DEVELOPING AND ASSESSING E-LEARNING SETTINGS BY DIGITAL TECHNOLOGIES

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Abstract. *The project is part of the Master program for chemistry teacher education at the university. The German acronym "E-lement" stands for "developing e-learning (German:* ***e-l****earning* ***e****ntwickeln) including assessing (German:* ***m****itsamt* ***E****valuation) by digital technologies (German: durch* ***n****eue* ***T****echniken). It consists of three elements: a theoretical course, an exercise and a practical course. The aim of the module is to deepen the content knowledge of selected school relevant topics, to reflect them didactically, to transform them into e-learning settings by using new technologies, to implement them in out-of-school lab days and to assess the outcomes of the pupils by using digital tools. The poster presents an overview of the elements of the module, the methodology and first results of the project.*

Key words: content knowledge, pedagogical knowledge, digital technologies, out-of-school labs, chemistry teacher education.

THE PROJECT E-LEMENT

Education in the digital age is a new challenge not only in the classroom but also in teacher education. It requires to widen the framework for teaching which has been described by Lee Shulman (1986). Pedagogical content knowledge (PCK) has to be extended to TPCK (TPACK) to include technological knowledge (Koehler & Mishra, 2009). Apart from the difficulty to define TPACK, it is important that social and contextual factors can make the relationship between teaching and technology more difficult. Teachers are often left alone with the new technologies and do not know how and where to integrate them (Koehler & Mishra, 2009). In order to overcome these obstacles we designed a project which is based on the general idea that learners (here teacher students) are much more motivated to acquire new knowledge when they are aware of the future relevance of their knowledge. And furthermore the combination of knowing and applying which is crucial for the project is in accordance with the notion of competence, one of the central challenges of education since PISA (Reiners, 2017).

These ideas are fundamental for a module in a Master program for chemistry teachers which consists of three elements.

In a theoretical course selected topics which have already been taught in subject-matter courses during their studies are taken up again and reflected as specific content for teaching at school. The reflection implies the analysis of the content, its curricular relevance, discussions of preconceptions, the design of possible learning contexts and the development of appropriate experiments.

Based on this course the teacher students are invited to use the result of the reflection and to develop adequate learning environments with digital technologies (Clark & Mayer, 2016.), like PowerPoint (Banerji, 2017). In order to support them they are introduced to e-learning units for classroom like blended learning (Keengwe, 2019), flipped classroom (Bergman & Sams, 2014), and game-based learning (Van Eck, 2006). Furthermore they should construct digital learning environments by themselves, like videos, audio recordings

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and animations and they also reflect on advantages and disadvantages of e-learning scenarios.

In the final practical course they are offered the opportunity to test the designed learning settings authentically, i.e. with real pupils in out-of-school lab days. In order to assess the learning outcomes the teacher students develop research questions by themselves, collect data by using digital tools like tablets and videos and analyze them qualitatively. Thus out-of-school lab days serve several functions: for the pupils they are innovative learning environments, for the teacher students they are authentic teaching environments and a platform to apply their knowledge. Furthermore the competence-oriented lab days offer the opportunity to collect first experiences in doing research and support the future teachers in making up their mind on the use of new technologies.

The main aim of the practical units, i.e. exercise and practical course is to support them on the way from mere recipients of new technologies to active constructors and thus make learning more meaningful to them. In order to find out whether this transformation was successful the module was evaluated. Data was collected by questionnaires which the teacher students had to fill out after the module. The questionnaires contain open-ended questions (Denzin & Lincoln, 2011) addressing their overall experiences (for example: "What are you taking out of the module? and "What else would you have wished for?") as well as structured questions to figure out their assessment of selected digital tools and scenarios.

FIRST RESULTS

Answers to the open-ended questions from a total of 21 participants were analysed using the qualitative content analysis according to Mayring (2015). The inductively formed categories indicate that after the module many teacher students now consider PowerPoint as an effective tool to develop e-learning arrangements (12 entries). For example, when asked what he learned from the module, one participant responds:

"Integration of digital learning environments; learning how to program with an ordinary program." [All German quotations in this article were translated by the authors.]

In addition, some participants (7 entries) think that using the program is an opportunity to design chemistry lessons. This is underlined by the following statement of a teacher student who developed an digital teaching unit after participating in "E-lement" and afterwards used it in her own chemistry class:

"I learned how to use the animation function of Powerpoint for school and even created a small unit on my own on induced dipoles and used it in class."

However, the teacher students are also concerned that the development of such a digital learning unit is very time-consuming (11 entries):

"You can also use PowerPoint in a different way, but it is very time consuming. Whether and when it can be used in school is questionable."

Regarding the structured questions, 11 out of 19 students stated that they would use the learning environment developed within the "E-lement" module in their own chemistry lessons, while six are undecided. In addition, 14 students see themselves in a position to create digital learning environments in the future (four undecided) and seven plan to do so in their future teaching (six undecided).

OUTLOOK

First results of the evaluation indicate that after participating in the module "E-lement" teacher students are prepared to develop and assess e-learning environments for digital chemistry lessons. Especially PowerPoint seems to be a useful tool for them. This can be regarded as a first step to support future teachers on their way from mere recipients of new technologies to active constructors. Though it turned out that many participants consider the development of digital learning units to be time-consuming, the fundamental potential of the module to become active constructors of new technologies is an important advantage in recent times of "home schooling".

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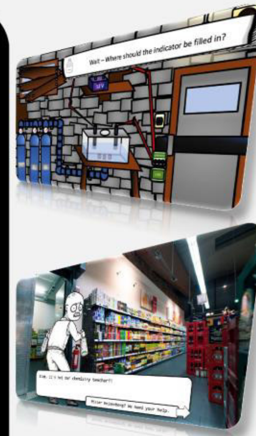

Figure 1: Screenshots and video from the students developed environments

Theoretical Background: Education in the digital age is a new challenge not only in the classroom but also in teacher education. It requires to widen the framework for teaching which has been described by Lee Shulman. Pedagogical content knowledge (PCK) has to be extended to TPCK (TPACK) to include technological knowledge (Koehler & Mishra, 2009). Apart from the difficulty to define TPACK, it is important that social and contextual factors can make the relationship between teaching and technology more difficult. Teachers are often left alone with the new technologies and do not know how and where to integrate them (Koehler & Mishra, 2009). In order to overcome these obstacles we designed a project which is based on the general idea that learners (here teacher students) are much more motivated to acquire new knowledge when they are aware of the future relevance of their knowledge. And furthermore the combination of knowing and applying which is crucial for the project is in accordance with the notion of competence, one of the central challenges of education since PISA (Reiners, 2017).

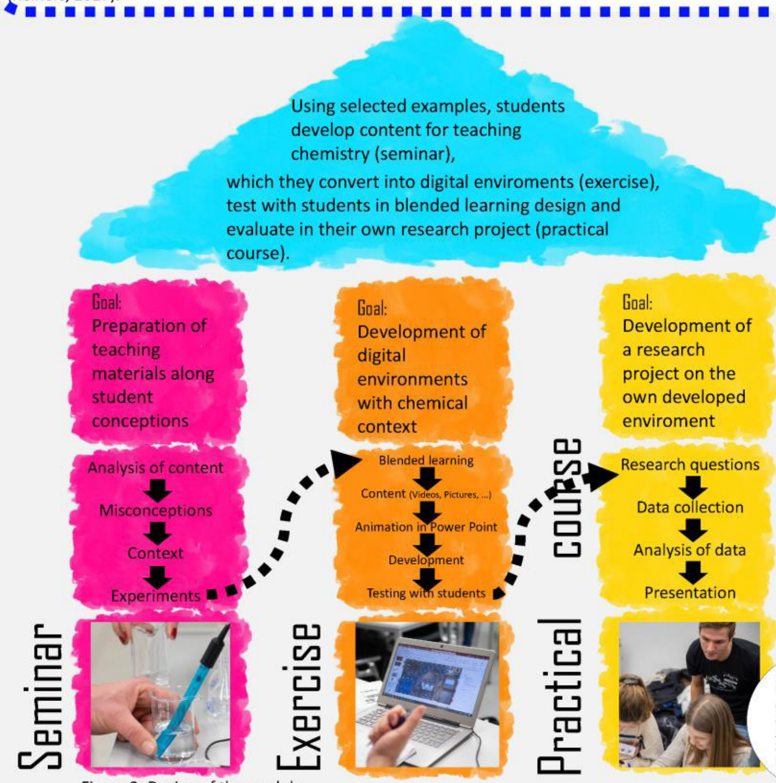

Figure 2: Design of the module

What do students think after the module about PowerPoint for e-learning?

Methodology: Data was collected by questionnaires which the teacher students had to fill out after the module. The questionnaires contain open-ended questions (Denzin & Lincoln, 2011) addressing their overall experiences as well as structured questions to figure out their assessment of selected digital tools and scenarios. A total of 21 participants have taken part in the evaluation of the module so far. The data were analysed using inductive category formation according to Mayring (2015).

Results: Twelve students consider Power-point a useful program for the development of e-learning environments. In addition, students see e-learning based on PowerPoint as a possibility for planning chemistry lessons. However, many consider the development of digital learning environments to be very time-consuming.

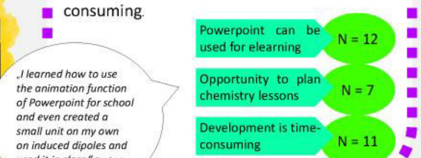

Figure 3: Category system

Outlook: First results of the evaluation indicate that after participating in the module "E-lement" teacher students are prepared to develop and assess e-learning environments for digital chemistry lessons. Especially PowerPoint seems to be a useful tool for them. This can be regarded as a first step to support future teachers on their way from mere recipients of new technologies to active constructors. Though it turned out that many participants consider the development of digital learning units to be time-consuming, the fundamental potential of the module to become active constructors of new technologies is an important advantage in recent times of "home schooling".

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