

Designing a teacher-guide for de-ritualising teaching with GeoGebra

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This presentation describes the development of a teacher-guide for using GeoGebra in secondary mathematics teaching. The methodology is an iterative development, and is part of a collaboration between student teachers, teachers, and researchers.

Commognitive theory informs the development, and in particular the move from ritual to explorative routines. The results highlight the challenges of explorative learning, where teachers stated how learners were looking for short-cuts. Therefore, the teacher-guide supports a gradual move from ritualized short-cuts, towards explorative participation in mathematics with GeoGebra. In particular, the guide challenged teachers to reflect on their question-posing. We claim this supports both students and teachers to participate in an increasingly explorative mathematics discourse.

Introduction

Earlier research on the use of GeoGebra in secondary mathematics teaching demonstrated positive influences on collaborative creative reasoning (Granberg & Olsson, 2015), and how curricular materials can support both teacher and student learning (Davis et al., 2011). Hence, this empirical paper presents the design of a teacher-guide for teachers' use of GeoGebra in secondary mathematics teaching. This study is part of a project where student teachers, teachers and researchers collaborate¹ on means for compensatory teaching. We ask: how can teacher-guides address the problems teachers experience when using GeoGebra in mathematics teaching?

Methodology

The study is based on design research, where the role of the researcher is to consider problems and design possible solutions (Huang et al., 2019). In this study, the problem is formulated based on teachers' challenges and experiences, and the possible solutions developed through iterative theoretical and empirical evaluations. This paper presents the first iterative cycle consisting of three phases. The first analytic phase consisted of the production of design ideas together with probing interviews with three teachers, who

¹ K-ULF-project: <https://www.kth.se/en/larande/forskning/pagaende-projekt/k-ulf-kompensatorisk-undervisning-for-larande-och-forskning-1.1048897>. We are grateful for the participation of mathematics teachers in Haninge, Nynäshamn and Stockholm.

were all experienced in using GeoGebra. The purpose was to identify problems and challenges teachers experienced. In the second phase, a first prototype of a teacher-guide was designed, based on the interviews, and informed by commognition. One problem raised by teachers was how students tended to take ‘short-cuts’, and avoid engaging in mathematical understanding when using GeoGebra. Commognitive theory emphasises how *ritual learning* is to imitate processes without agentive participation, and how *exploration* is to take agentive control of ways to proceed (Lavie et al., 2019). Thus, we found rituals a promising theoretical construct for students’ ‘short-cuts’. Lavie et al. (2019) suggest that participating in *de-ritualising moves* entails a gradual move from rituals, towards explorations. Such moves (flexibility, bondedness, applicability, performer’s agentivity, objectification and substantiability) were used to develop the prototype for the teacher-guide. The third phase was an evaluation of the prototype, in a focus-group interview with four teachers.

Results

The teacher-guide promoted teachers to plan questions for the students, to be answered in interaction with a chosen GeoGebra activity, based on the six suggested moves. First, the teachers in the focus group emphasised that repetition of procedures is necessary before moving on to exploration, and how this needed to be incorporated in the teacher-guide. This confirmed how rituals are an essential starting point. Second, exploration was considered difficult to achieve for all students, according to the teachers. The inclusion of questions to promote all the suggested moves at once was considered overwhelming, confirming a need for a slow motion in de-ritualization. Last, the teachers used their experience from the classroom for planning questions and used the teacher-guide to evaluate their questions. In that way, the guide helped support the reformulation of the questions, and helped make the purpose of questions explicit.

Discussion

Our contribution is a teacher-guide which supports a gradual movement from rituals to explorations. As such, it aligns with ambitions for creative reasoning in mathematics teaching with GeoGebra (Granberg & Olsson, 2015), where at the same time, students are provided access to gradually extending their participation in mathematics discourse.

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