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Literature study

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Contents

Introduction

The literature study is an important aspect of writing scientific literature, and therefore also relevant for designing educational resources. It contains a discription and evaluation of the existing literature relevant to the topic of the study (?, ?). For a succesful literature study, the researcher has to formulate research questions. The answers to these questions can then be used for completing and deepening the analysis.

In the case of designing resources to teach the fundamental principles of quantum mechanics, it is important to look at the different studies which investigate the teaching of quantum mechanics. Hence, the main research question for this literature study is:

What is known about teaching quantum mechanics from earlier research?

This question leads to several different follow-up questions:

- What are the motivations to teach quantum mechanics?

- What are the intrinsic difficulties of teaching quantum mechanics?

- What is the current experience from quantum mechanics teaching in schools?

- What are aspects important for implementing quantum mechanics teaching in schools?

- What are the pre-existing conceptions that students have about microscopic phenomena?

- Which existing strategies currently exist for teaching quantum mechanics?

First, the method will be described which was used to gather the articles, and the method which was used to analyse these articles in a systematic way. This will be followed by a summary of the results from the literature study.

Method

First, the search terms for the literature study had to be considered. A quick look on Google Scholar with the terms "quantum mechanics teaching" already yielded many relevant results. Then, the thesaurus from EBSCO Host was consulted to look for relevant similar terms. When looking for "quantum mechanics", the only relevant term which was found was "modern physics", which is the superterm used for both quantum mechanics and relativity theory. Another term similar to quantum mechanics is quantum physics, but because everything quantum related could be relevant, the term used was "quantum*". This resulted in the first search term being "quantum*" OR "modern physics". The term "teaching" could be elaborated by terms like "instruction", "learning" and "education", but this set of terms already became obsolete during the next step, which entails considering the databases.

The first consulted database was ERIC, the database for articles in the field of education. Because the articles within this database are already education related, it was decided to only consider the first set of terms ("quantum*" OR "modern physics"). This results in 1,225 articles. Then, a couple of limiters were applied, which were to search only for articles wich were peer reviewed and published in scientific journals and with the full text available. This resulted in 636 articles. After that, a limiter was added to search for articles conceirning secondary education only. This yielded 63 articles. Finally, only articles published since 2003 were considered, because quantum mechanics — especially quantum mechanics teaching — is a changing field, and articles older then 12 years might not be relevant anymore. With all these limiters — peer reviewed, published in scientific journals, full text available, secondary education only and published since 2003 — there were 26 articles left.

Other databases were also consulted, namely Psycinfo, Scopus and Web of Science, with the terms used by ERIC, added by the teaching set and the terms "highschool" OR "secondary education" (("quantum*" OR "modern physics") AND ("teaching" OR "learning" OR "education" OR "instruction) AND

("highschool" OR "secondary education")), but this only yielded a limited amount of results, of which the articles were either irrelevant or already found by using ERIC.

    After this, the articles themself were considered. Four articles were dismissed by title only. These were articles about other topics then quantum mechanics, so they were irrelevant. The rest of the articles were read by abstract, introduction and conclusion. After this, 16 articles contained (partial) answers to the research questions, so the rest of the articles was dismissed as well. After this, a literature matrix was set up with the research questions in one axis and the different articles in the other, and then the cells were filled in by reading the articles thoroughly. The results of this filled in literature matrix will be discussed in the next section.

Results

Motivations to teach quantum mechanics

Intrinsic difficulties of teaching quantum mechanics

Current experience from quantum mechanics teaching

Aspects important for implementing quantum mechanics teaching

Pre-existing conceptions from students about microscopic phenomena

Existing teaching strategies

References

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