

# Final report for NV faculty: Student Active Learning and Online Assessment with STACK (**SALAS**)

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June 1, 2024

## Scope of the project

The purpose of the project was **to implement the online automatic assessment system, STACK, for the exercises of the Electricity and Magnetism course (FY1003)**. This project aligns with the active learning teaching strategies implemented at the Physics Department. The Project is also in line with the realization of the Fremtidens teknologistudier (FTS ) principles III, IV, and IX <sup>1</sup>.

RC, who is responsible for teaching the FY1103 course, together with JRP, was granted funding last year to develop a new version of the exercises for the Electricity and Magnetism (FY1003) course. Within the current funding project, "Mindre utdanningsprosjekt ved NV H23V24", the PIs were awarded 60000 NOK to hire and train a Master's student. The main task of the Master student was to implement the newly developed exercise in the automatic computer-aided assessment STACK <sup>2</sup>. STACK is an open-source online assessment system for STEM that can relieve teachers and teaching assistants from repetitive and technical work, and, at the same time, ensure consistency in assessment, minimizing the possibility of human errors. On one hand, STACK offers formative assessment by providing personalized help and hints to students. This allows students to progress step-by-step towards finding the correct answers at their own pace. On the other hand, STACK provides valuable insights into student learning situations for teachers, which is particularly beneficial in large classes. It enables instructors to tailor lectures and emphasize specific concepts based on real-time assessment data.

The STACK implementation for online assessment has also been very successful in other international institutions, mainly in mathematical subjects, as already reported by different

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<sup>1</sup><https://www.ntnu.no/fremtidensteknologistudier/prinsipper>

<sup>2</sup><https://stack-assessment.org/>

publications<sup>3-4-5-6</sup>. Furthermore, the implementation of STACK for online assessment has been successful at the Department of Mathematical Sciences (IMF) at NTNU in Trondheim, where it has been used for several years in their courses' compulsory activities and exercises<sup>7</sup>. Based on their collaborative and positive experience, we have set up a fruitful collaboration and had exceptional assistance from IMF to establish FY1003 as a STACK-pilot course in Physics.

## Results

With funding from the NV faculty amounting to 60,000 NOK, we hired a Master's student from November 1, 2023, to December 31, 2023. RC, with support from the IMF department, initially trained the student who quickly immersed themselves in their duties. The IMF department generously allocated server space for our pilot FY1003 STACK exercises in Physics. These exercises have been successfully implemented in STACK, and they have now been transferred to the Physics server. We conducted our first sessions with students in the Spring of 2024, receiving positive feedback.

Students appreciated the exercises and suggested incorporating more "randomization" features to aid, especially, in exam preparation. Teaching Assistants found this method promising and supported the idea of expanding randomization to enhance student preparation. The introduction of STACK for FY1003 exercises received positive comments in the 2024 reference group report (refer to FY1003-reference-group final report 2024 in KASPER).

In the Spring of 2024, 48 students participated in the STACK pilot exercises. They accessed a well-tested STACK environment provided by the Department of Mathematics at NTNU and the new STACK server in Physics. We are pleased to report that no significant technical issues were encountered, ensuring students could access exercises seamlessly regardless of their location and time.

## Continuity of the project

The project remains currently ongoing, with RC continuously improving the exercises and analyzing statistics to address the main conceptual problems that students encounter while solving the exercises. The hints provided for solving problems and supporting automatic assessment are constantly being evaluated for effectiveness and improvement. Following this successful initial pilot, these exercises are set to be used in the coming years, as STACK presents an ideal alternative given the constraints on teaching personnel support. We are actively seeking funding opportunities to introduce a "randomization" feature into FY1003-STACK exercises. This feature would automate the variation of input numbers, enabling the creation of exercise catalogs for students to work through independently and at their own pace, particularly useful for exam preparation.

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<sup>3</sup><https://iopscience.iop.org/article/10.1088/1361-6404/aa5e9d/pdf>

<sup>4</sup><https://iopscience.iop.org/article/10.1088/1361-6552/abfd40/pdf>

<sup>5</sup><https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9820546>

<sup>6</sup><https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9820596>

<sup>7</sup><https://stack.math.ntnu.no/>

STACK facilitates collaborative workgroups while offering personalized feedback and hints to help students resolve misconceptions. Furthermore, the use of STACK promotes standardized teaching approaches across IFY and IMF, which already share the MTFYMA study program, thereby benefiting students across both departments.

Other professors involved in the project, all engaged in first-year teaching courses, have been briefed on the outcomes. They gained experience from our FY1003 pilot course to potentially extend this approach to their courses at IFY. This initiative aligns with the vision articulated by the PIs in previous calls and activities aimed at integrating Interactive Computational Tools into innovative teaching methodologies. The PIs are also involved in the continuation of the project, "SALAS2" already financed by the NV faculty to extend the positive experience to other courses in physics.

Lastly, our project has garnered significant attention internationally, particularly because STACK is primarily utilized for mathematics exercises rather than physics. We have established extensive experience and collaborations with physics departments in Australia and Finland, where they are currently implementing or planning to implement the same software in their respective departments.

## Budget

The total funding, i.e. 60000, was used in agreement with the original plan to hire a Master's student to implement the 13- FY1003 exercises in the STACK software. The details of the project are as follows: K-sted 66200501 Delprosjektnummer: 976804125. That contract period was from 01.11.23 to 31.12.23.