

## WHY CHOOSE PHYSICS – IN NORWAY AND FINLAND ?

**Ellen K. Henriksen, Carl Angell**

*Department of Physics, University of Oslo, Norway*

**Jari Lavonen**

*Department of Teacher Education, University of Helsinki, Finland*

**Anders Isnes**

*Department of Teacher Education and School Development, University of Oslo, Norway*

**Abstract.** Questionnaire data from Norway and Finland were compared to explore the factors that influence upper secondary school students' choice of subjects (notably physics). Results indicate that personal and emotional factors (interest, abilities), but also practical factors (entrance requirements, usefulness) are keywords for students' choice. Although both Finnish and Norwegian students claim to base their educational choice mainly on personal interest and ability, there is a tendency for Norwegians to be relatively more influenced by background and Finns to be more influenced by the educational system (teachers, entrance requirements). These differences are discussed in light of educational policy and sociological theory.

**Key words:** school physics, educational choices, educational policy.

### Introduction

Many western countries experience a decline in student numbers within science and technology in general and physics in particular (Jorgensen, 1998; Institute of Physics, 2001). To improve recruitment, it is essential to understand young people's reasons for their educational choices. Predictors for the choice of physics have been shown to include perceived future relevance, interest, achievement, gender etc., and for female students also perceived difficulty and appreciation (Stokking, 2000; Trusty, 2002).

Norway and Finland are two Nordic countries with many similarities but also differences. A key concern in Finnish educational policy during recent years has been raising the level of scientific and mathematical competence (LUMA, 1999), and Finnish students performed remarkably well in the international assessment programme PISA (OECD, 2001; Välijärvi et al., 2002.). Finland also enjoys great success within research and high-technology industry. Norway, on the other hand, bases its economy primarily on export of raw materials (oil and fish), and although the recruitment problem in science and technology is discussed, a consistent policy to improve the situation has been lacking.

The aims of the present work were:

1. to explore the factors that influence students' choice of subjects in upper secondary school in Norway and in Finland
2. to compare the priorities of physics choosers with those of non-choosers and the priorities of boys with those of girls in both countries

### The methods of research

This study is part of two larger projects with almost 3000 participating students from Norway and Finland. More extensive results from the national projects are published elsewhere

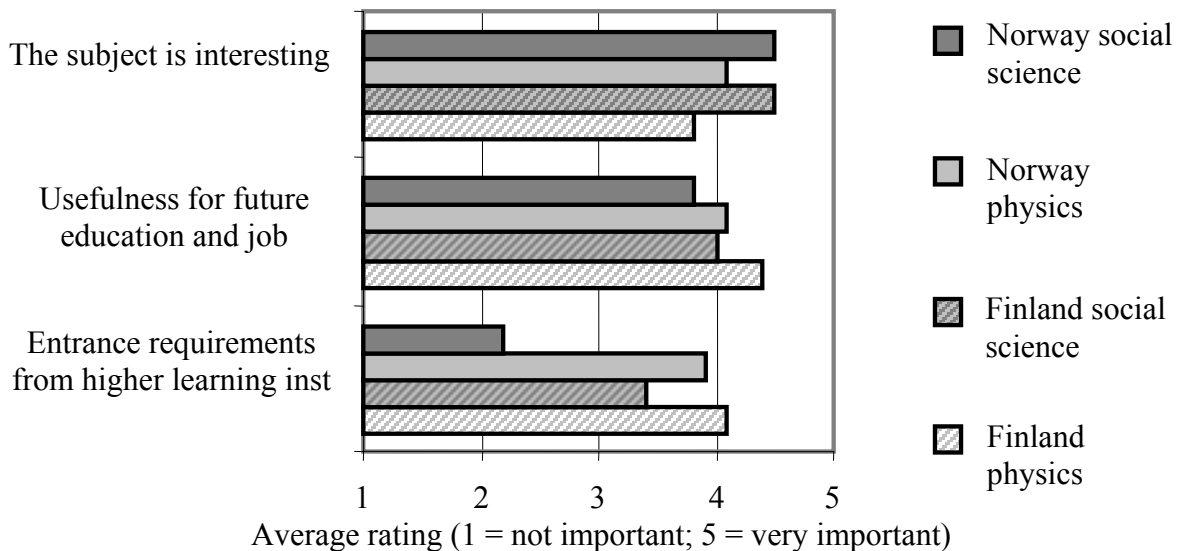
(Angell et al., 2001; Angell et al., 2003; Lavonen et al., 2003). Questionnaires were administered to random samples of students (age 17-18) in their second year of upper secondary school in both countries. In the present study, we consider only the students who have chosen physics or social science, respectively, as their most important subject of specialisation (Table 1). The questions analysed here were closed with a 5-point Likert scale. All differences mentioned in the text are significant to the 95 % level.

**Table 1. Information about respondents.**

Respondent group	Number of responses	Proportion of females (%)
Finnish physics students	398	15
Finnish social science students	444	65
Norwegian physics students	173	29
Norwegian social science students	134	66

### Results of the research

Students were asked to rate different arguments they might have had for choosing their most important subject of specialisation (physics or social science). Figure 1 shows students' rating of three different arguments for subject choice, split according to nation and subject. In both countries, social science students rate interest in the subject higher than do physics students, whereas physics students put relatively more emphasis on entrance requirements and usefulness for future profession and education. Physics is, to a greater extent than social science, a subject chosen for instrumental reasons (although interest is very important for physics choosers, too).

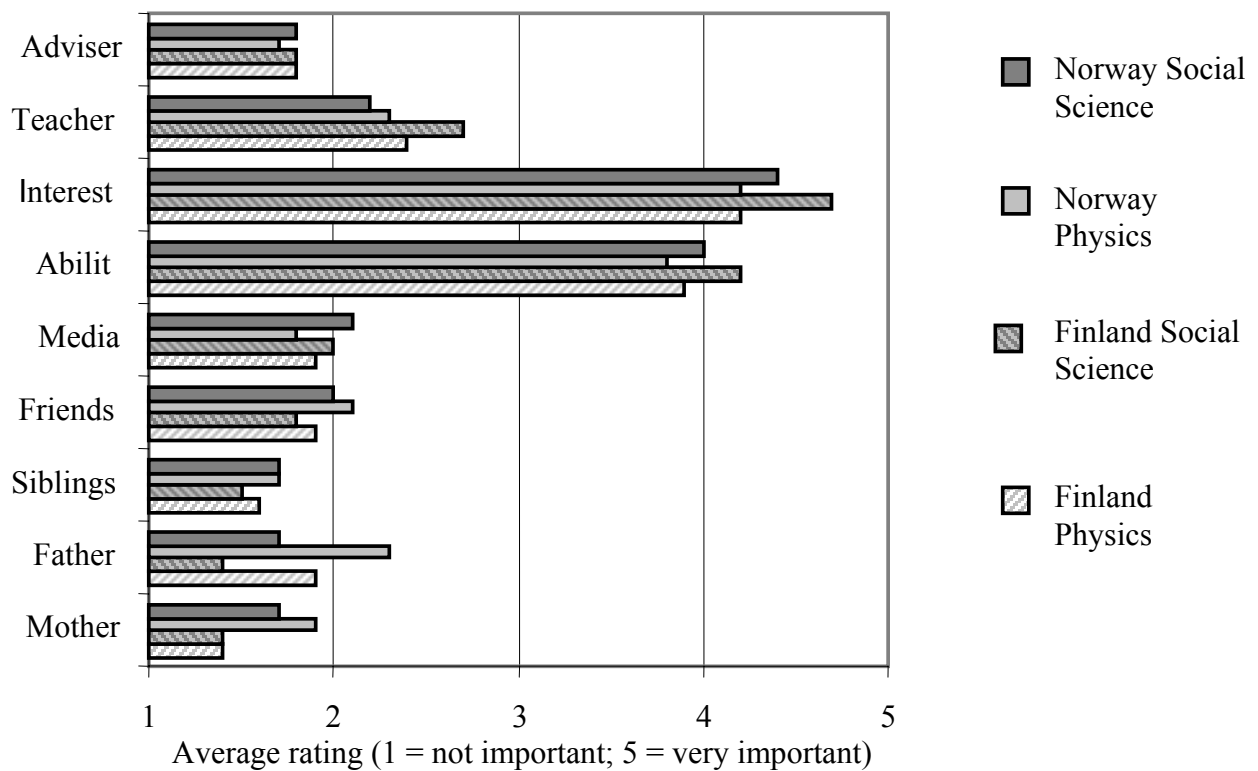


**Figure 1. Students' rating of arguments for subject choice.**

Finnish students in general put more emphasis on formal entrance requirements than Norwegians do. Gender differences are surprisingly small (in most cases insignificant) throughout our sample – students differ by subject choice rather than by gender or nationality.

A second question concerned which sources might, explicitly or implicitly, have influenced students' subject choice. Students in both countries and with both genders rate

personal interest and abilities very high, whereas parents, siblings, friends, teachers, advisers and mass media are all rated low (Figure 2).

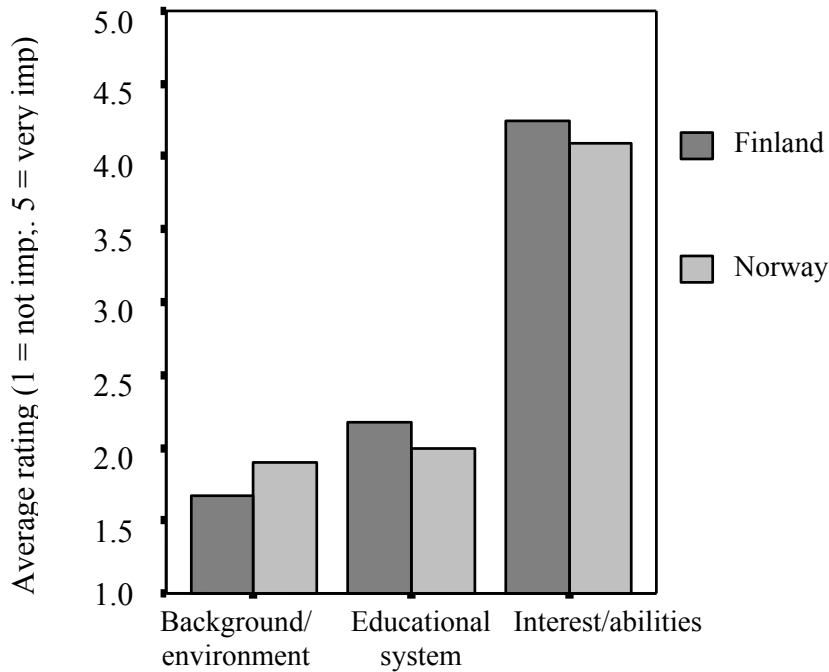


**Figure 2. Students' rating of various influence sources on subject choice.**

In both countries, social science students rate interests and abilities as stronger influence sources than do physics students. Norwegian students (particularly physics students) rate parents as a stronger influence than do the Finns, whereas Finnish students claim to be more strongly influenced by teachers in school.

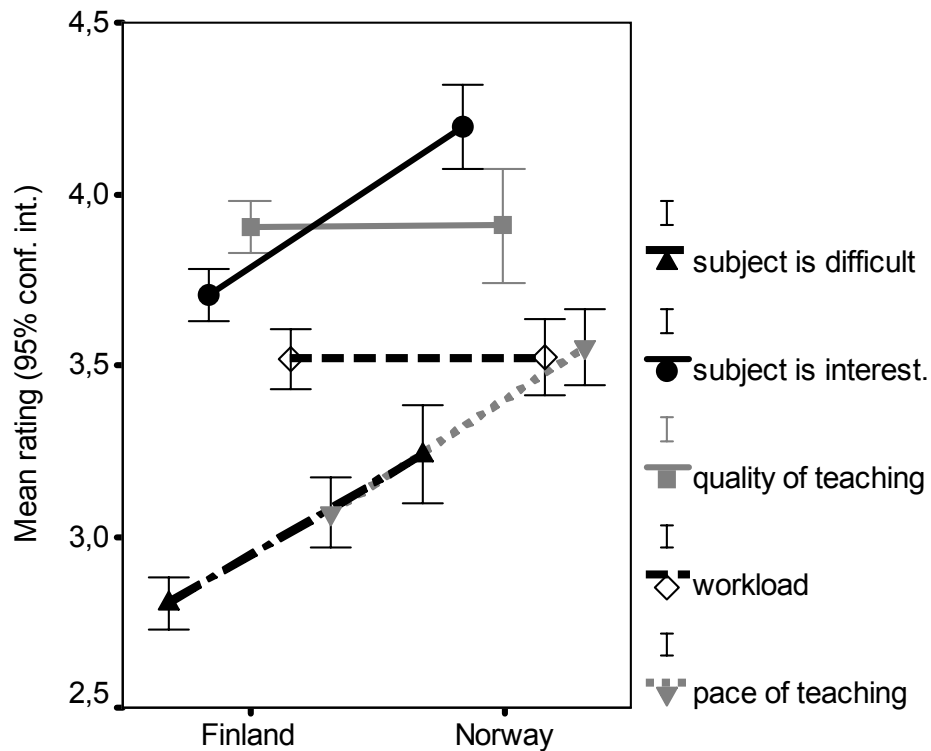
Factor analysis of the items presented in figure 2 yielded three factors. The first contained items related to students' socioeconomic background and influences from their environment: parents, siblings, friends and mass media (Cronbach alpha = 0.71). The second factor, consisting of the items "advisers" and "teachers", we term "Educational system" (Cronbach alpha = 0.53). The third factor is comprised by the items "interest" and "ability" (Cronbach alpha = 0.71). These three factors together accounted for 60 % of the total variance.

As the plot of these three factors in figure 3 shows, Norwegian students tend to be more influenced by their background and environment, whereas the Finns are more influenced by the school system as well as their personal interests and abilities. The relatively strong dependence of subject choice and performance on socioeconomic background in Norway has recently been commented on by several researchers (Turmo, 2003; Markussen, 2003). May we identify a tendency here pointing to stronger influence and guidance from the educational system in Finland, possibly related to that country's recent success within both school science and science and technology at large?



**Figure 3. Students' combined ratings of influence sources within the three factors "Background/ environment", "Educational system" and "Interest/abilities".**

We were also interested in how physics students experience their subject. Figure 4 shows that physics students in both countries find the quality of teaching high but the workload great. Norwegians, to a greater extent than Finns, find the subject interesting, the pace of teaching high and the subject difficult. Especially in Norway, the subject's (deserved) reputation of high workload and difficulty probably contributes to keeping the number of physics students down.



**Figure 4. Physics students' degree of agreement (on a 1-5 scale) with different statements about their physics course.**

## Conclusions and implications

Our results are largely in line with previous research (Stokking, 2000; Davenport et al., 1999) and indicate that personal/emotional factors (interest and abilities), but also practical/instrumental factors (entrance requirements, usefulness) are keywords for students' choice of subjects in upper secondary education. Especially Finnish students emphasise the usefulness of physics for future education and job or for entrance requirements. This might be an effect of educational policy, through counseling, and through advising students and parents. The demanding nature of the subject probably keeps student numbers down, particularly in Norway. Despite this, physics choosers are enthusiastic about the subject and the instruction.

Generally, students' responses are similar between nations and genders so that students may be characterised by subject choice rather than by nationality or gender. In the case of physics, we speculate that this may be related to the strong and quite uniform culture that "school physics" represents, which seems to be similar across nations. This culture has recently been described by for instance Carlone (2003), and it is characterised by traits such as an image of being difficult and objective and an emphasis on concepts, laws, and calculations rather than human, historical and social aspects of science. It seems that this culture attracts a certain type of students. Physics may be described as a subject choosing its students, rather than the reverse.

How does the process of physics choosing its students come about? Clearly, in line with the results presented here, it is related to student characteristics such as abilities, interests and background. As we have seen, students in our survey rated personal interests and abilities as the overwhelmingly most important influence sources for their choice. However, we did not get much information regarding how the students imagined that these interests and abilities had arisen.

Theory may aid us here. The concept of "cultural capital", introduced by the sociologist Pierre Bourdieu, is useful (Bourdieu and Passeron, 1990). Numerous investigations have shown that specific aspects of the home background such as the number of books in the home, parents' education, orientation toward school, learning and traditional "high culture" shape adolescents' interests, values and priorities and thereby also (to some extent) their school performance and educational choices. Several recent studies (Turmo, 2003; Markussen, 2003) have shown that educational choice patterns as well as performance for Norwegian students are surprisingly strongly related to cultural capital. This is surprising because Norway with its social democratic government for several decades has nourished educational policies that explicitly aim at removing social biases in education. Although the relation to home economic capital seems to have gotten weaker, the relation to home cultural capital seems to persist.

The picture that emerges from our study is that although both Finnish and Norwegian students claim to base their educational choice mainly on personal interest and ability, there is a tendency for Norwegians to be relatively more influenced by background and Finns to be more influenced by the educational system (teachers, advisers, entrance requirements).

These differences may be related to educational policy (LUMA, 1999). Raising the level of scientific and mathematical competence has been a key concern in Finnish educational policy during the last few years, and Finnish students performed remarkably well in the PISA assessment. This trend may also be linked to the recent success of Finnish science and technology. In Norway, on the other hand, there has been a lot of discussion about falling enrollment in science and technology, but a strong and consistent policy to change this has been lacking. Regarding educational choice guidance from school, we believe that most counselors do not have a science background themselves and may, because of this and because of the subject's reputation of being hard, be less likely to guide students in the direction of physics.

Thus, our recommendations based on this small study are:

- More attention should be given to educational choice guidance in secondary school – probably particularly so in Norway. Physics in particular might profit from this, and physics teachers should take an active role as "ambassadors" for their subject.

- If recruitment is to be improved, physics needs to get away from the image of being difficult and work-intensive; probably also from the prevailing culture of the subject (which is likely to be even harder to change).
- Finally, there is a need for more research exploring the interaction between students' socioeconomic background, their interest and performance in various school subjects (notably physics), and their actual educational choices.

## References

Angell, C., Henriksen, E.K and Isnes, A. (2001). "Should I stay or should I go?" Students' impressions of physics and their reasons for choosing it in upper secondary school and university. In: R. Pinto & S. Surinach. (Eds.) *Physics education beyond 2000. Selected contributions from the International Conference*. Paris: Elsevier.

Angell, C., Guttersrud, Ø., Henriksen, E.K. and Isnes, A. (2003). Physics: Frightful, but Fun. Pupils' and teachers' views of physics and physics teaching. *Science Education* (in press).

Bourdieu, P. & Passeron, J.C.(1990). *Reproduction in Education, Society and Culture (2nd edition)*. Sage Publications.

Carlone, H.B. (2003). Innovative science within and against a culture of "achievement". *Science Education* 87, 307-328.

Davenport, E.C. Jr., Davison, M.L., Kuang, S.D., Ding, S., Kim, S., & Kwak, N. (1999). High school mathematics course-taking by gender and ethnicity. *American Educational Research Journal*, 35, 497-514.

Jorgensen, B.C. (1998). Mathematics and Physics Education in Society – The Justification and Enrolment Problems from a General Perspective. In: J.H. Jensen, M. Niss & T. Wedege (Eds.), *Justification and Enrolment Problems in Education Involving Mathematics or Physics*. Roskilde, Denmark: Roskilde University Press.

Institute of Physics (2001). *Physics – building a flourishing future. Report of the inquiry into undergraduate physics*. London: Institute of Physics.

Lavonen, J., Juuti, K., Byman, R., Meisalo, V. Koponen, I. and Saloranta, S. (2003). Teaching and Studying Physics and Chemistry in Upper Secondary Schools: A survey of the Students' Perspective in Finland. In: L. Haapasalo & K. Sormunen (Eds). *Towards Meaningful Mathematics and Science Education: Proceedings on the IXX Symposium of the Finnish Mathematics and Science Education Research associations*. University of Joensuu, Bulletins of the Faculty of Education, No 86.

LUMA (1999). Finnish Knowledge in Mathematics and Sciences in 2002: Revision of the Joint Action Programme (LUMA). Department of Education and Science Politics Publications 72. Helsinki: The Ministry of Education.

Markussen, E. (2003). Valg og bortvalg. Om valg av studieretning I og bortvalg av videregående opplæring blant 16-åringer I 2002. *NIFU skriftserie nr. 5/2003*, Norsk institutt for studier av forskning og utdanning, Oslo (2003). (*Norwegian institute for studies in research and higher education. In Norwegian only*).

OECD. *Knowledge and Skills for Life. First Results from the OECD Programme for International Student Assessment (PISA) 2000*. Organisation for Economic Co-Operation and Development (2001).

Stokking, K.M (2000). Predicting the choice of physics in secondary education. *International Journal of Science Education* 22, 1261-1283.

Turmo, A. (2003). The relationship between 15-year-olds' scientific literacy and their socioeconomic background – a Nordic perspective. *Scandinavian Journal of Educational Research*, (in press)

Trusty, J. (2002). Effects of High School Course-Taking and Other Variables on Choice of Science and Mathematics College Majors. *Journal of Counseling & Development*, 80(4), 464-475.

Väljjärvi, J., Linnakylä, P., Kupari, P., Reinikainen, P. & Arffman, I. (2002). *The Finnish success in PISA – and some reasons behind it*. Jyväskylä: Kirjapaino Oma Oy. Available online: <http://www.jyu.fi/ktl/pisa/publication1.pdf>

## Резюме

### ПОЧЕМУ ВЫБИРАЮТ ФИЗИКУ - В НОРВЕГИИ И ФИНЛЯНДИИ ?

**Еллен К. Генриксен, Карл Ангелл, Яри Лавонен, Андрес Иснес**

Данные анкетного опроса из Норвегии и Финляндии были сравнены, чтобы исследовать факторы, которые влияют на выбор учащихся средней школы предметов (особенно физики). Результаты указывают, что не только личные и эмоциональные факторы (интерес, способности), но также и практические факторы (требования, полноценность) - ключевые для выбора учащихся.

И финские и норвежские учащиеся утверждают, что основывали свой образовательный выбор главным образом на личном интересе и способностях. Наблюдается тенденция, что выбор финских учащихся больше всего повлияло образовательная система (преподаватели, требования). Для норвежских учащихся главным был общий контекст выбора. Эти различия обсуждены в свете образовательной политики и социологической теории. Физика, по мнению респондентов, трудный предмет. Гендерные различия были маленькие в течение исследования.

Больше внимания в средней школе необходимо уделить руководству выбора предметов, особенно в Норвегии. Преподаватели физики должны взять активную роль как "послы" для своего предмета.

Наконец, есть потребность в большем количестве исследований. Необходимо выяснить взаимодействие между социально-экономическим фоном учащихся, их интересами и работой по различным школьным предметам (особенно физики).

**Ключевые слова:** физика, образовательный выбор, образовательная политика.

*Received 05 November 2003; accepted 10 January 2004.*

#### ***Ellen Karoline Henriksen***

Ph.D, senior lecturer, Department of Physics, University of Oslo,  
P.O. Box 1048 Blindern, 0316 Oslo, NORWAY.  
E-mail: [e.k.henriksen@fys.uio.no](mailto:e.k.henriksen@fys.uio.no)

#### ***Carl Angell***

Ph.D, associate professor, Department of Physics, University of Oslo,  
P.O. Box 1048 Blindern, 0316 Oslo, NORWAY.  
E-mail: [carl.angell@fys.uio.no](mailto:carl.angell@fys.uio.no)

#### ***Jari Lavonen***

Ph.D, professor, Department of Teacher Education, University of Helsinki,  
P.O. Box 9, FIN-00014 University of Helsinki, FINLAND.  
E-mail: [jari.lavonen@helsinki.fi](mailto:jari.lavonen@helsinki.fi)

***Anders Isnes***

associate professor, Department of Teacher Education and School Development,  
University of Oslo,  
P.O. Box 1099 Blindern, 0317 Oslo, NORWAY.  
E-mail: [anders.isnes@ils.uio.no](mailto:anders.isnes@ils.uio.no)

© Scientific Methodic Center “Scientia Educologica”, Lithuania; The associated member of Lithuanian Scientific Society, 2004.



Copyright of Journal of Baltic Science Education is the property of Scientific Methodical Center and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.