

Paper – short oral communication

Effects of collaborative modelling lesson series and debriefing on students' ability to engage in mathematical modelling, assumption making and on students' self-efficacy

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A number of studies have demonstrated that each phase of the modelling cycle can pose cognitive barriers to students (Galbraith & Stillman, 2006; Goos, 2002; Klock & Siller, 2020; Stillman, 2011). Galbraith & Stillman (2001) highlighted assumption making as an important part of the modelling process. Seino (2005) argued that assumptions are 'the bridge' that connects the real world and the mathematical world. For students who have not been previously engaged with mathematical modelling, the teacher's primary function is not to provide assumptions, but rather to clarify what assumptions are and to inform students of their importance.

Small group discussions have been shown to promote the development of modelling competencies (Galbraith & Clatworthy, 1990; Maaß, 2006). Wester (2021) investigated the opportunities what can be learnt when small-group discussions are used as an integrated part of whole-class teaching. The findings indicated that the absence of subsequent whole-class discussions following small-group discussions have less effect on student learning. However, there remains a lack of knowledge about what effect collaborative modelling and debriefing have on students' ability to engage in mathematical modelling and also have on students' self-efficacy. Additionally, it is unclear how to provide support for making assumptions when using collaborative modelling tasks and what the effects are. The objective of the present study is to investigate the effect of a lesson series with collaborative modelling tasks, whole-class discussions and the opportunity to improve assumptions have on students' ability to engage in mathematical modelling and on students' self-efficacy.

The study involved four teachers (two males and two females, with a mean experience of 12.5 years) and 199 grade eight students (aged 13-14) from four schools in the Netherlands. A quasi-experimental research design was employed, with a pre-test, post-test and with two conditions. One of the intervention conditions was collaborative modelling with focus on assumptions in debriefing (CMAD). In the debriefing the teacher devoted additional attention to the assumptions that students had made and stimulated them to reflect on how they could improve their model. The other intervention condition was collaborative modelling and debriefing (CMD), the teacher did not undertake an additional step in the whole-class discussion and limited their discussion to the findings of the groups in class. To examine the effect of the interventions we used mathematical modelling tasks, recordings of student interactions in the collaborative learning groups, student questionnaires and interviews with participating teachers.

The results indicated that the students improved significantly in their mathematical modelling ability and in their self-efficacy in both conditions. The main effect of intervention was not significant, suggesting no overall difference in test scores and self-efficacy between conditions. However, it was evident from their work that CMAD demonstrated a greater concern with making assumptions. The findings of the students' interactions indicated that the CMAD students demonstrated a higher level of proficiency in collaborative modelling. It is important to note that students employed the use of drawings and gestures to simplify the modelling problems. Furthermore, a marked discrepancy in assumptions was observed between schools. Following the interventions, semi-structured interviews were conducted with the participating teachers. The teachers would like to teach mathematical modelling in the future. However, they indicated to find it challenging. One notable challenge was to intervene and resist the temptation to offer solutions.

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