

# Make it real: Student teachers' professional development through fabrication of their own manipulatives

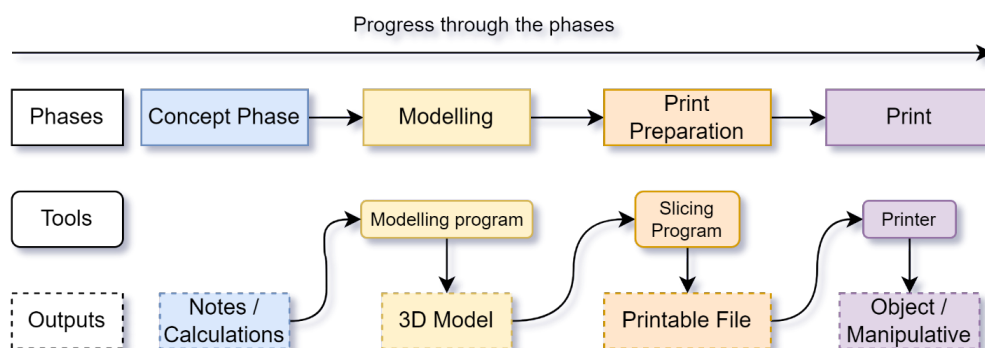
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## 3D printing

3D printing (3DP) is a novel technology that allows the fabrication of complex models accessibly, with several general benefits, especially in education, such as raised student engagement and motivation (Ford & Minshall, 2019), but also mathematics-specifics benefits like better mental representations of 3D objects (Huang & Lin, 2017, cited by Pearson & Dubé, 2022). The general 3D modelling and printing (3DMP) process is outlined in figure 1:



**Figure 1: The general 3DMP process broken down regarding phases, their respective tools and corresponding outputs**

Using this, we developed a weekly (2×45 min) seminar at Goethe University, where 10–12 mathematics student teachers per semester are taught the principles of 3DMP to create their own physical manipulatives for mathematics education. Physical manipulatives are physical objects used in mathematics classes that incorporate at least one intended mathematical principle or content, aid the student in understanding something, or allow the student to explore facets and principles of mathematics with their hands. Through this, we aim to increase student teachers' content knowledge, technological knowledge, and pedagogical knowledge (TPACK model: Mishra & Koehler, 2006).

## Similar approaches and research question

Similar approaches, where (student) teachers fabricate their own manipulatives are done by Lieban et al. (2019), where different technologies are used to create teaching resources, and Arslan & Erdogan (2021). In the latter, the authors showed that the pre-service teachers' self-efficacy and technological pedagogical content knowledge (TPCK) was raised significantly.

In our approach, we want to answer the following questions: *Which phase of the 3DMP process corresponds with which area of knowledge in the TPACK-Model?* and *What practices do student teachers undertake when designing and manufacturing their own manipulatives?* According to our state of research, this question has not been researched yet.

## Method

Through a study, we intend to answer these questions. Three interviews during one semester, focusing on the created manipulatives, will be held. Additionally, project diaries will be used to further investigate what mathematical content knowledge the students used (and learned) during which activities, as well as how they plan to use their manipulative(s) in lessons (pedagogical knowledge). In Winter 2023/2024 the study will be piloted.

## Expected results

We expect to find that the Concept phase relates to the pedagogical knowledge, and the Concept and Modelling phases relate most to the content knowledge. Students may find the work on the model rewarding, but may struggle with the technicalities of and the work with the 3D printer difficult.

It is also of interest to investigate if the actual printing also holds mathematical value. This poster is of interest to TWG15 because of the technological impact of 3D printers and the implications for teaching mathematics.

## Acknowledgements

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## References

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