University students' self-evaluation: digital solutions for identifying highly motivated students

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BACKGROUND

In Sweden, as in many countries, first-year mathematics courses in engineering programs are held in large student groups (>200 students. This restricts the possibilities to follow students' level of preparation and limits the opportunities to adapt teaching to the group. Large groups of students correspond to a wide spectrum of levels of prior knowledge. This diversity makes the process of teaching difficult and many times ineffective. Different backgrounds in big student groups require a big effort to adapt the teaching methods, the tempo and the information.

Hence, there is a need to find methods to follow students' development in order to increase all students' possibilities to apply mathematical knowledge in innovative and creative ways. Specifically, methods to identify students' in need of more challenging tasks are important to develop. At the university level, we are particularly interested in discovering highly motivated students at an early stage of their studies. This enables us to involve them in small research projects in their first year of studies.

THE STUDY

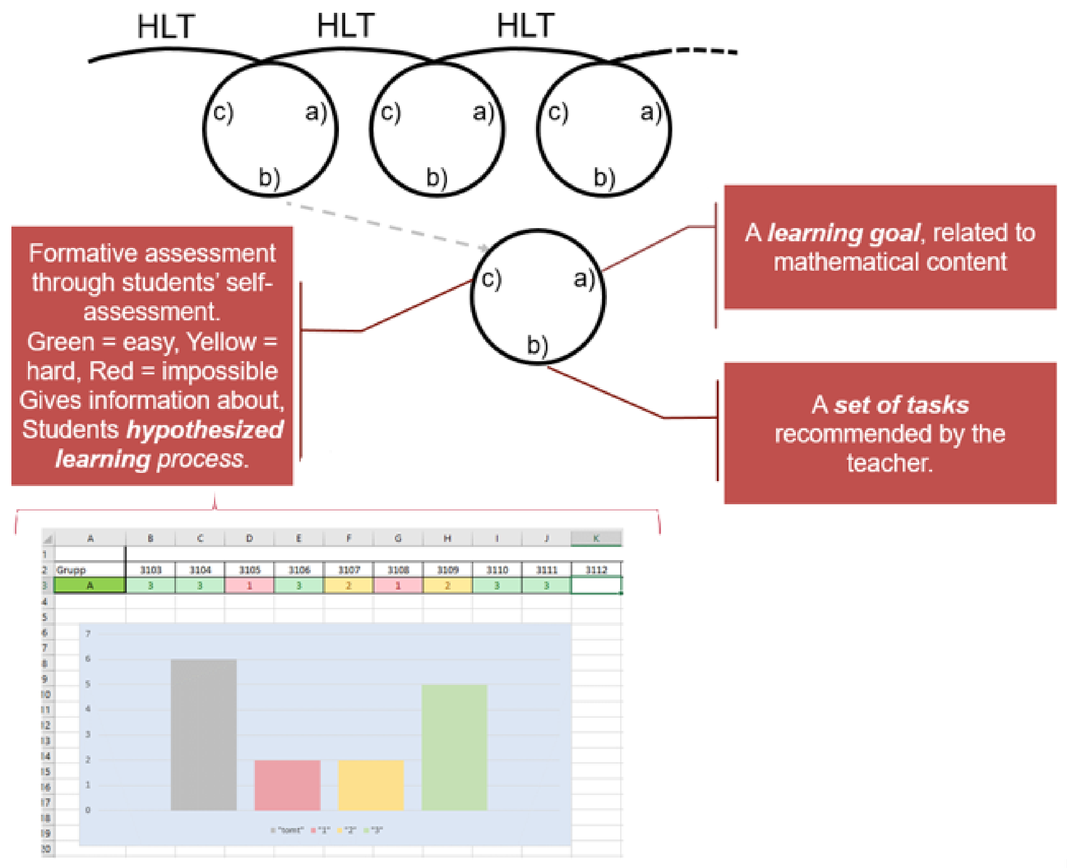
The overall aim of the project is to develop strategies for Learning Management Systems (LMS) to orchestrate differentiation of mathematical tasks and activities.

For this purpose, we develop a new digital tool that can be reached via LMS. The long-term goal is to develop an infrastructure that supports each student's mathematical learning and which nurtures innovative and creative ways of thinking.

The research question guiding our project is:
How can LMS be used as an effective instrument for improving mathematics teaching and learning?

The research is conducted within ***design research cycles*** (McKenney & Reeves, 2018). ***The hypothetical learning trajectory*** and design principles will be outlined from both theoretical and practice related knowledge (Lithner, 2007). Figure 1 shows the overall design of the project. We did two cycles 2019-2020.

Figure 1. The role of the Hypothetical Learning Trajectory (HLT) in the design of the project.



The students were offered the possibility to download via LMS in their mobile or other devices a special digital tool that stores all recommended, tasks for every lecture in the course. We constructed this tool with the purpose to give both students and teachers a better picture of the students' continuous progress in their work.

Highly motivated students

The students having very good self-evaluations were challenged by being offered the possibility to read new theoretical parts related to the course and to use them in order to solve tasks that are more difficult. The tasks were constructed as to engage the students in creative mathematical reasoning (Lithner 2007) in order to challenge their mathematical knowing and develop their problem solving ability as well as their conceptual understanding.

Another way to be challenged was by projects where the students needed to solve a given problem finding ways that were usually connected to the course but not part of it .

The students were supposed then to submit a written report and in case of successful solutions, they were invited to present and discuss their work in a seminar opened for all interested students in the course.

PRELIMINARY RESULTS

In the both cycles, already after some weeks, the lecturer could identify students capable and willing to work with more challenging tasks. During the first cycle, twelve students managed to work with the tasks. However, only seven students submitted correct written reports before deadline. During the pandemic, fifteen students showed interest to work with challenging tasks and six students submitted correct written reports before deadline.

Principles for task choice and task construction

- **Taking into consideration the theoretical interest highly motivated students have, that cannot be covered in a basic Calculus course**

First-year Calculus courses are focusing on procedures and algorithms; rarely the lecturer has the possibility to prove theorems or to reach more advanced theoretical parts. Highly motivated students show often interest for these topics. A way to challenge such students is to suggest new theoretical areas as self-study, and tasks connected to them.

- **Taking into consideration the independence, curiosity and creativity of highly motivated students**

Highly motivated students tend to choose their own methods and create new ways of solving problems. Unfortunately, first-year Calculus courses contain too few tasks where creativity can be given space. That is why a way to challenge such students is to offer the possibility to work with small projects connected to the course, encouraging their creativity, independence and need of deepening their knowledge.

REFERENCES

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