

Reimagining student laboratories: creating a digitalized chemistry lab

Nicolai ter Horst & Timm Wilke

Introduction

Digital media have long since arrived in didactic chemistry research. This research is often linked to the goal of improving the classroom experience and the students' understanding of chemical content, even leading to a transformation of the teaching and learning culture. If this succeeds, new media can contribute to the individualization of learning and to the much-demanded differentiation in heterogeneous learning groups [1]. At the Friedrich Schiller University Jena, a student laboratory is being established that uses and researches the potential of digital media for teaching and learning and promotes the improvement and transformation of current learning settings. With this laboratory, digital media can be used to make the student lab day as interesting as possible and to tailor it closely to the learner's needs. The concept of the digitalchemlab, the planned pilot learning module and the associated research project will be presented in the following.



Fig. 1 : Model sketch of the planned digital student laboratory

3. Research Project

The example module will be tested with three to four school classes and is planned for the summer of 2022. One school class will serve as a control group that will carry out the learning module without the digital elements and tools but with the same tasks, all analogue. The research project is supported and accompanied by the department for educational psychology [6]. The aim is to investigate the knowledge gain, the use of the offer as well as the motivational orientation of the participants. Both qualitative and quantitative research methods will be used. First results should provide indications for improving the offer, which will then be tested and evaluated in a main study.



Fig. 3: Students conducting experiments on household cleaners

1. Digital Student Laboratory

The planned digital student laboratory is a spatial addition to the already existing, classical student laboratory (Fig. 1). iPads will be used in combination with digital media and learning tools in both areas to improve and individualize learning ways. Establishing a digital student laboratory offers many advantages and opportunities: (a) the influence on student interest [2] through student lab visits, which has been investigated by various studies, could be strengthened through the use of digital media, (b) the cooperation of schools and university can be improved through the development of digital and hybrid learning modules, and (c) student lab visits can become more flexible by a broader offer of i.e. online and face-to-face courses, and thus (d) more easily attended multiple times. This could help to amplify initial positive effects on interest and ability self-concept in the field of science [3].

2. Example Module

The topic of household cleaners was chosen as an example module with a topic close to everyday life with great curricular relevance and direct application possibilities. The module is based on a so-called differentiation matrix [4] which is a method of differentiated or inclusive teaching. It combines elements of cooperative learning and individualization. The 4x3-matrix includes twelve different tasks (Fig. 2), which the students can work on in any order they like. Two different types of tasks are included, each to be performed either in individual/partner work (digital tasks) or in partner/group work (experiments). The learning module is eBook [5] based, so that students can navigate through the differentiation matrix using their iPad and the eBook's user interface. However, all fields are also set up in the real world, therefore creating a hybrid learning offer (real-live experience mixed with digital elements).

	A. Classification and contents of household cleaners	B. Acids and bases combat dirt	C. Acid-Base-Chemistry made easy
Analysing/Creating	Further household cleaners 15 min	Tensides – tools for every use? 15 min	Calculating acid and base proportions 15 min
Applying	Ingredients of household cleaners 20 min	Cleaning the drain (effects of alkaline cleaners) 20 min	Neutralization of a drain cleaner solution 20 min
Understanding	pH-value of household cleaners 10 min	Decalcifying and derusting (effects of acid cleaners) 20 min	Conductivity of washing powder and washing solution 20 min
Knowledge	Classification of household cleaners 15 min	Stain-free with acids and bases 10 min	Acid-Base-Chemistry and household cleaners 10 min

Fig. 2: Differentiation matrix of the digital learning module (translated)

4. Conclusions and Outlook

Creating a digital student laboratory offers a variety of potentials. The example module (Fig. 4) is a first building block for new learning offers in the digital student laboratory (Fig. 5). If piloting and evaluation are successful, further learning modules and student teacher trainings based on the new concept will be created. In this way, the digital student laboratory can be used to further advance digitalization in chemistry teaching and the student laboratory.

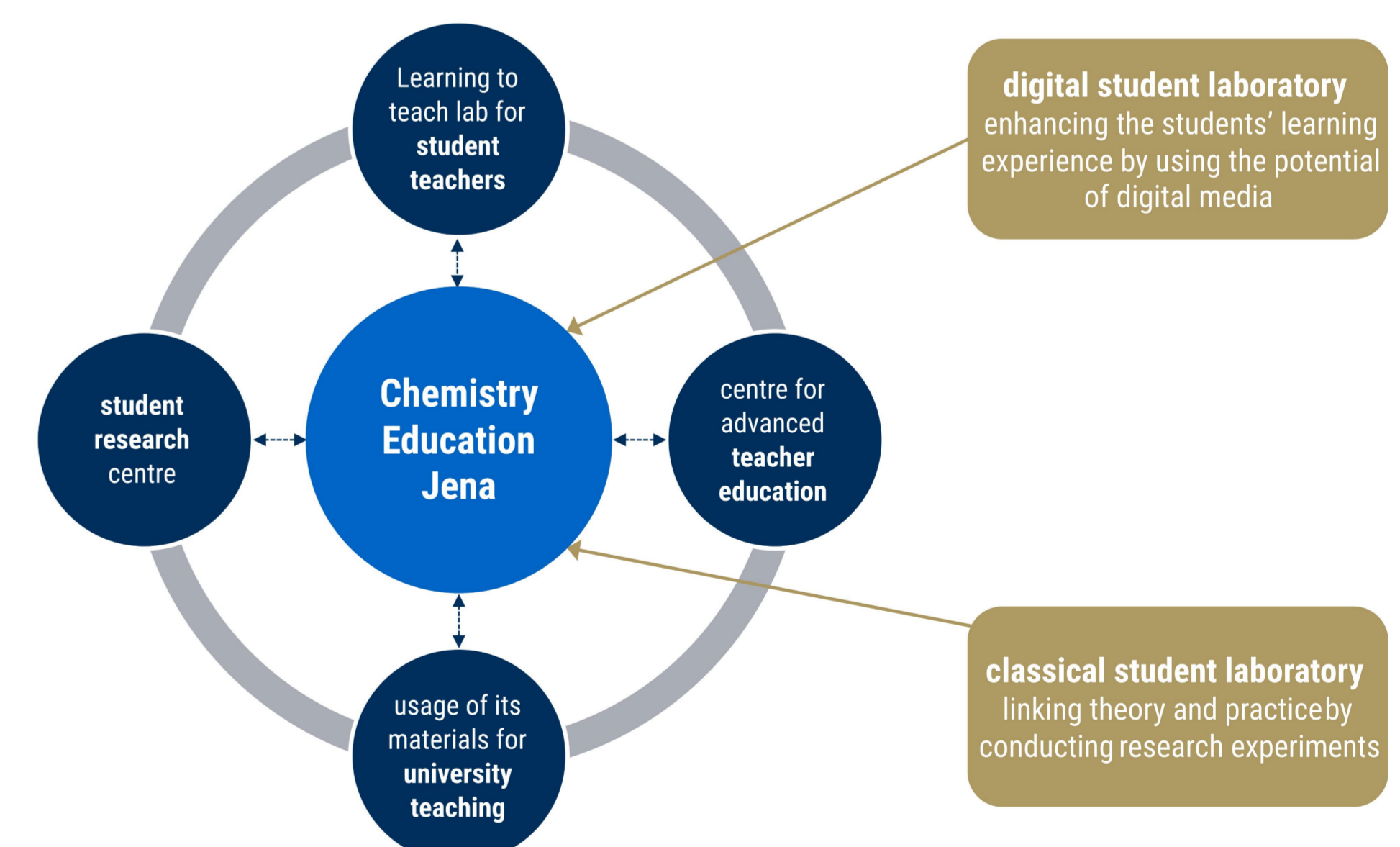


Fig. 5: Services offered by the Chemistry Education Department

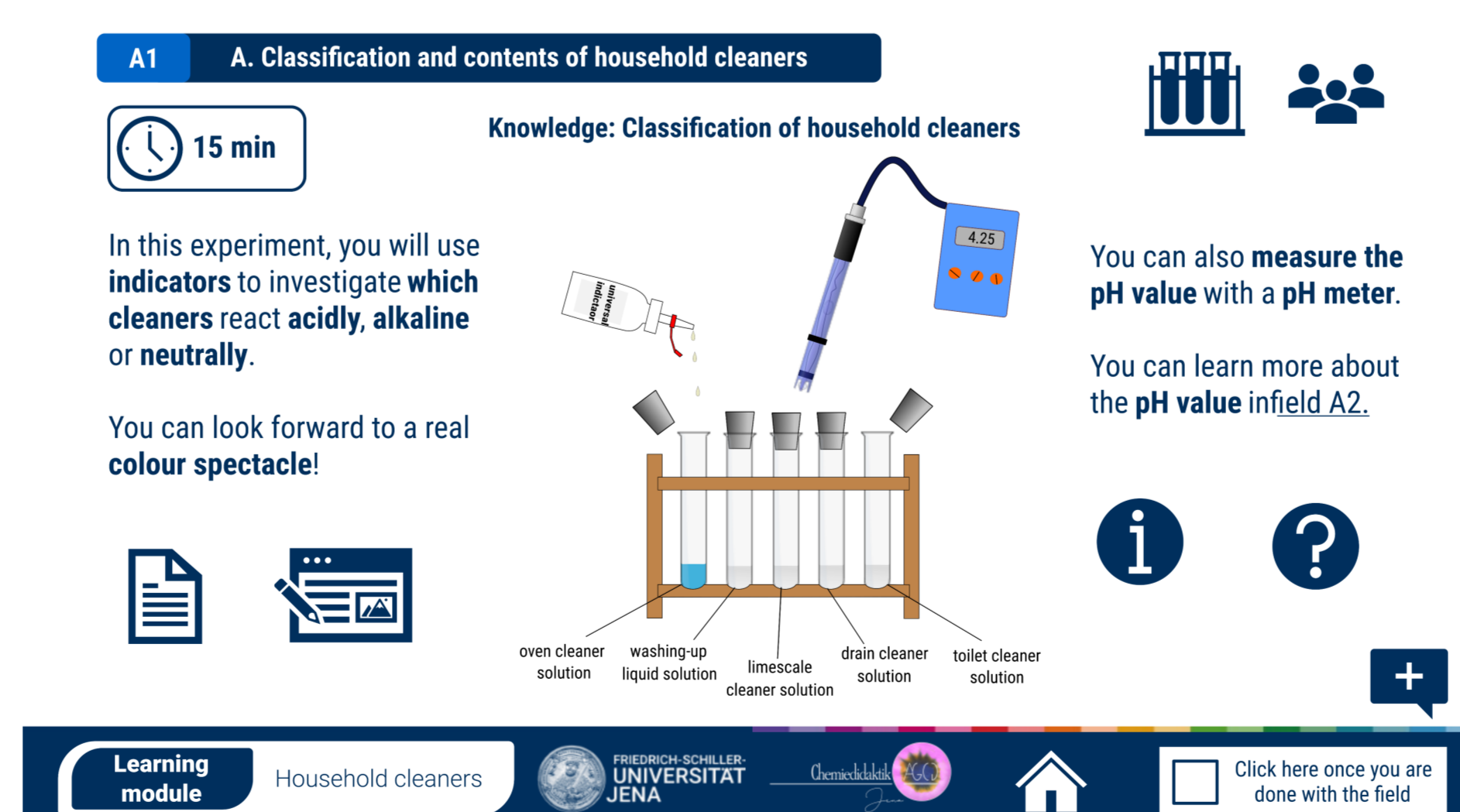


Fig. 4: Excerpt of the digital learning module (translated)

Literatur / References

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Nicolai ter Horst
Research Assistant
Friedrich Schiller University Jena
Chemistry Education Department
August-Bebel-Str. 2, D-07743 Jena
nicolai.ter.horst@uni-jena.de



Die Friedrich-Schiller-Universität Jena wird im Rahmen der gemeinsamen „Qualitätsoffensive Lehrerbildung“ von Bund und Ländern aus Mitteln des Bundesministeriums für Bildung und Forschung gefördert.



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