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<td>Title</td>
<td>Representations of problem solving in China, Singapore and US mathematics textbooks: a comparative study</td>
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Abstract

This study aims to analyze how problem solving is represented in three series of mathematics textbooks at the lower secondary level in China, Singapore, and the United States from a comparative perspective. More specifically, the main purpose of the study is to investigate how two important aspects of problem solving, namely, problem types and problem solving strategies, are represented in these textbooks.

This study defined a problem as “a situation that requires a decision and/or answer”, as it was believed that such a definition was more meaningful as well as operational for textbook analysis study. Based on this definition, a general conceptual framework was established for the classification of problem types and problem solving strategies in the study.

Seven main classifications of problem types were formulated and used for data coding. These classifications include application problems versus non-application problems, routine problems versus non-routine problems, open-ended problems versus close-ended problems, traditional problems versus non-traditional problems, among others.

The representation of problem solving strategies was observed at two levels: general strategies and specific heuristics. The general strategies were analyzed using Pólya’s four-stage problem solving model. The specific strategies were examined based on a rather comprehensive list of concrete problem solving heuristics, including “acting it out”, “looking for a pattern”, “working backwards”, to just name a few.

The study adopted content analysis as the main research method. All the problems in the textbooks and all the solutions to the text problems were examined and then coded, based on the established framework. After that, the coding results were analyzed by both quantitative and qualitative methods.

Both similarities and differences on the representation of problem solving in the textbooks across the three countries were investigated. In general, all the textbooks provided a large number of problems, which were presented in a variety of ways. The majority of problems in the examined textbooks were routine, traditional, and close-ended. Most problems were not contextualized in real world situations in all the three
series. More types of non-traditional problems were found in the US textbooks and the
distribution of the non-traditional problems in the US books was also in a more balanced
manner than that in the two Asian ones. However, it was revealed that the problems in the
US textbooks were least challenging, in terms of the number of steps involved in the
problem solutions.

On the representation of problem solving strategies, the study found that the
problem solutions presented in the Asian texts in most cases covered just "how to carry
out the plan", which was the third stage in Pólya's model, whereas the majority of
problem solutions in the US books were presented with at least two problem solving
stages. All the textbook series introduced a considerable number of specific heuristics
and the Singapore series introduced the heuristics in the most explicit way. In addition,
the study showed that in most cases all the textbooks only presented one solution to a text
problem.

The possible reasons (including from both social and cultural perspectives) for the
similarities and especially for the differences were explored in the study. Moreover, the
results from the textbook comparisons were also used to analyze the possible influences
of those textbooks on students' different performance in mathematics as found in cross-
national comparisons. Suggestions about how to improve the representation of problem
solving in mathematics textbooks in those three countries were also provided at the end
of the study.

The findings of this study clearly suggest that there likely exist considerable gaps
between the national syllabi/curriculum standards and the textbooks developed based on
these syllabi/standards, and therefore it is important for policy makers, curriculum
developers and researchers, textbook authors, and most importantly, teachers, to realize
the existing gaps and take necessary actions to overcome the difficulties and problems
they could bring to the teaching and learning of mathematics in classroom.

Finally, an investigation of empirical nature on how Singaporean mathematics
teachers used the textbooks in their teaching practice was conducted as a sub-study for
this doctoral study. A detailed report was attached in Appendix B.