FuNEKoL *Effective diagnosis of competence in teacher education*

Pädagogische Hochschule HEIDELBERG University of Education

Multimedia-based teaching of mathematics - also a question of cognitive load

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Aim of the study

The aim of this study is to measure the development of the competencies of prospective teachers in teaching mathematics with computer-applets regarding the two facets *cognitive load* and *mutual supplement of multiple representations*.

Theoretical Background

- Active linking between different forms of representations could foster learning and understanding of mathematics (Kaput, 1989)
- (Simultaneous) processing of multiple mathematical representations could extend extraneous cognitive load, especially if representations are less mutual supplementary than negatively interfering with each other due to, for example, split-attention effects or redundancies (Brünken & Leutner, 2001)
- The TPACK-framework (related to the categories of Shulman, 1986), shows that technological pedagogical content knowledge is essential for effective teaching with technologies (Koehler & Mishra, 2009)

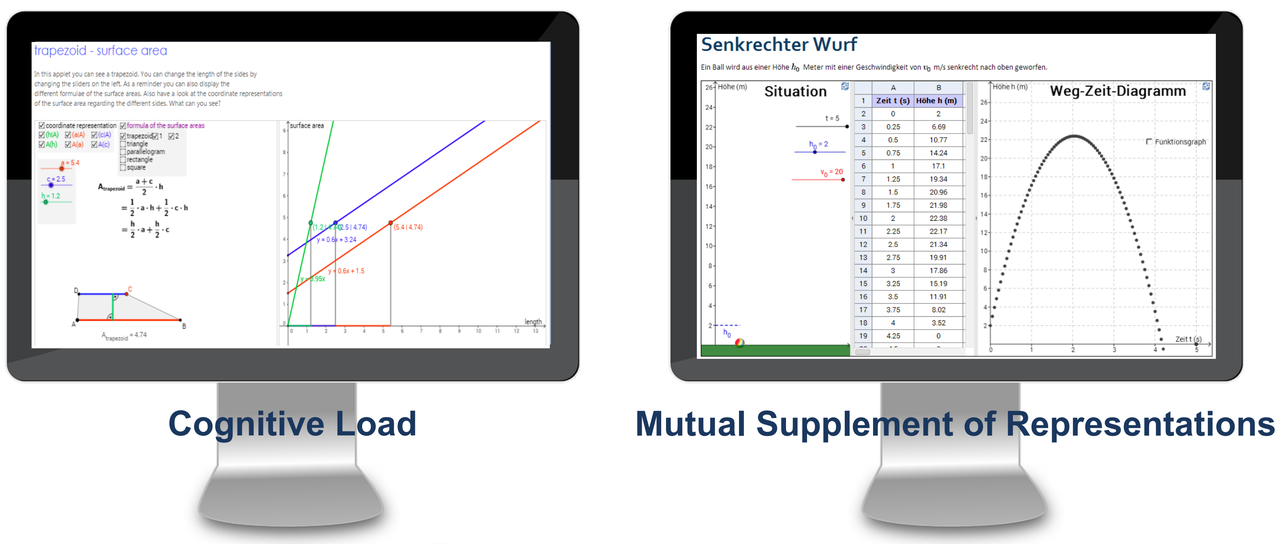


Figure 1: The two facets in the video-vignettes

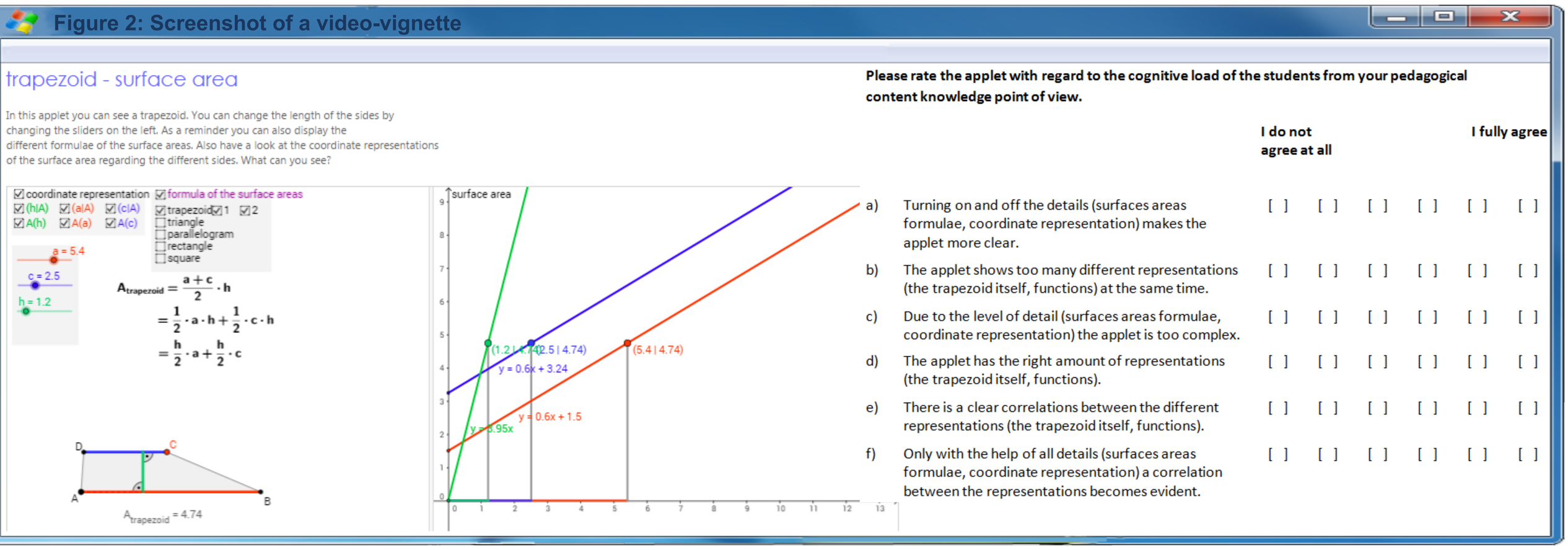
Method

- In the test, vignettes were used as they are ought to be an effective type of assessment to measure competencies (Blomberg, Stürmer & Seidel, 2011)
- The vignettes show various situations during mathematics teaching using multimedia-based representations and are constructed with a closed-ended question type (see figure 2)
- The test consists of ten video-vignettes that were validated by a multistage expert rating
- Surveyed covariates: self-concept, mathematical content knowledge, pedagogical knowledge
- 402 prospective teachers for mathematics took part in the assessment between June and December 2015

Research questions

- Is it possible to reproduce the structure of the two facets cognitive load and mutual supplement of multiple representations?
- Does a positive self-concept in respect to media influence the competency of prospective teachers?
- Does the data reproduce the three knowledge categories of Shulman in order to assure discriminant validity?

Figure 2: Screenshot of a video-vignette



Results

The results confirm the theoretically expected structure with the two facets *cognitive load* and *mutual supplement of representations* (RMSEA = .011, CFI = .991, TLI = .987, χ^2 = 19.983; χ^2/df = 1.052), as well as an expected positive correlation between the self-concept in respect to media and the pedagogical content knowledge test score (r = .153, p = .002). As assumed, there is an interplay amongst the three knowledge categories of Shulman (1986): pedagogical content knowledge test score correlates with the content knowledge test score (r = .261, p < .001) as well as pedagogical content knowledge and the pedagogical-psychological knowledge test score (r = .194, p < .001), while content knowledge and pedagogical-psychological knowledge correlate in a similar manner (r = .318, p < .001).

Discussion

So far the first results are promising. The expected structure of the competencies of prospective teachers regarding the two selected facets could be proven by structural equation modelling.
Moreover, the expected low correlations between pedagogical content knowlegde, content knowledge and pedagogical knowledge show the validity of the test.

In further research the ecological validity will be investigated by testing students without mathematical background.

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FuNEKoL **10 - Multimedia-based representations**

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