Teaching Laboratory Classes in the Natural Sciences (7)

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Blended Learning & Digital Competencies

The term Blended Learning describes the combination of face-to-face teaching and digital elements. Digital media can support lab classes in several of ways, including the following:

- **Moodle**: Some lab class teachers use Moodle successfully to assign students material that helps them prepare for a lab session.[1] Students acquire the necessary knowledge through online quizzes, electronic scripts, or additional material that help them catch up on the required knowledge if needed.[2] When you enter assignment results in Moodle, students can view their current points or grades at any time. This serves as a permanent feedback opportunity, and at the same time increases the transparency in grading. At the end of the semester, teachers can simply export the final grade as calculated by Moodle to u:space.
- **Lab videos**: Videos of experts filmed solving problems or performing experiments are instructional videos that may be very useful in lab classes. Students may gain valuable insight for their own experiments from watching the video example. The use of such videos may be helpful even in large classes where live demonstrations cannot be seen by all students.
- **Virtual labs**: In the past years and for various natural science fields, websites have been developed that allow students to perform experiments virtually. In these virtual experiments, the processes are generated based on digital process calculations and represent reality as closely as possible. The exact design of the programs varies; in most cases students plan an experiment, choose materials, and deal with unforeseen events or consequences.[3] Then students analyse the virtual experiments according to the research questions. It is important to note, however, that the motor skills and experiencing experimentation with all the senses "falls by the digital wayside."[4] However, virtual training options that are always available to students can serve as useful additions to experiments in class. For example, as preparatory assignments, virtual experiments can help prepare for experiments in the lab.

Links to virtual labs

Here are some virtual laboratories from different fields that you may use in your teaching [all last accessed on 29.08.2020]. You may link directly to relevant experiments from your Moodle course.

- List of Virtual Labs, Simulations or Interactive Learning Objects (https://media1-production.mightynetworks.com/asset/9157779/Virtual_Lab_Resources.pdf) (compiled by the University System of Georgia, USA)
- Various disciplines: MERLOT Collection (https://www.merlot.org/merlot/) (California State University)
- Chemistry: ChemCollective (http://www.chemcollective.org/find.php) (Carnegie Mellon University)
- Physics: PhET Interactive Simulations(https://phet.colorado.edu/) (University of Colorado Boulder)
- This article in the Chronicle of Higher Education on How to Quickly (and Safely) Move a Lab Course Online (https://www.chronicle.com/article/how-to-quickly-and-safely-move-a-lab-course-online/) may be of interest, particularly during the COVID-19 pandemic.

Student learning outcomes in lab courses can include **lab-specific digital competencies**, for example using software for measuring (learning modern measurement techniques), data processing, analysing, and visualising results. For several years now, experts have been demanding to explicitly include discipline-specific digital competencies in lab courses and have been pointing out that students do not learn these competencies on their own and in passing.[5] Especially when students should learn step by step to independently plan and perform experiments, it is important that teachers recognise conveying a thorough understanding of the necessary software as part of their responsibilities.

References

[1] See Kreiten, M. *Chancen und Potenziale web-basierter Aufgaben im physikalischen Praktikum*, Dissertation, Universität zu Köln, 2012.

[2] Nagel, Clemens C. *eLearning im Physikalischen Anfängerpraktikum*. "Studien zum Physik- und Chemielernen", edited by H. Niedderer, H. Fischler, and E. Sumfleth, Volume 246, Berlin: Logos Verlag Berlin, 2009. For an example of a learning path (Moodle activity "Test") including videos, experiment instructions, quizzes and self-assessment, please see the video „Laborlehre und praktischer Übungsbetrieb: Wie machen Sie das? (https://infopool.univie.ac.at/videos/laborlehre/#c337068)“ (starting at 12:20, in German).

[3] Coppola, B.P. "Laboratory Instruction: Ensuring an Active Learning Experience." In *McKeachie's Teaching Tips: Strategies, Research and Theory for College and University Teachers*., edited by Marilla D. Svinicki, and Wilbert J. McKeachie, 13th edition, 280-289, here: 285. Belmont, CA: Wadsworth Cengage Learning, 2011.

[4] The following sensual perceptions are missing in particular: sense of touch, sense of smell, proprioception, and sense of balance. See. e-teaching.org. *Virtuelle Labore*. 31.03.2016. https://www.e-teaching.org/didaktik/gestaltung/virtuelles_Labor (https://www.e-teaching.org/didaktik/gestaltung/virtuelles_Labor) [last accessed on 01.09.2020].

[5] Mühlenbruch, Tobias, and Volkhard Nordmeier. „Optimierung naturwissenschaftlicher Experimentalpraktika." In Heterogenität und Diversität – Vielfalt der Voraussetzungen im naturwissenschaftlichen Unterricht., edited by S. Bernholt, 414-416. Gesellschaft der Didaktik der Chemie und Physik, Jahrestagung in Bremen 2014, Kiel: IPN, 2015.

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