Argumentation in university textbooks

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Introduction

Reasoning and argumentation are central within both mathematics and science education. However, it is not always clear what these concepts mean. In addition, mathematics is frequently described as based on deductive reasoning, logic, and exact answers, while science is founded on experimentally based inductive reasoning. Such differences might contribute to differences between the subjects regarding the type of argumentation that is present and valued in, for example, textbooks. However, empirical evidence to support claims regarding different types of texts in different subjects is often lacking. Recently an empirical study presented evidence for linguistic differences in Swedish secondary school textbooks in science and mathematics (Riebeck, 2015). The differences include that mathematics texts contain more logical connections and exclamatory sentences compared to science texts, and that science texts contain more declarations of subject knowledge and a higher degree of nominal phrases compared to mathematics texts. These results indicate that there could be differences in the types of argumentation between these subjects. In addition, the quality of students' reading comprehension of a text is connected to the coherence of the text (McNamara et al., 1996). Coherence includes how different phenomena are connected by argumentation, which further emphasizes the relevance to examine argumentation in textbooks in different subjects.

The purpose of this study is to further the understanding of the role of argumentation in science and mathematics texts. The research question is: What are the similarities and differences, concerning the *amount of* explicit argumentation, between biology, chemistry, and mathematics textbooks?

Method

In this study we use the following definition of argumentation: "the act or process of giving reasons for or against something" (merriam-webster.com). We use the concept *argumentative structure*, which focuses on the key components in an argumentation, and is based on Toulmin (1958). An argumentative structure consists of a *conclusion*, a *premise* and an *argumentation marker* (e.g., "since"). We focus here on *explicit* argumentations, that is, situations when there exists an argumentation marker that is possible to identify in a tangible way. Also, we delim-

it this particular short communication to report on argumentation markers that consist of words.

Data consists of 20 pages each from one university textbook in biology, one in chemistry, and one in mathematics. To compare the books, we calculated *the number of argumentative structures per declarative sentence*. This measure will mirror what proportion of the statements in each book that are explicitly backed up by arguments. First, for each page, the total number of declarative sentences was counted (commands, questions, and exclamations were excluded). Second, argumentative structures were searched for in each declarative sentence. To compare the amount of explicit argumentation between the three books, preliminary analyses using independent samples t-tests were performed with textbook page as unit of analysis.

Results and conclusions

Table 1 shows the amount of explicit argumentation in the biology, chemistry, and mathematics textbooks. There are significant differences in number of explicit argumentations between chemistry and biology ($p<0.01$), between mathematics and chemistry ($p<0.01$), and between mathematics and biology ($p<0.001$).

Table 1: Amount of explicit argumentation in the textbooks.

Book	Number of statements	Number of explicit argumentations	Argumentations per statement M (± sd)
Biology	590	105	0.15 (± 0.11)
Chemistry	365	100	0.26 (± 0.14)
Mathematics	262	110	0.45 (± 0.28)

In line with the results by Riebeck (2015), our results show that the mathematics textbook contains more argumentative structures than the science textbooks. However, there are also differences between the different science subjects. Since reading comprehension is connected to text coherence (McNamara et al., 1996), these results indicate that students' comprehension of texts in different subjects might vary. More in-depth studies of both textbooks and students' comprehension of the textbooks are therefore important.

References

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