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Research on mathematical literacy in schools - Aim, approach and attention

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Research in mathematical literacy has different emphases; whether the teaching and learning of mathematical literacy or the synthesis of results from worldwide studies that emphasises mathematical literacy (e.g. the PISA 2003 studies) to focus on the curricular implications. However, a comprehensive review of the current empirical research on the area is missing. The poster presentation focuses on what research brings attention to in empirical studies where mathematical literacy is highlighted. These are both quantitative and qualitative based projects, and include for instance articles with data collection where mathematical literacy is emphasised in the development of tools for the data collection or in what is being measured, and articles focusing more on teachers' implementation of mathematical literacy in teaching and learning. The poster also focuses on what research finds to be implications for teaching and future research on mathematical literacy.

The poster is based on our work on a review article, submitted to an international journal, that aims to address the research on mathematical literacy in primary and lower secondary school, by bringing together, comparing and synthesizing the diverse body of current research, emphasise implications for research on the area, and point to necessary areas for research to come. Through the poster we aim to inform about our review on research on mathematical literacy in school. The poster is used to present a systematic review of recent empirical studies through comparing, analysing, and discussing the body of articles in relation to the following key questions:

1. *What methodologies have been used to examine emphasis on mathematical literacy in primary and lower secondary school?*
2. *How is mathematical literacy conceptualised?*
3. *What is the focus of attention in research on mathematical literacy?*
4. *What are the implications for primary and lower secondary school teaching, and recommendations for future research on mathematical literacy?*

We have applied methods well-known for review articles that aim to identify a state of the art within a field of research on school related issues, and to make suggestions for further research within the area at hand (e.g., Beltman, Mansfield & Price, 2011). This counts for the identification of parameters for the review, search in data bases based on the identified parameters, and selection of publications to form the basis of the review and analysis. The body of articles for the review consists of 28 articles that fulfil the selection criteria used. The studies were conducted worldwide, but with a clear majority of European and Asian contributions.

Our findings show that the research is dominated by quantitative approaches, and do not focus on what goes on in the classroom. It focuses on the outcome of what goes on in school. The lack of identified attention to qualitative research on teaching for mathematical literacy seems to be due to four main reasons. The decision to apply existing data from PISA studies for more quantitative analyses on mathematical literacy related areas, application or even exploitation of the mathematical literacy concept in studies that are not directly focused on mathematical literacy, and tension between policy documents and practice in school on one hand, and tension between learning achievements and mathematical literacy on the other hand. This leads to lack of attention to best-practice projects. Hence, it seems that research in the future to a larger extent might report research based results on what schools and teachers ought to do in order to teach for mathematical literacy. Several of the articles use data from PISA test results, and are therefore obliged to acknowledge the prevailing OECD definition at the time of testing, because the attention to mathematical literacy in the PISA tests is based on this definition. In addition, some of the articles reviewed connect subject matter theories within mathematics education with the concept of mathematical literacy. A common factor for these articles is their interest regarding the teaching of mathematical literacy in school. Regarding implications for primary and lower secondary school teaching and further research on mathematical literacy, three main challenges were identified: both researchers and teachers are uncertain about how to develop students' mathematical literacy, specific attempts to work directly with mathematical literacy through mathematics alone have not been successful, and teaching for mathematical literacy appears to require non-traditional methods for teaching mathematics.

Furthermore, the subject of mathematical literacy is given extensive attention both at political and societal levels (OECD, 2009) and within mathematics education research. In fact, Sfard (2014, p. 141) urges the research community to address this issue: "The question of how to teach for mathematical literacy must be theoretically and empirically studied. When we consider the urgency of the issue, we should make sure that such research is given high priority." The approach to such a quest seems to be through increased emphasis on qualitative research, for instance, through studies of best-practice and research projects involving practising teachers. Therefore, the research community's attention needs to shift from nurturing data and findings that highlight student results on mathematical literacy tests to research on what to do in order to improve the students' opportunities to develop mathematical literacy. A starting point for such a shift in focus could be to examine how mathematical literacy is understood, facilitated and experienced in schools.

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