# G.3 Designing Digital Self-Assessment and Feedback Tools as Mentoring Interventions in Higher Education

Project

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## 1 Introduction

Higher education in Germany traditionally follows a one-size-fits-all paradigm. The ignorance of diverse students' needs jeopardizes high-quality and equal educational opportunities for all. Digital technologies can provide economical solutions to individualize teaching and learning, even in large university classes. However, their design has to incorporate pedagogical theories, specific contextual requirements, and users' needs (Laurillard, 2008).

In this project contribution, we want to demonstrate our approach to this challenge. We briefly describe how we connected the pedagogical concept of mentoring to theories of self-regulated learning and used this as a framework for developing formative assessment and automated feedback tools as digital mentoring interventions. The mentoring interventions aim at facilitating self-regulated learning, especially self-monitoring and strategy-adaption. We present three different implementations in structured and ill-structured domains and the key results of a qualitative evaluation survey.

## 2 Connecting the concept of mentoring and theories of self-regulated learning

Mentoring is one effective way to address diverse students' needs. It can be defined as a trustful relationship between a mentor who is experienced in a particular academic domain and a mentee who wants to reach individual academic goals in the said domain. Mentors act as instructors, trainers, motivators, and counselors. Their activities do not only aim at cognitive skills but follow a holistic approach, addressing motivational, psycho-social, and emotional aspects of the mentee's development. Most importantly, mentors tailor their actions to the mentee's needs and adapt them as the mentoring process evolves. While every mentoring process is unique, there are common characteristics of success. For example, mentors and mentees must establish a regular practice of joint reflection.

They discuss the mentee's accomplishments in preceding tasks, his or her progress towards their goals, and possible strategies to reach them (Eby et al., 2007; Ziegler, 2009).

From an SRL perspective, crucial features of such reflective practice are formative assessment and external feedback. SRL is a complex, cyclical process. Learners set goals and make strategic plans, act on their plans, monitor their progress, and adapt their learning strategies if needed. They evaluate their learning outcomes and reflect on the process to improve plans and strategies in the following learning cycle (Zimmerman, 2015). Formative assessment and external feedback are effective activities to support self-regulated learning (Panadero et al., 2017). They funnel additional information to learners that support their judgments of learning and can improve self-monitoring and strategic adaption during the learning process (Butler & Winne, 1995, Winne, 2018).

However, providing formative assessment and personalized feedback to all students in large university classes would be very time-consuming and nearly impossible to implement on the large scale. In the light of the previous conceptual deliberations, we assume, that digital tools for formative self-assessment and automated feedback could induce effects that are comparable to the reflective practice in a successful mentoring relationship and facilitate the students' self-regulated learning.

## 3 Formative assessment and automated feedback as digital mentoring interventions

We implemented digital tools for formative self-assessment and automated feedback as mentoring interventions in different higher educational settings. In all three settings, the students differ significantly in their prior experiences and skill levels, resulting in varying needs for assistance. In each case, the number of participants is too large to address the diversity adequately, identify problems, and remedy misconceptions early on to ensure high quality learning outcomes for all students.

The first showcase intervention was developed for a research seminar in the Computer Engineering department at the Chemnitz University of Technology. The seminar introduces the methods of scientific work, e.g., literature research, scientific writing, etc. For completion, the students must prepare a presentation and hand in a scientific report. The participants are Bachelor's and Master's students, who have diverse cultural and academic backgrounds with varying experiences of the fundamentals of scientific work. The mentoring intervention was provided in the learning management system OPAL. It contains self-tests for every lesson. The multiple-choice questions display real-world examples of scientific texts and require the students to find the flaws according to what they have learned in the course. The automated feedback is implemented as a rule-based system that points out the mistakes a student made along with pre-written explanations of what would have been the right solution and why. In the evaluation survey, the students report high levels of satisfaction with this mentoring intervention. The open-ended answers in the survey indicate that the students use the self-tests as an opportunity to practice the new knowledge and monitor their learning progress. They find the feedback especially useful to realize and adjust any misconceptions, which also helps them prepare their final report.

The second showcase intervention was developed for a module in the engineering sciences as part of two Bachelor's Programs at the Leipzig University of Applied Sciences (HTWK). It requires students to learn fundamental mathematical concepts, their mutual relationships, and how to apply both for solving typical mathematical problems. The students need to pass a final exam to complete the module. Contrary to Showcase 1, all the students are in the 1st semester but come from different educational pathways and, thus, differ in their prior mathematical knowledge. The mentoring intervention contains exam preparation modules as well as a mock exam and is provided via the learning management system OPAL. The preparation modules contain additional exercises at different difficulty levels. The system live-evaluates the students' inputs and gives corrective calculation-based feedback along with hints for the right solution and explanations about categorized mistakes. Students can use the mock exam generator once under realistic exam conditions but can repeat it as often as desired. The evaluation survey reveals high satisfaction ratings for both tools, the mock exam and the preparation modules. Students report that they used them as an additional training opportunity. It supported them to judge their mastery level in each lesson more accurately, while the feedback helped them to direct their efforts at their weaknesses.

The third showcase intervention was developed for two reading-based courses in the educational sciences at the University of Leipzig and the University of Dresden. Both courses are part of the teacher education programs. The students are in different semesters (1st to 8th), study different subjects, and thus, have diverging reading and comprehension skills. In both courses, students must write an exam with close-ended questions. The mentoring intervention provides summary writing tasks for each topic. Writing is a very effective learning activity (Klein & Boscolo, 2016), but providing automated feedback for open-ended tasks is more challenging than for close-ended questions, as in showcase 1 or 2. We choose a computer linguistic software, T-MITOCAR, that automatically generates knowledge maps based on individual texts (Pirnay-Dummer, 2020). The students receive a feedback document containing knowledge maps of their writings compared to the seminar reading. This feedback intends to support the students' self-reflections on their knowledge level and, thus, their strategic adaption (e.g., go back to the seminar reading to repeat or take a closer look at some aspects). The students report lower satisfaction than in other showcases. They find the writing tasks helpful to recapitulate and consolidate their knowledge and appreciate the immediate and individual feedback on their assignments. However, only some of them could use it as self-monitoring support, while most students find the visualizations unfamiliar, confusing, and even frustrating.

## 4 Conclusion

In this project contribution, we showed how we connected the pedagogical concept of mentoring to theories of self-regulated learning and used this as a framework for developing digital tools for self-assessment and feedback as mentoring interventions to support self-regulated learning in higher education. We implemented different types of formative self-assessments and automated feedback in different subject domains. In showcases 1 and 2, students worked on close-ended tasks. The assessment tools automatically identified right and wrong answers and connected them to pre-written feedback texts. In showcase 3, open-ended writing tasks were provided to the students with automatically generated visual feedback (knowledge maps).

Comparing the answers in the evaluation survey, we conclude that the students used the formative assessments and automated feedback as intended to assess their learning progress and adapt their learning strategies. In general, they appreciate the opportunity to practice, to detect misconceptions, and to remedy knowledge gaps. In addition, the students report that the tools had a positive impact on their motivation to engage with the learning content regularly. Deploying digital tools for formative assessment and automated feedback can be an economical way to support the students self-regulated learning. However, our survey results also show that the students prefer corrective and informative feedback as it was implemented in showcases 1 and 2. More uncommon or unfamiliar types of feedback, like the knowledge maps in showcase 3, did not work as well. We will try to improve the usability of the knowledge maps, e.g. by giving the students more instructions on how to make use of them. Also, it seems promising to experiment with other digital feedback tools, e.g., auto-graders, to find creative solutions and improve the information quality of the feedback. At least, our showcases demonstrate not only the potential of digital technologies to individualize teaching and learning in higher education in an economic way but also their limits as soon as a task or domain is ill-structured and hard to formalize.

## Literatur

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