

# How do pre-service teachers evaluate dynamic worksheets for learning functional relationships?

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*The appropriate choice of media is a key task in lesson planning. In the past years, there have been several studies which indicated potential in the use of digital media in the classroom. Nevertheless, these technologies are rarely used in everyday teaching. While one initially thought that this was due to the lack of infrastructure, it seems to be more due to a lack of skills. For this reason, the present study investigates what skills teachers need in order to teach functional relationships with dynamic worksheets, what skills pre-service teachers already possess and how these can be fostered.*

*Keywords: Dynamic worksheet, (technological) pedagogical content knowledge, pre-service teacher training, functional relationships, qualitative research*

## Theoretical background

Lesson planning is a daily and important part of teachers' work. Here, the choice of appropriate media is a key task, especially when the aim is on achieving mathematical learning goals. From a theoretical point of view, dynamic worksheets have high potential for developing functional thinking as seen with Lichti & Roth (2018). A dynamic worksheet consists of an applet (dynamic figure constructed with GeoGebra which is often embedded in a web page) and accompanying tasks and/or explanations (Hohenwarter & Preiner, 2008, p. 318).

## The ability of evaluating dynamic worksheets for learning functional relationships

With the TPACK model, Mishra and Koehler (2006) have created a framework for what teachers need to know in order to use technology in a meaningful way. In order to adapt this framework to the ability of evaluating dynamic worksheets for learning functional relationships, the special features of developing functional thinking were brought into connection with the features of dynamic mathematics software like GeoGebra. In addition, e-learning principles according to Mayer (2009) were considered, as the extraneous cognitive load in dynamic worksheets "should be small in order to foster more effective learning of mathematical concepts" (Hohenwarter & Preiner, 2008, p. 314). As a result, five main aspects are identified: Learning goals, representations, interactivity, tasks and multimedia principles. These five main aspects and their sub-aspects have been validated by experts (N=14) for adequacy and completeness.

## Research questions

The study aims to describe how pre-service teachers engage in evaluating dynamic worksheets and enhance pre-service teachers' ability of evaluating dynamic worksheets. Resulting research questions are:

1. How do pre-service teachers engage in the evaluation of dynamic worksheets?
2. How does training influence the way pre-service teachers engage in the evaluation?

3. To what extent can the ability of evaluating dynamic worksheet be promoted?

## Method

Data collection runs in two parts. During the entire duration, the students' screen is recorded. In the first part, the students are encouraged to think aloud, as this method enables the reconstruction of thought processes (Wallach & Wolf, 2001) and thus resembles a simulated lesson preparation.

Specifically, the students are asked to evaluate a dynamic worksheet in relation to a given learning goal for its use in the classroom. In the second part, a pre-structured guide is used to give students a reflection scheme as a scaffold. In this way, differences within a data collection can be investigated and the data collection itself can serve as a learning opportunity. Data will be collected at three different times during a teaching-and-learning-lab course in which students are trained to evaluate and develop dynamic worksheets.

Data will be analyzed with qualitative content analysis (Kuckartz, 2018), with the aim of a potential type-building of how students proceed when evaluating dynamic worksheets. In addition to the interview and think aloud data, students' topic-specific PCK and CK, previously GeoGebra experience and teaching experience are collected as secondary features.

## Expected Results

A pilot study indicated that students tend to address only superficial features of applets, especially in earlier stages of the course. Deeper argumentations and suggestions for improvement were more frequently found in later stages of the course. Furthermore, it seems that in later stages of the course students find relations between different aspects.

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