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Report: Use of funds - UiB insentivmidler for studiekvalitet 2024

Project: Homework breadth vs depth

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Funds allocated: 46 000

Short project summary:

This project investigated the importance of homework as a key input in learning mathematics. Specifically, we investigated whether students benefit more from
a) homework that guides them in depth through *why* something works (e.g., where a formula comes from, how it relates to other theories the students already know) and focuses on rigorous understanding, or from
b) homework that highlights *applications and examples* in breadth, and guides students to deduce more general principles from familiar situations.

By systematically varying the types of homework assigned to students and tracking their study inputs (e.g., videos watched, practice quizzes attempted), we mapped out how these study inputs translate into learning. Our results are directly relevant to lecturers of mathematics-based courses, as they can inform future course design.

Methods:

All incoming economics students at UiB (from one-, three-, and integrated five-year study programs) were invited to participate in the study. Consenting students completed an in-take mathematics test, and were subsequently randomized into either the *depth* or the *breadth* study track of *Forkurs i matematikk*, an elective refresher course for first-year students.

The depth track materials focused on formal exposition of materials (e.g., proofs and derivation of formulas), while the breadth track materials focused on building visual intuition for results, and applications of formulas in real-life situations. For example, when discussing limits, the depth track worked on formulas and calculations of limits of sequences such as f(n)=1/n, while the breadth track visualized these sequences in Excel and plotted the convergence over time.

Both tracks completed the same weekly review assessments, and the same graded homework assignments. Both tracks were invited to in-person and on-line interactive seminars and office hours taught by the lecturer and a teaching assistant.

Students who performed poorly on the in-take test or expressed concern that they had forgotten a lot of high school math skills were given access to additional supportive study materials, regardless of the track they were assigned to.

Since the course was not for credit, students were instead rewarded monetarily: all graded assignments allowed the students to earn up to 500 kroner, while the final exam was worth up to 1000 kroner.

Timeline:

The in-take test was administered in the first week of the fall semester in 2024; the course took place throughout the fall semester.

Evaluation:

The consenting students' grades and canvas study progress (quiz completion, time spent watching videos, etc.) was evaluated at the end of the fall semester 2024.

Based on the results, neither track seems to significantly outperform the other in either student engagement, study time, or accumulation of math skills: in particular, both tracks result in statistically equivalent:

- On-line and in-person class attendance
- Completion of online practice quizzes
- Engagement with online study materials (measured as number of page views on canvas)
- Time spent watching video lectures (both total time and time per lecture watched when excluding re-watches of the same lecture)
- Performance on both graded and ungraded assignments

Ideally, we would be interested in whether participation in Forkurs i matematikk improves study performance, however, since we cannot randomize access to Forkurs (for ethical reasons), we cannot make conclusions about the "value added" of this course.

However, anecdotal evidence suggests that the course was useful; in particular, the lecturer of the statistics course in spring 2025 noted that the cohort seemed better prepared and struggled less with formal notation. Additionally, a student representative noted in a meeting with the lecturer and teaching committee in the economics department in April 2025 that the course was useful as a reference, and was used by the students who struggled during their first semester as an efficient way of refreshing their skills.

Way forward:

Based on these promising results, the economics department has decided to continue the Forkurs i matematikk for the school year 2025/2026, and offer a free choice between the breadth and depth tracks for all students.