A case of four groups of stakeholders: Do we want the same physics curriculum?

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Abstract. This study explores the views of leading physicists, other scientists, physics teachers from upper secondary schools, and physics teacher educators regarding the physics curriculum. We administered a questionnaire based on previous qualitative research. Only in a few cases the evaluations by other groups of respondents were statistically significantly different from those by leading physicists (indices encouragement and modern physics branches). We also did not identify a reasonable difference between teachers who knew they commented on physicists' ideas and those who did not. Thus, there is a strong consensus among the investigated groups on what the physics curriculum should be.

Introduction

The study explores whether there are shared ideas about what a physics curriculum for upper secondary schools should be. The ideas of leading physicists about the desirable physics curriculum are our starting points. They were reflected by other groups of stakeholders – scientists from other related fields, physics teacher educators, and physics teachers from upper secondary schools. Finding ideas about a curriculum shared by various groups of stakeholders gives a greater mandate to promote such a curriculum in educational practice. The presented research is part of a larger study leading, among other things, to the creation of a physics textbook [1].

In the international environment, the ideas of various groups of stakeholders regarding the desirable curriculum of both physics and more generally science are investigated. Regarding the views of natural scientists, studies [2, 3, 4] probe to be influential. Teachers' ideas are thematized by, for example, [5, 6]. Only rarely, the perceptions of different groups of stakeholders are compared [6]. This study seeks to address the gap in the extant literature by answering the following research questions:

- To what extent are the ideas of leading physicists regarding the physics curriculum acceptable to scientists from related fields, physics teachers, and physics teacher educators?
- Are the opinions of physics teachers who know that they are commenting on the ideas of leading physicists different from those of physics teachers who do not?

Methods

Quantitative and descriptive methods were used in this study. The study is based on a questionnaire survey administered to various groups of participants. Questionnaire items were constructed based on previous qualitative research [1]. The study participants were 26 leading physicists, 32 scientists from other related fields, 539 physics teachers from upper secondary schools, and 31 physics teacher educators.

Using statistical methods (exploratory factor analysis, maximum likelihood extraction, varimax rotation), strong and consistent ideas about the physics curriculum were first sought and then individual groups of participants were compared from this perspective (Welch's t-test).

Results

Analysis of the collected data led to the creation of seven indices that included 42 of the original 56 categories. These indices include *classical physics branches, modern physics branches, methods used in physics, context, encouragement, width and depth,* and *students' cognition*. Only 24% of the cases were the evaluations by other groups of respondents that were significantly different from the evaluations by leading physicists. *Encouragement* was evaluated more positively by leading physicists than by scientists from related fields, physics teacher educators, and physics teachers from upper secondary schools. By contrast, *modern physics branches* were evaluated less positively by leading physicists than by scientists from related fields and physics teachers.

Regarding the second research question, we can state that there is no reasonable difference between upper secondary physics teachers who know that they are commenting on leading physicists' ideas and those who did not know. We identified only two ideas (*explain phenomena* and *large-scale physics*) with a statistically significant difference between the two groups of teachers, but with a small effect size. The opinions of physics teachers turned out to be independent of their (un)awareness of commenting on the ideas of leading physicists.

Conclusions and discussion

There is a strong consensus on what the physics curriculum for upper secondary schools should be. The consensus is briefly defined by the aforementioned indices and was reached among four significant groups of stakeholders: leading physicists, scientists from related fields, physics teachers from upper secondary schools, and physics teacher educators. Although the remaining three groups of stakeholders expressed their views on physicists' ideas, we can conclude that the direct authority of the leading physicists is unlikely to influence the views of others. Knowing that a shared view of a desirable physics curriculum exists can be seen as a promising starting point for developing a new physics (or science) curriculum and implementing it in mainstream education.

References

[1] V. Žák and P. Kolář, Physics curriculum in upper secondary schools: What leading physicists want, *Sci. Educ.* **107** (2023) 677-712.

[2] R. Schwartz and N. Lederman, What scientists say: scientists' views of nature of science and relation to science context, *Int. J. Sci. Educ.* **30** (2008) 727-771.

[3] S. L. Wong and D. Hodson, From the horse's mouth: What scientists say about scientific investigation and scientific knowledge, *Sci. Educ.* **93** (2009) 109-130.

[4] L. D. Yore, B. M. Hand and M. K. Florence, Scientists' views of science, models of writing, and science writing practices, *J. Res. Sci. Teach.* **41** (2004) 338-369.

[5] L. Hansson, Ö. Hansson, K. Juter and A. Redfors, Curriculum emphases, mathematics and teaching practices: Swedish upper-secondary physics teachers' views, *Int. J. Sci. Math. Educ.* **19** (2021) 499-515.

[6] A. R. Taylor, M. G. Jones, B. Broadwell and T. Oppewal, Creativity, inquiry, or accountability? Scientists' and teachers' perceptions of science education, *Sci. Educ.* **92** (2008) 1058-1075.