Washington. The qualitative part enables us to get more information about the pre-service teacher's basics they use to set up their experimental stations and the implementation, so they have to keep a journal.

In the presentation the examination set up and the results of the first elicitation will be presented.

Keywords

pre-service teacher education, pedagogical-content knowledge, teaching-learning-lab, out-of-school-lab

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