

Formative E-Assessment as a Tool for Learning and Supporting the Development of Self-regulated Learning Processes

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Plan

Course

- Old format
- Challenges and Goals
- New Format

Students' Feedback

Empirical Evidence

- Analysed Data
- SEM

Future Perspectives



Course Format





Introduction to Mathematics Course Old Format

Target audience: First-year students of Economics and Social Sciences (~ 400 students)

6 ECTS points

Duration: two semesters

- **1st semester:** 4 hours of lectures per week & 2 hours of exercises
- **2nd semester:** 2 hours of lectures per week & 1 hour of exercises

Learning materials: textbook, weekly exercise sets

Teaching staff: 1 lecturer and 1 assistant

Evaluation: A 90-minute written exam at the end of both semesters, consisting of 8 exercises with multiple tasks, which contribute 50% to the final grade.



Challenges

1. The subject of mathematics
2. Students' lack of experience with self-regulated learning processes
3. Frontal lecturing



Goal

Create a course format that:

- Promotes the development of regular learning habits.
- Involves students more actively in the learning process.
- Allows for reacting to audience specific difficulties.
- Enables automated personalised feedback.



New Course Elements

1. Week	2-14. Week	Before the exam
SEE (Prior knowledge test)	Quizzes Summaries Mid-semester questionnaire	Mock exam Exam preparation via Zoom Final questionnaire



Course Elements

Individual pre-processing	On-site activities	Individual post-processing	Blended exam preparation
SEE (Prior knowledge test) Preparation quizzes	Lectures Exercise classes	Training quizzes Summaries & peer-feedback on summaries	Mock exam & peer-review of 2 other mock exams Exam preparation

Self-reflection

SEE: alignment of expectations and reflection about the role and relevance of mathematics

Quizzes: subjective understanding, effort, and used preparation materials

Mid-semester survey: learning behavior and time management

Final survey: Reflection on the learning process, rate their own performance by a grade

Implementation - STACK

Ergänzen Sie die folgenden Aussagen mit den richtigen fehlenden Angaben.

1. Wir betrachten die lineare Funktion $f(x) = 3 \cdot x + 2$ und die Exponentialfunktion $g(x) = 2 \cdot 3^x$.

Wenn x um eine Einheit wächst, .

✓ Richtige Antwort. Gut gemacht!

Wenn x um eine Einheit wächst, .

✗ Falsche Antwort

2. Die Formel der Exponentialfunktion und der Potenzfunktion können beide in der Form $A \cdot a^b$ gegeben werden.

Im Fall der Exponentialfunktion, variiert .

In Ihrer Antwort fehlen eine oder mehrere Variablen!

Im Fall der Potenzfunktion, variiert .

In Ihrer Antwort fehlen eine oder mehrere Variablen!

3. Die Funktion $f(x) = 10^x$ ist , deswegen hat die Gleichung $10^x = \frac{1}{9}$.

In Ihrer Antwort fehlen eine oder mehrere Variablen!

4. Wir betrachten einen Prozess, der durch die Exponentialfunktion $f(t) = 1000 \cdot 0.93^t$ beschrieben ist. Dieser Prozess ist ein und hat eine .

In Ihrer Antwort fehlen eine oder mehrere Variablen!

Maxima code

```
p: rand_with_prohib(2,10,[]);  
q: rand_with_prohib(1,10,[p,1]);
```

```
r1: rand_with_prohib(0,1,[]);  
if is(r1=0) then p: 1/p;
```

```
r2: rand_with_prohib(0,1,[]);  
if is(r2=0) then q: 1/q;
```

```
a: float(rand_with_prohib(85,120,[100])/100);
```

```
magnitudeA: 10^rand_with_prohib(3,4,[]);  
A: rand_with_prohib(1,9,[])*magnitudeA;  
l1: A+A*1/rand_with_prohib(2,5,[3]);  
t1: rand_with_prohib(5,15,[]);  
wf: round((l1/A)^(1/t1)*10000+0.01)/10000;
```





Criteria for Bonus Points

- Prior knowledge test
- Mock exam & peer-review of 2 mock exams
- 2 surveys
- Preparation quizzes (minimum 4 out of 5 with a minimal performance of 10%)
- Minimum 5 out of 6 summaries & peer-feedback
- All training quizzes, with a minimum performance of 80%.



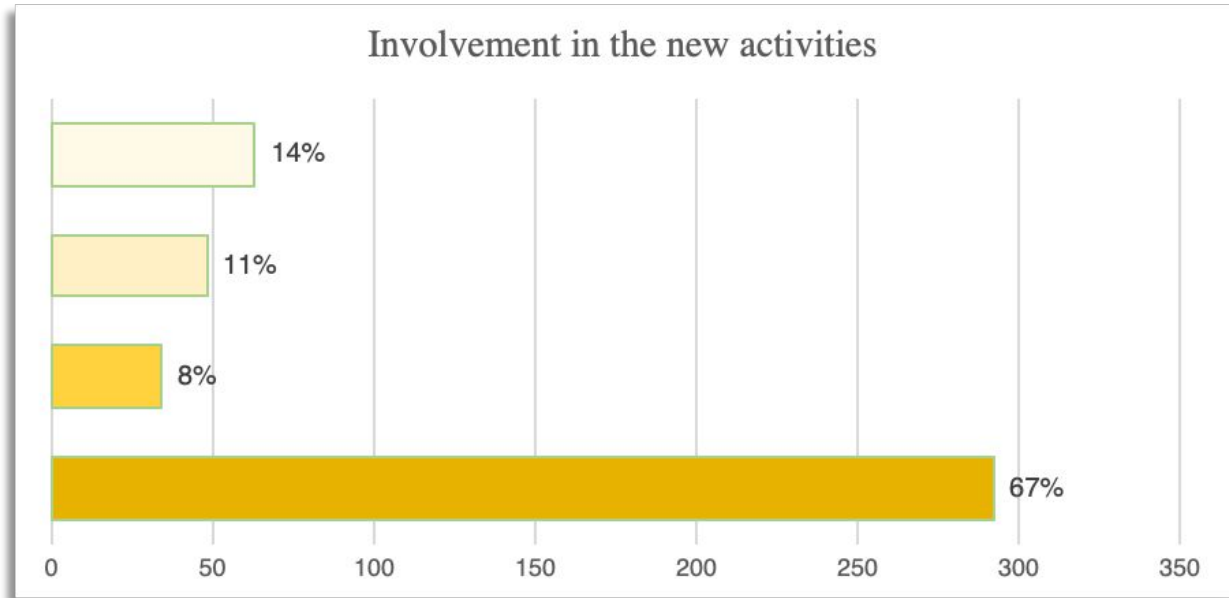
Students' Involvement

No involvement.

Started and given up early.

Not managed to complete all tasks.

Completed all tasks.





Students' Feedback





Students' Feedback

The new tasks of the course were found useful by the students.

- Pre-knowledge test & preparatory quizzes (64-81%)
- Training quizzes (93%)
- Summaries (64%)
- The mock exam (70%)



Students' Feedback

Overall opinion

The newly introduced course activities helped to **stay on track** during the semester. (92%)

It would be appreciated, if other lectures also had similar learning activities. (89%)

Appreciated details

Automated feedback about the correctness of solutions. (86%)

Organisation of information on the ILIAS course page. (84%)

Reminder emails about upcoming deadlines. (89%)



Students' Feedback

Further aspects

The study tips on ILIAS page

- are helpful, (56%)
- contribute to developing effective learning strategies. (37%)

The recommended team work during summaries deepened the understanding of the topics. (44%)

Empirical Evidence



Analysed Data - Model Variables

Prior knowledge test

- performance,
- attitude towards mathematics.

Quizzes

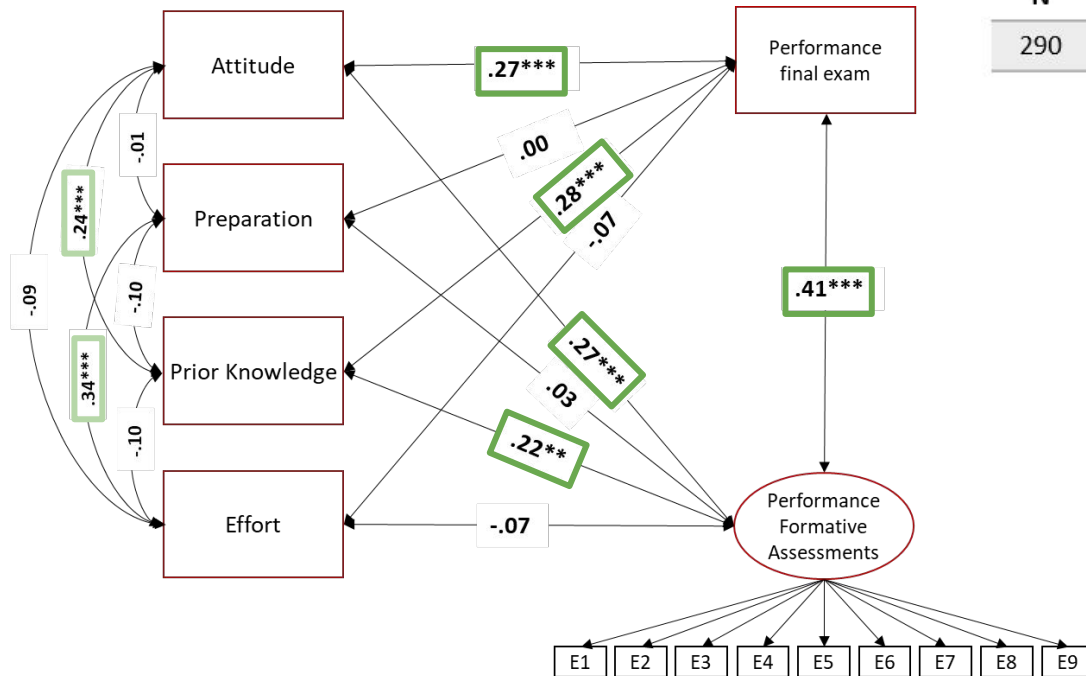
- performance & time for solving the exercises,
- subjective effort, understanding and used preparation materials.

Final exam

- performance.

Empirical Evidence

SEM for Introduction in mathematics



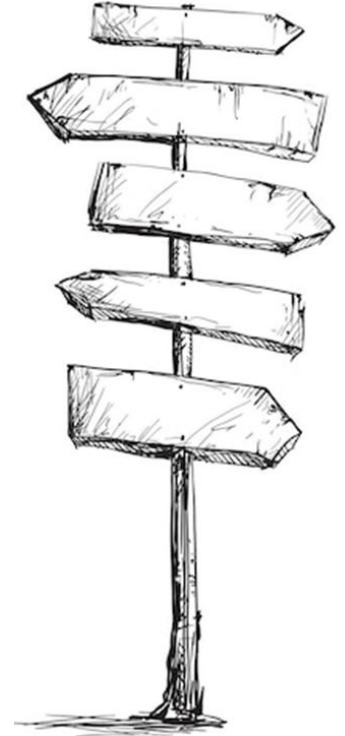
N	χ^2	df	p	CFI	RMSEA	SRMR
290	142.470	65	< .001	.901	.064	.053



Implication

Focus on supporting students:

- Possibility to engage with particular topics on an ongoing basis
- The beginning of the term is very essential
 - Activate previous knowledge
 - Link to previous knowledge
 - Possibility to catch up on previous knowledge gaps
- Pleasant learning environment





Future Perspectives



Future Perspectives

Adjust the new course activities

Analyse unused data

Plan a personalised intervention



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