Fakultät NT

UNIVERSITÄT DES SAARLANDES

Coding & Digitalization in Physical Chemistry to enhance Learning Outcomes and Digital Skills

A project draft

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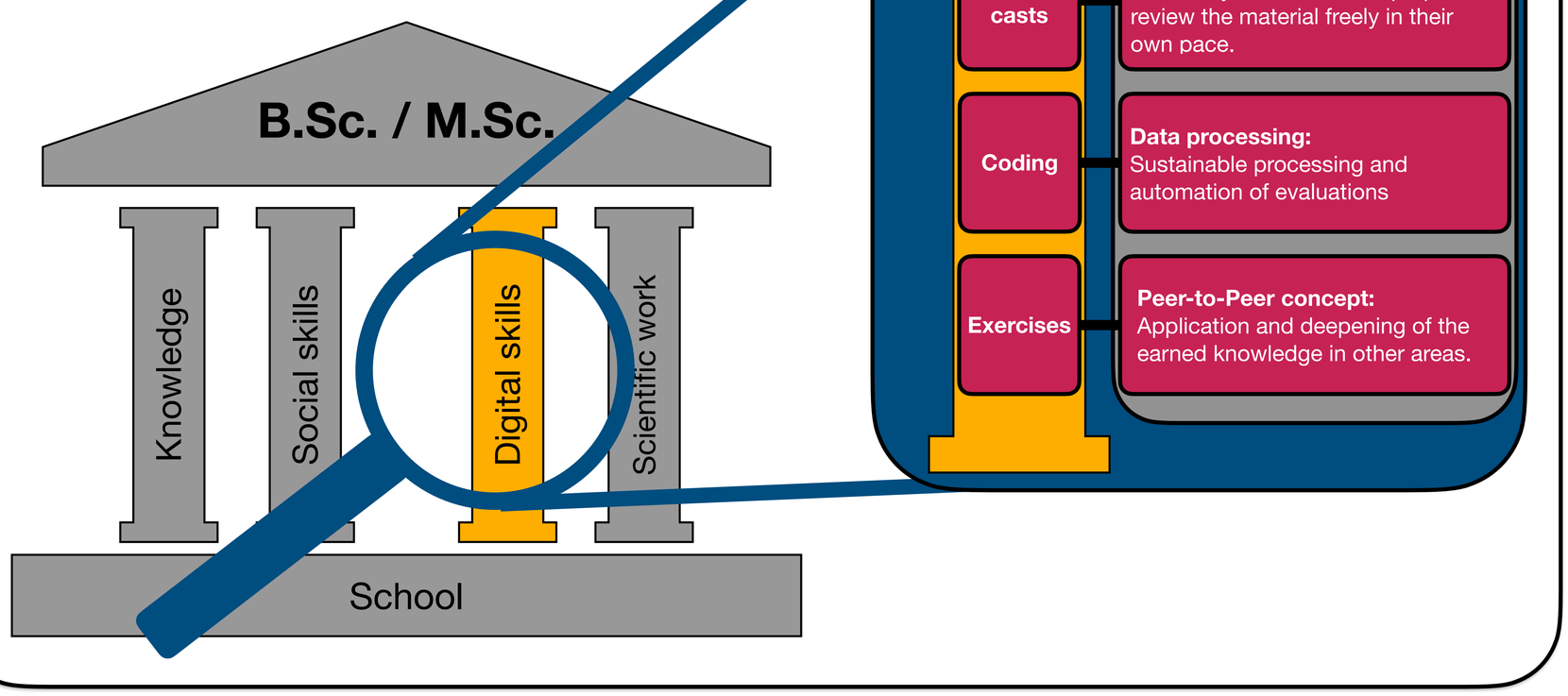
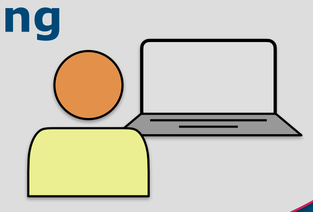
Mastering digital skills is more important than ever as digitalization infiltrates every aspect of our lives in general and the scientific process in particular.[1] Analytical hardware, the evaluation of experimental data, laboratory journals and reports in universities and industry are now most often digital, whereas computer science and coding classes at high school are still often rare, which means that many freshman university students have little experience of using computer software or writing their own code. This lack of experience and hence self-confidence in coding may become a serious hinderance for (successful) data analysis accompanying practical work as students progress through their academic training, especially in the natural sciences.[2][3]
In this work we discuss comments from students, lecturers and teaching assistants on the use of MATLAB in chemistry. Furthermore, we discuss our ideas to address this issue by stepwise improvement of teaching using different approaches.

Universitary education (Quadruple bottom line model)

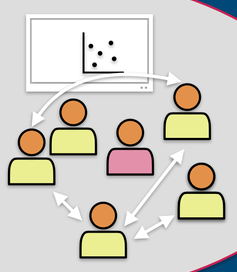


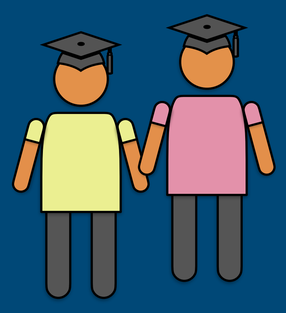
First idea:

Blended Learning



Flipped classroom





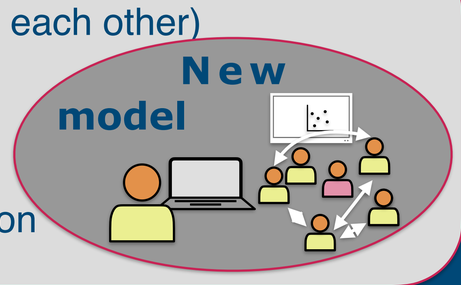
- ⊕ Individual learning
- ⊕ Visibility learning level
- ⊕ Media diversity
- ⊖ Technical equipment
- ⊖ Problems with a lack of media- and self-learning skills

- ⊕ Motivation through media
- ⊕ Personal contact
- ⊕ Individual learning
- ⊖ Technical equipment
- ⊖ Problems with a lack of media- and self-learning skills

Development during semester

Conclusions:

- ⊕ Individual learning (own speed, repetition, helping each other)
- ⊕ Reduce failures and frustration of the students
- ⊕ Increase motivation in independent work
- ⊕ Better understanding of the contents
- ⊕ Correct application ➔ Tested by written examination



Comments on MATLAB:

Student 5:

„In chemistry, as in any other science, empirical data are fitted to a model. […] In MATLAB, the toolbox that Origin offers is expanded many times over and there are many more possibilities. […] one should not compromise and through programming, functional relationships often become clearer than by simply pressing Run."

➔ Need for a better understanding of the basics
➔ Use of MATLAB instead of a black box (Origin, Excel)

Teaching Assistant 2:

„Usually in the beginning students have their doubts […], but when they start to work with larger data sets,[…], they see more clearly why the process of gaining some experience in coding […] is crucial. The activation barrier in the beginning is very high, so we have to catch their attention right in the beginning […]. Otherwise, they will have a constant lack of understanding, leading to frustration."

➔ Need of MATLAB, but it needs to be taught in an appropriate course.

Professor 1:

„The chemistry students don't see why they need it and they want to learn much more about physical chemistry and less about how to program MATLAB. Even the colleagues […] don't see how students can benefit from Matlab. We need well-trained students who know basic PC."

➔ More focus on knowledge not on Coding
➔ But: Should chemists just use apps like a black box and be dependant on other scientists who can program?

Literature:
[1] The Future of Education and Skills. Education 2030. Https://www.oecd.org/education/2030/E2030%20Position%20Paper%20 (05.04.2018).pdf (OECD, 2020).
[2] J. A. Jackman, D. A. Gentile, N.-J- Cho, Y. Park, Nature Human Behaviour 2021, 5, 542-545. [3] Chongtay, R. (2016). Using Visual Programming and Robots to Help Novices to Overcome Fear of Coding. In EDULEARN16 Proceedings: 8th International Conference on Education and New Learning Technologies Barcelona, Spain. 4-6 July, 2016. (pp. 3658-3665). IATED Academy. EDULEARN Proceedings Vol. 2016.

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