Waiting for physics? An inquiry into first year physics students' experience of a traditionel science curriculum.

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Waiting for physic? An inquiry into first year physics students' experience of a traditional science curriculum.

How can we help more students to reach a higher level of outcome in our science bachelor's programmes? This is a basic question in educational development and one obvious place to look for answers is with the students who leave. Currently, the most thorough inquiry into why undergraduates leave the sciences at tertiary level convincingly concludes that the most prominent difference between students who stay and students who leave is their initial interest in science (Seymour and Hewitt 1997). Students who stay are often *intrinsically* interested by the subject and conversely, students who leave, are often *extrinsically* interested (*ibid.)*. However, it is still an area for research how studying affects students' motivation and vice versa.

A study of attrition at a research-intensive Swedish university by Johannsen *et al.* (2009) concludes that two types of introvert discourses dominate students' explanations for leaving physics prematurely. Several studies indicate (e.g. Illeris *et al.* 2002) that students in the post-modern Scandinavian welfare societies tend to look for explanations for their educational choices and approaches *within themselves* rather than at the systemic level. This could be the background for the two types of introvert discourses of attrition: 'It just happened that way' and 'Not good enough'. Neither discourses address the explanation to the systemic level: There is no reference to the educational context, like e.g. curriculum structure and teaching methods. These results represent a challenge to educational research: Direct inquiry with students does not seem to provide suggestions for feasible solutions at the systemic level.

We have conducted a longitudinal study with 26 students enrolled in the bachelor's programme in physics at a large Scandinavian research university. The research question was: What meaning do the students ascribe to the study when deciding to stay or leave? A questionnaire was sent to all students enrolled in the Bachelor of Physics programme before their first encounter with the programme. Of 86 students, 64 students answered the questionnaire and from these a representative sample of 26 students was chosen for the interview study. The students were interviewed at least twice during their first year. 15 students were selected for more intensive inquiry and were interviewed more frequently, up to 7 times. Interviews were semi-structured. Themes were extracted and further inquired during the process.

Like Seymour and Hewitt (1997), we find that the students who are most continuously confident in their choice of education are the intrinsically motivated students. Even so, these students have a hard time dealing with their studies. They experience a conflict between their interests and motivation and the actual curriculum as reflected in teaching and programme structure. They experience a curriculum overload and hence a pressure for applying surface approaches, that they do not feel comfortable with. The following excerpt with a well-achieving student exemplifies this:

> '*I let myself fail the exam. […] I thought it was among the most exiting subjects so far, and when I feel like that about something, then it's just a pity only scratching the surface. […]But I don't think it's supposed to be like that. From their perspective I don't think the re-exam is supposed to be used as an… opportunity for immersion. […]When I do, it feels like I am giving up.*
> *[…]*
> *I know that I really want this [physics]. And if I do, why is it that I do not get the reading done, the work done and so on?'*

Parallel to Johannsen *et al.* (2009) we see a tendency to introvert discourse: Although the student do consider the curriculum at the systemic level, the perspective is still that of the individual: The student feels he/she should be able to deal with the curriculum as it is, and do not challenge e.g. the

teaching methods. The student experience a conflict between his intrinsic interest in physics and the physics he experiences in text books, assignments, and classroom. He has rather vague ideas about the kind of physics which motivates him, but he has experienced glimpses of it, and his main motivation for keeping up with his studies in spite of frustrations is an acceptance that he needs a certain level of insight before he can experience the 'real' physics. We propose that the idea of *didactical transpositions* (Chevallard 1999) can be used as a fruitful perspective of analysis here.

Chevallard propose to see physics research as a form of human practice, including ways of handling things, and justifications in the form of theory. Likewise for the students' expected work in their studies. However, physics as research and physics as it is carried out in the classroom are two very different forms of human practice. Thus, in order for 'research physics' to be taught, it must be *transposed* into 'physics to be taught'. 'Physics to be taught' is given by the curriculum in general: Textbooks, assignments, teaching methods, learning goals etc. In light of this perspective, one source of the frustration, that the students experience, can be ascribed to the experience that the 'physics taught' is too far from their ideas of physics.

As the idea of didactical transpositions implies, 'physics taught' is necessarily different from 'research physics', and the students' ideas about 'research physics', which drive their motivation for studying, may be more or less in line with actual practices in physics research. We suggest that there is never the less room for improvement in the curriculum structure.

There are basically two problems to be dealt with: Curriculum overload and traditional curriculum structure. The traditional curriculum structure is described anecdotally by physicists as first 400 years old physics, then 300 years old, and so fourth, until eventually after 4 years you finally experience real physics. This requires a form of 'deferred gratification', which seems to be a problem for a large group of students – of whom some learn to deal with it, others do not. Inspiration for solutions could be found in research of engineering education, where these kinds of curriculum problems have been dealt with during the past 10 years.

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