

High School Teachers' Perspectives on Teaching Quantum Physics – Questionnaire Design

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Abstract. The role of quantum physics in the high school curriculum has been emphasized recently. However, the curricular documents cannot bring a complete picture of incorporating quantum physics into the school reality. In this paper, we present a quantitative questionnaire for high school physics teachers as a research tool for investigating the current state of teaching quantum physics at high schools around the Czech Republic in more details. Collecting responses from 263 teachers, we found that 79% of them dedicate to quantum physics in their teaching. In further research, we focus on outlining the typical teaching time, teaching goals, topics, etc.

Introduction

Quantum physics is becoming increasingly important as the background knowledge for the emerging quantum technologies, which is reflected by its recent incorporation into the school curricula of many countries [1]. Given that the Czech curricular documents provide schools with a great degree of freedom [2, 3], they cannot bring a complete picture of the actual quantum physics teaching. However, to help improving quantum physics instruction, the knowledge of its current state is needed. Therefore, our research aims at describing the teaching reality more closely.

Theoretical framework

Quantum physics is anchored in the Czech high school curricula in the section *Physics of Microcosm*, side by side with nuclear and particle physics, by up to three key competences (depending on school type [2, 3]), and a list of topics (e.g. quanta and waves, quantization of energy, atomic models, laser, etc.). The physics instruction is typically split into common lessons attended by all students, and optional seminars. Therefore, the teaching can vary from a brief introduction to an extensive instruction. To outline the teaching reality in quantum physics in more details, we focus on developing the research tool to answer the following research questions:

- RQ1 What part of the Czech high school physics teachers does in reality incorporate quantum physics topics into their teaching within common lessons, or optional seminars?
- RQ2 If teachers do incorporate quantum physics into their teaching, what are the characteristics of their teaching? Specifically, a) How much time do teachers typically dedicate to quantum physics? b) What topics do teachers typically address? c) What are teachers' teaching goals regarding quantum physics? d) What teaching methods and materials do teachers use?
- RQ3 If teachers do not incorporate quantum physics into their teaching, what are their reasons for doing so?
- RQ4 What part of Czech physics teachers think that high school students should be introduced to the basic principles of quantum physics?

In this paper, we only restrict to answering the research question RQ1, as the main attention is given to the questionnaire development.

Methods and findings

At this initial point of our research, we prioritized outlining the general picture of teaching quantum physics to the view at individuals. Therefore, we chose an electronic quantitative questionnaire as a research tool for collecting data from as broad sample of teachers as possible. For the questionnaire design, the guidelines outlined in [4] were followed, and its schematic structure is in Fig. 1. The questionnaire has three thematic parts: Questions on common physics lessons (e.g. teaching time for quantum physics, teaching goals, topics, etc.), questions on teachers' opinion on teaching quantum physics and its attractiveness for students, and questions on optional physics seminars laid similarly to the first part. The final questions collect meta information about respondents' school, teaching experience, etc.

After piloting with 22 teachers, the questionnaire was sent to email addresses of 2510 high school physics teachers, which covers the population of approx. 2500 Czech high school physics teachers sufficiently. The data were collected within the period of March 17, 2024–April 8, 2024, and 263 responses were obtained (171 from gymnasia, 89 from vocational high schools, 3 teachers reported a combination of both school types), yielding the response rate of 10%. The preliminary results show that most of the responding teachers (79% out of 263) do teach quantum physics in their lessons. However, the remaining 21% of teachers do not dedicate to quantum physics at all.

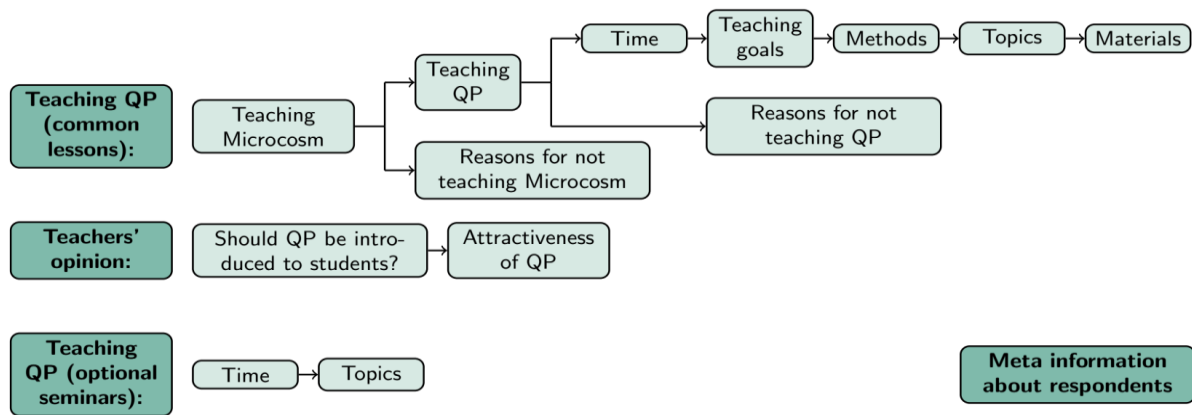


Figure 1. Schematic structure of the questionnaire.

Conclusions

We have developed a quantitative questionnaire for physics teachers as a research tool for investigating the overall state of quantum physics instruction at high schools in the Czech Republic. Concluding that 79% out of 263 teachers dedicate to quantum physics, the following steps will be to outline the main characteristics of the teaching (such as teaching time, teaching goals, topics, etc.) as well as to understand teachers' reasons for not teaching quantum physics.

References

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