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Using multimedia in mathematics teaching – New challenges for teachers' competencies

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The application of multimedia-based representations provides new opportunities for teaching mathematics. As the students are offered new options and new challenges, teachers are also faced with modified requirements respective to their teaching competencies. This project focuses on the development of an instrument to assess and foster multimedia teaching competencies.

Keywords: Computer, multimedia, video-vignettes, teachers' competencies.

Using multimedia-based representations in mathematics teaching could support the students to gain a different access to the underlying structure of the mathematical problem which probably leads to a deeper understanding of the topic (Ainsworth, 1999).

However, too many representations can provoke a cognitive overload (Chandler & Sweller, 1991). Furthermore, teachers have to be careful not to generate misconceptions through the representations (e.g., Hadjidemetriou & Williams, 2002).

While several studies investigated the effect of multimedia-based representations on learning outcomes, little is known of how to measure the competencies teachers need in order to take advantage of the potential of multimedia-based representations.

To measure these competencies, video-vignettes, which show various situations during mathematics teaching using multimedia-based representations, have been developed. These representations have been integrated in a classroom situation with interactions between students, teachers and the computer. The vignettes are constructed with a closed-ended question type, where each statement has to be answered on a scale from one to six according to its appropriateness for the situation. This type of assess-

ment is thought to be effective to measure teachers' competencies (Blomberg, Stürmer, & Seidel, 2011).

35 vignettes have been developed, with 6 to 14 statements each, validated by a multistage expert reviewing process. The first step consisted of qualitative interviews with nine experts to assure relevance and clarity of the situations. In the second step, the vignettes were implemented in an online-tool, which was reviewed by 104 experts to get insights into the appropriateness and difficulty of the assessment. This is the data-base for the choice of the vignettes. For the current study only 10 vignettes are planned to be used. They are chosen from the data-base by sequentially applying different criteria, comparable to the step-wise selection procedure of Witner and Tepner (2011). The content of the individual vignettes was analysed separately after the second step of the expert reviewing process and only vignettes comprising interactions between students and computer were chosen, so that the number of vignettes could be reduced to 26 (criterion 1). A second analytical criterion does not refer to a whole vignette, but to each statement. The more of a consensus between the experts concerning a statement, the better it would be ranked. To measure this consensus, we will have a closer look at the quantity of experts that chose each of the possibilities from one to six. We are going to determine the absolute value of the differences between these quantities varying from the modal value and furthermore from the median, calculate the sum of the differences of each statement and standardise this value, so that the statements can be ranked. Furthermore, the experts' ratings concerning relevance (criterion 2) and clarity (criterion 3) will be analysed (as well as any available comments of the experts). Relevance and clarity of the vignettes were also ranked by the experts on a scale from one to six.

According to these four different criteria, the vignettes will receive a score corresponding to the criteria, so that ten vignettes with four statements each will be chosen for the pilot study in spring 2015.

In a next step, an experts' norm will be generated. A selection of vignettes, based on psychometric properties, will be used in the final assessment that will be validated in summer 2015.

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