NTNU

Norwegian University of Science and Technology

Enhancing Project Outcomes In First-Year PBL Courses

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Presentation Overview

Objectives

- Evaluate impact of doubling teaching sessions
- Measure effect on student confidence
- Assess improvement in project outcomes

Agenda

1	2	3	4	5
Background & Problem	Methodology	Results	Discussion	Conclusions

01

Background & Problem

First-year students in Computer Architecture PBL

What is Project Based Learning (PBL)?

Bridges theory and practice

Develops critical thinking

Promotes self-directed learning

Mirrors real engineering work

The Problem for First Year Students

1. Limited foundational knowledge
2. Low confidence in complex tasks
3. Weak self-learning ability
4. Subpar project submissions

Root Cause

- Teaching sessions
  - Only 6 teaching sessions in 2023
  - Insufficient for deep understanding
  - Students underprepared for projects
- Result
  - Low-quality, unambitious work

Study Objectives

- Enhance foundational knowledge
- Improve self-learning ability
- Improve project outcomes
- Intervention
  - Increase the number of teaching sessions

02

Methodology

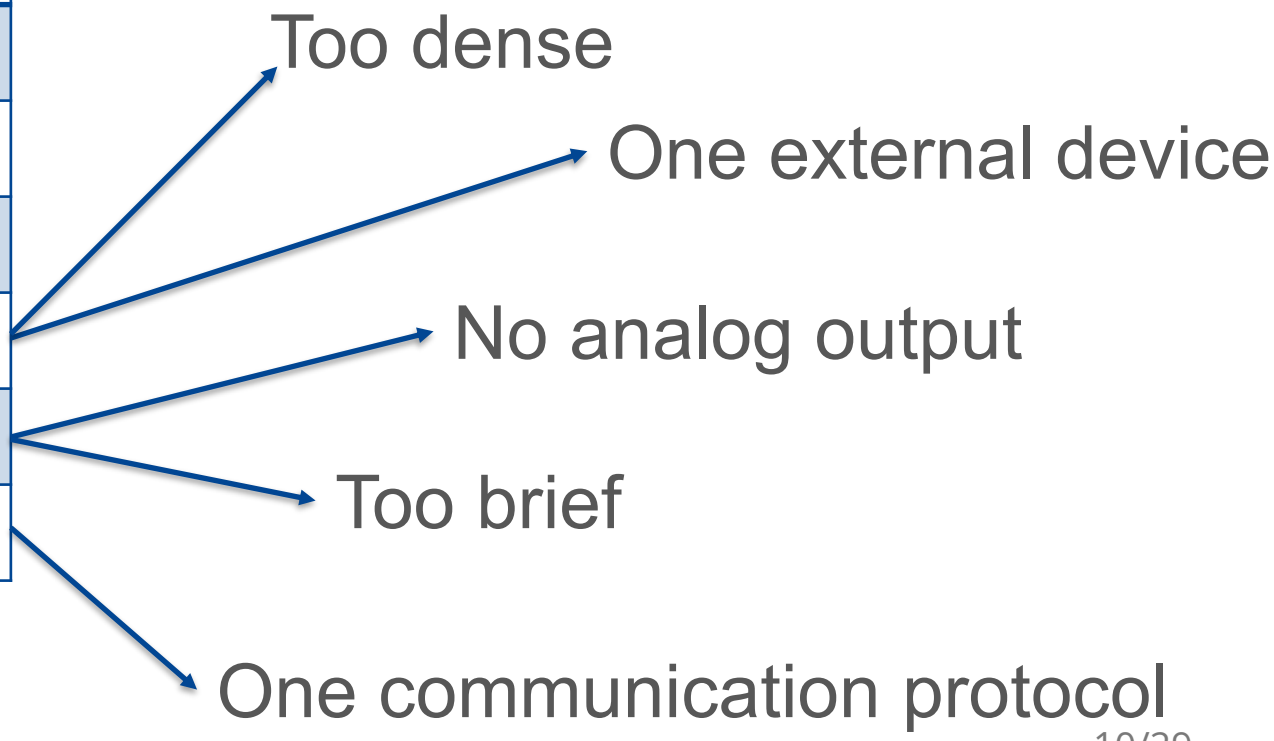
Course, intervention & evaluation

Course Context

- Computer Architecture
  - 5 ECTS
  - Bachelor of Engineering — Telematics
  - First-year students
  - 40 students per cohort

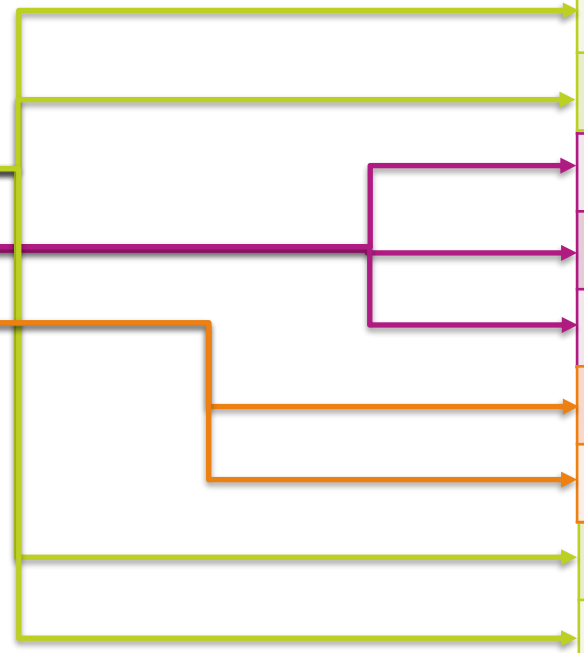
2023: 6 Sessions (Original)

#	Topic
1	Microcontrollers intro
2	Digital Output
3	Digital Input
4	Interrupts + Timers + LCD
5	Analog-to-Digital Conversion
6	Serial I/O



2024: 12 Sessions (Intervention)

#	Topic
1	Microcontrollers intro
2	Digital Output
3	Digital Input
4	Interrupts + Timers + LCD
5	Analog-to-Digital Conversion
6	Serial I/O



#	Topic
1	Microcontrollers intro
2	Digital Output
3	Digital Input
4	Interrupts
5	Timers
6	Digital-to-Analogue Conversion
7	Analog-to-Digital Conversion I
8	Analog-to-Digital Conversion II
9	Serial I/O
10	I2C
11	Servo Motors
12	LCD

Other interventions

Area	Before (2023)	After (2024)
Lecture	Traditional	Traditional lecture with guided tasks
Assignment	1 session → 1 assignment	2 sessions → 1 assignment
	Focuses on 1 module	Focuses on 2 or more modules
Lecture period	3 weeks	12 weeks
Project period	15 weeks	6 weeks

Evaluation Methods

- Project grades
  - A–F distribution
  - Same examiners
- Student survey
  - Pre & post
    - Learning benefit
    - Workload
  - Post only
    - Confidence
    - Self-learning

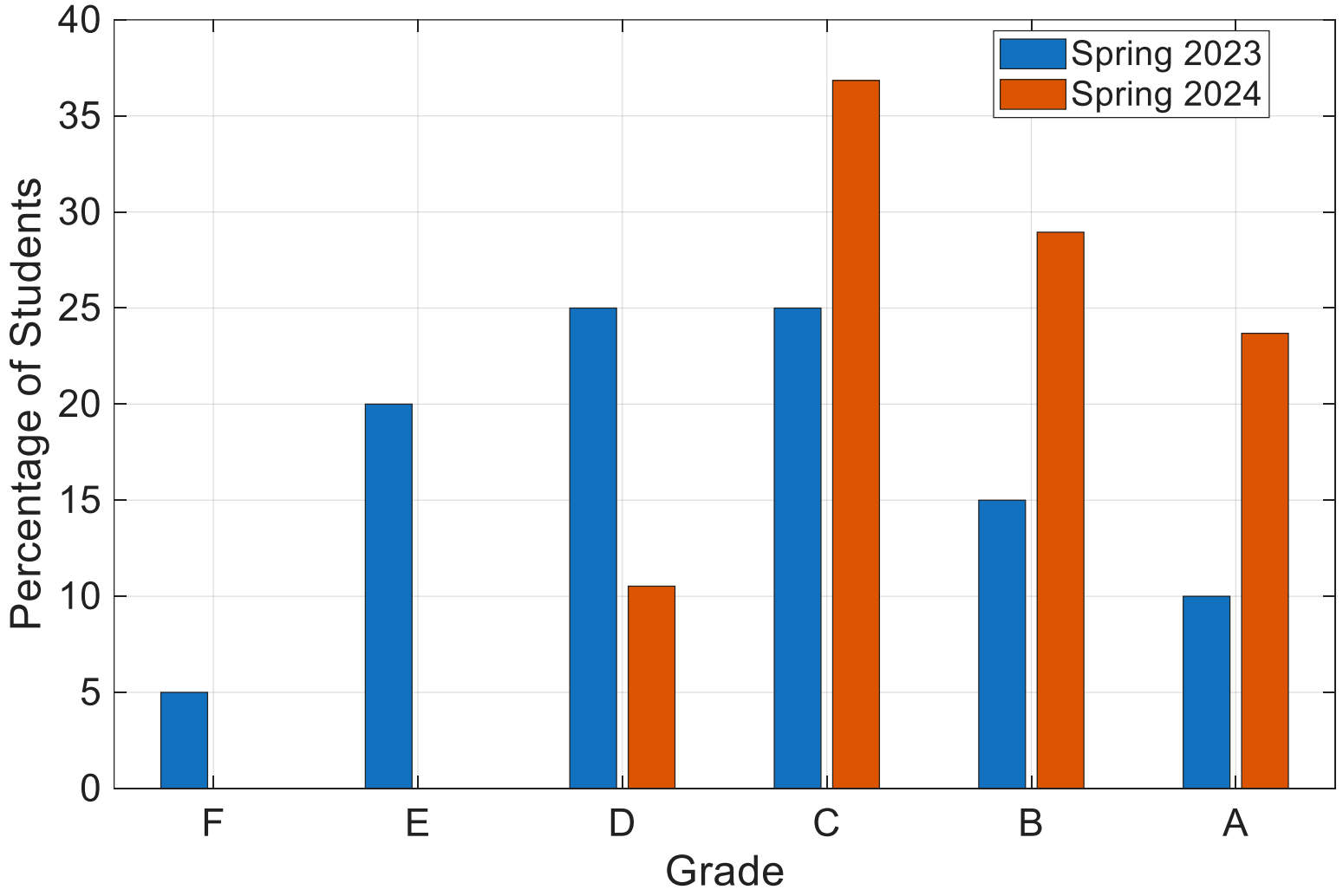
03

Results

Project grades & student survey

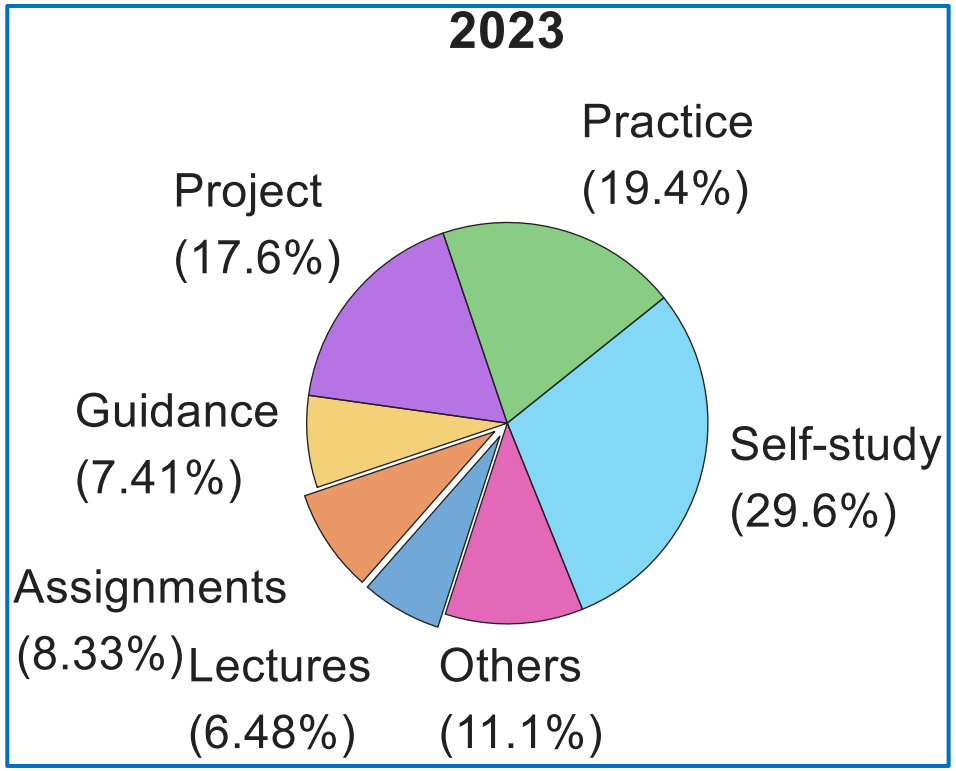
Results — Key Numbers

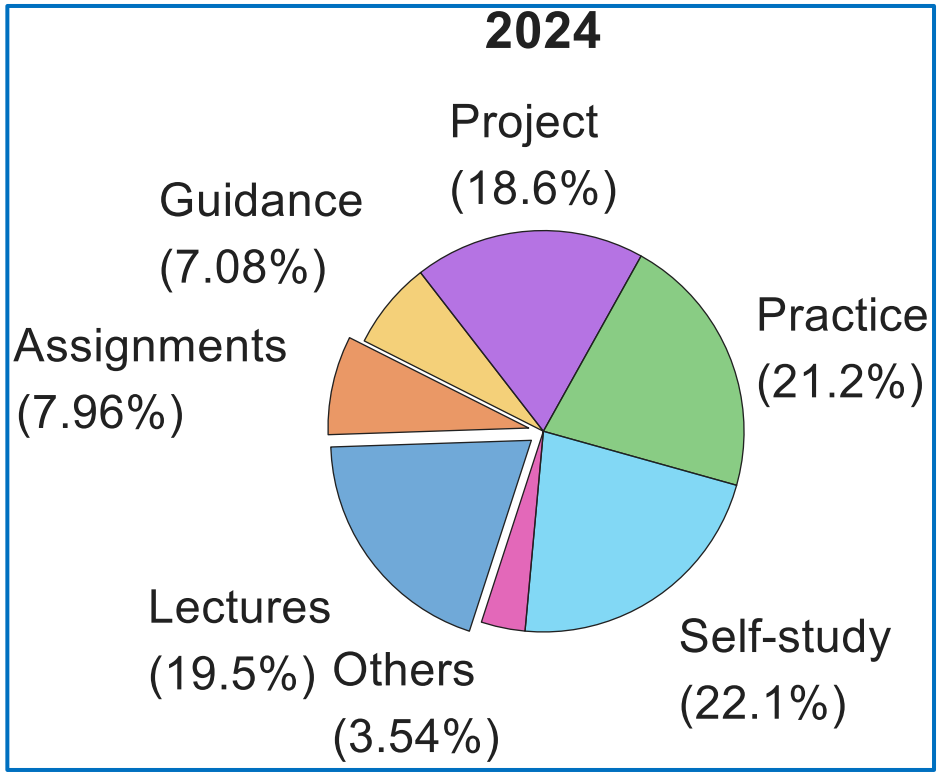
- B or higher
  - 2023: 25%
  - 2024: >50%
- D or lower
  - 2023: 50%
  - 2024: 10%



Survey — Learning Activity

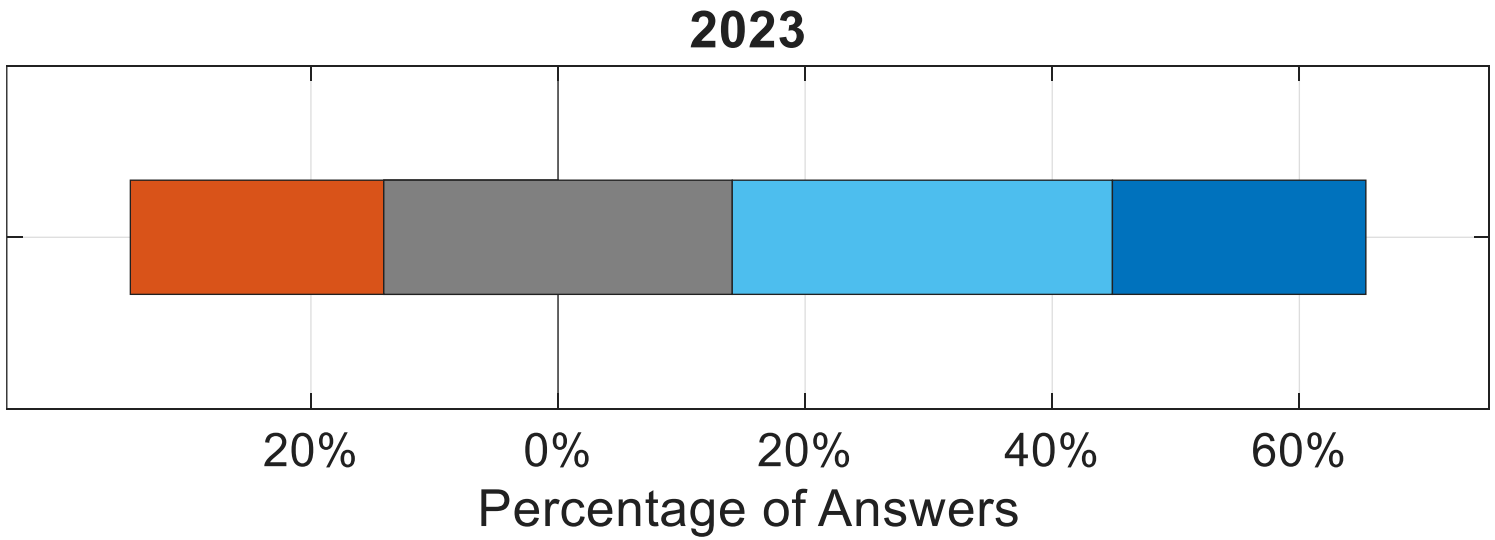
- Which activity gave greatest benefit?
  - 3× increase in lectures





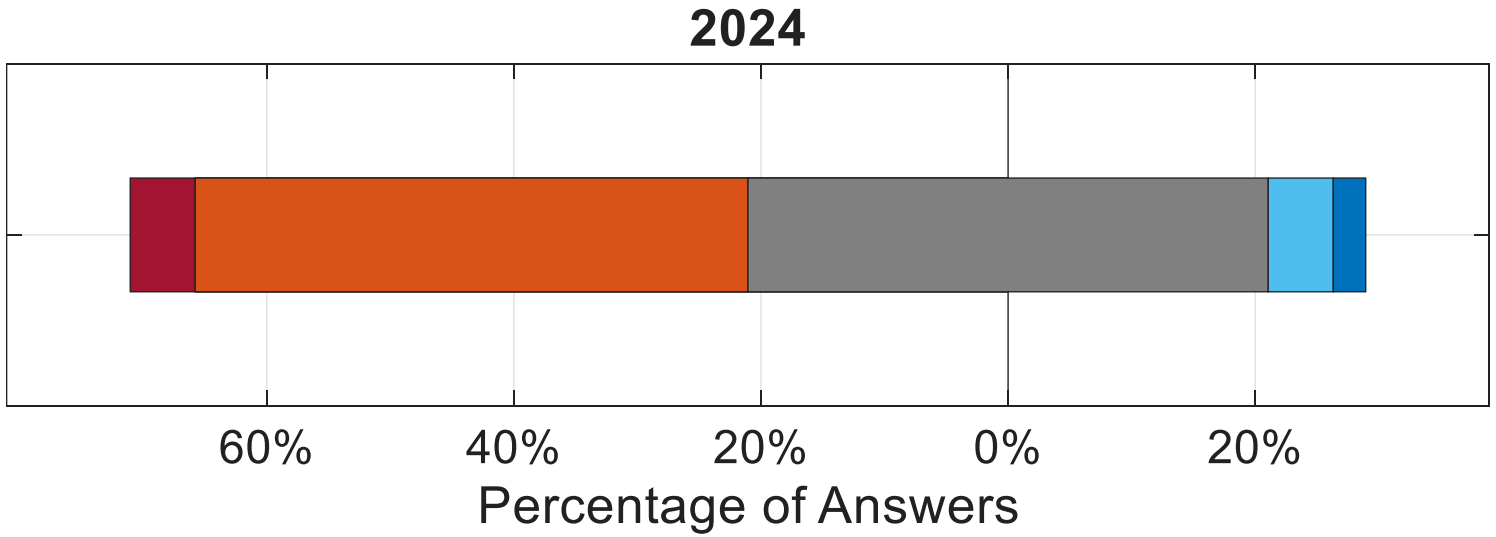
Survey — Workload

- Did workload match credits?
  - 65% found workload too heavy



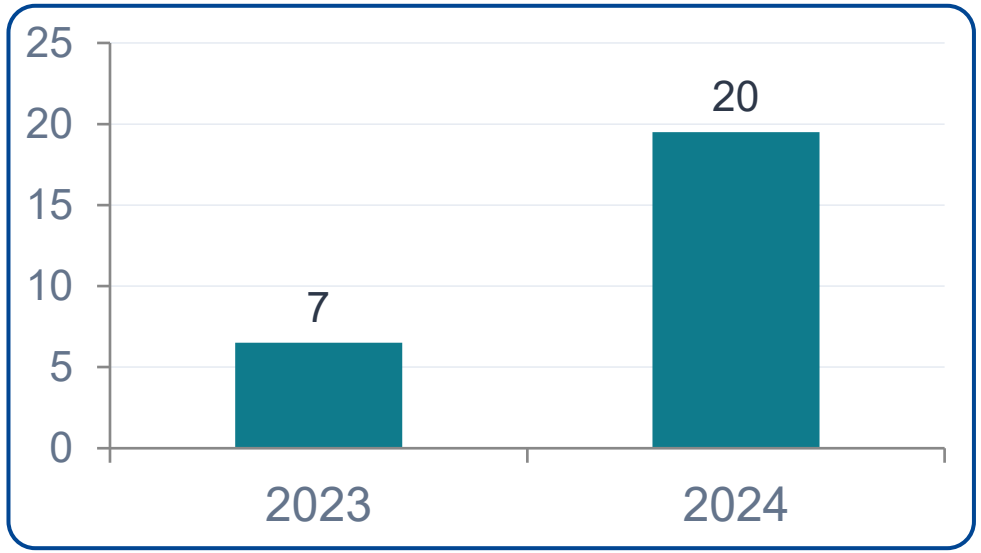
Survey — Workload

- Did workload match credits?
  - 30% found workload too heavy



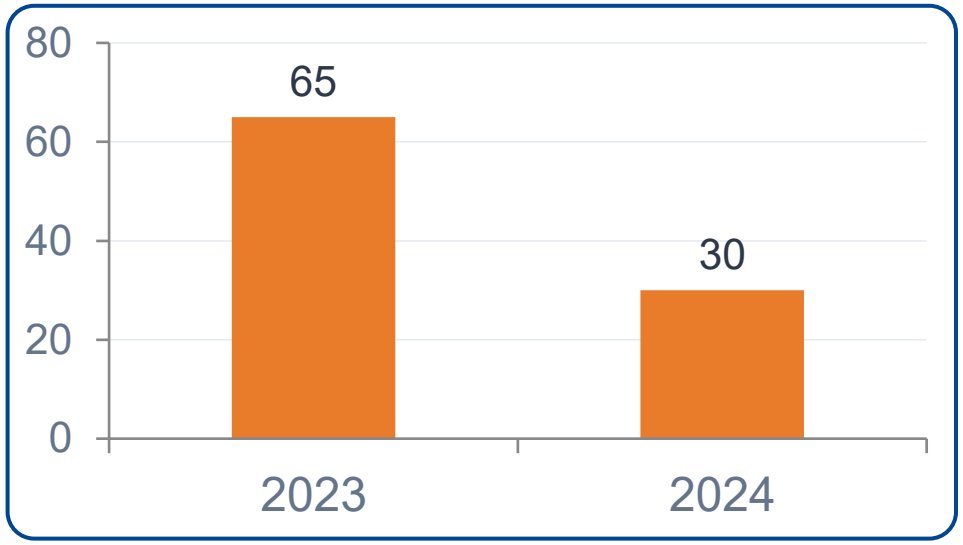
Survey — Learning & Workload

Lecture cited as best learning activity



3x increase

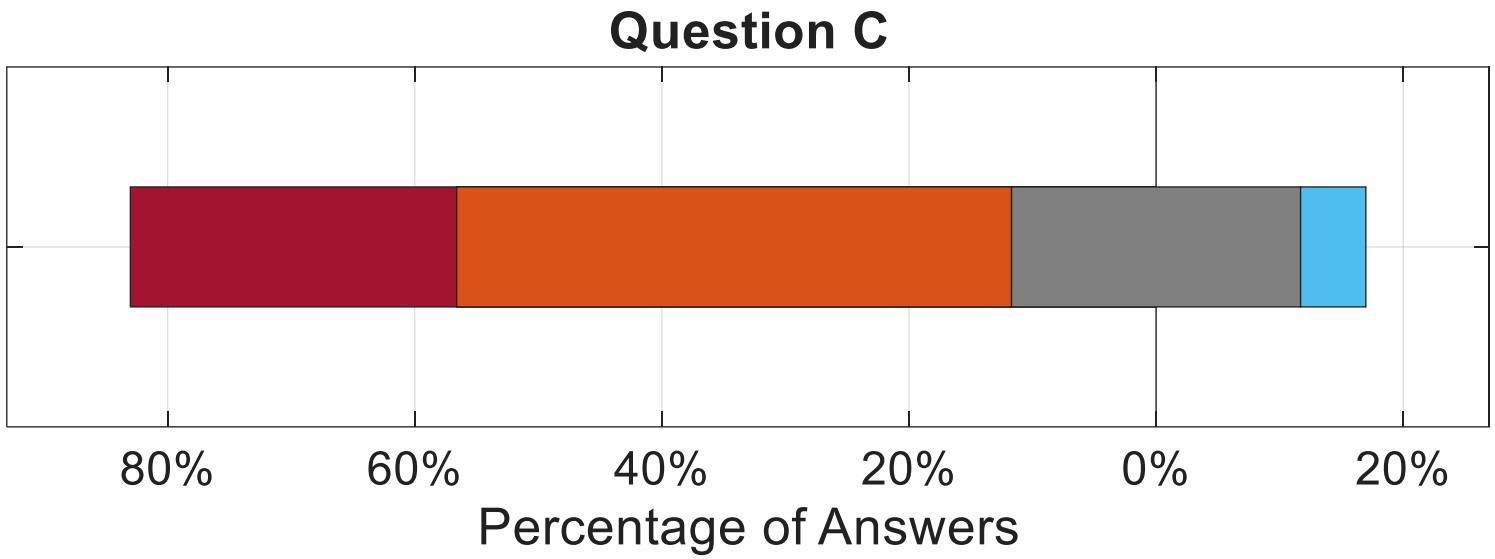
Students finding workload too heavy



Cut by more than half

Survey — Confidence

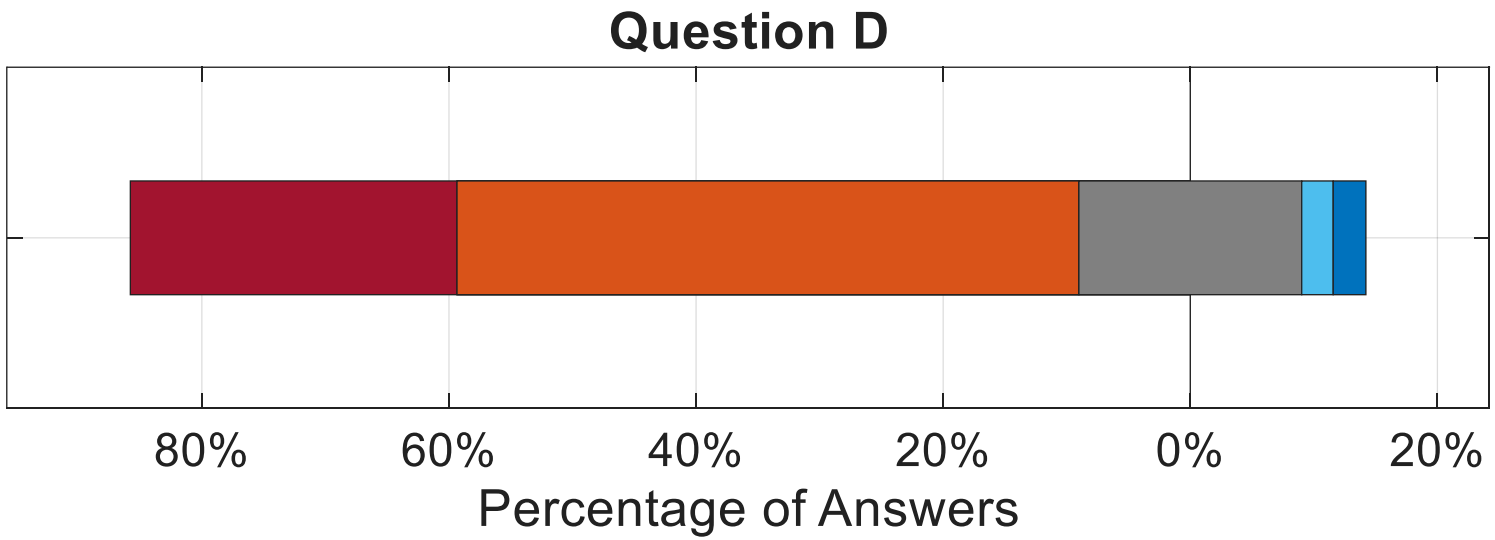
- Did the teaching sessions give you confidence?



  - More than 80% agreed sessions built their confidence
  - More than 25% agreed to a very large extent

Survey — Self-Learning

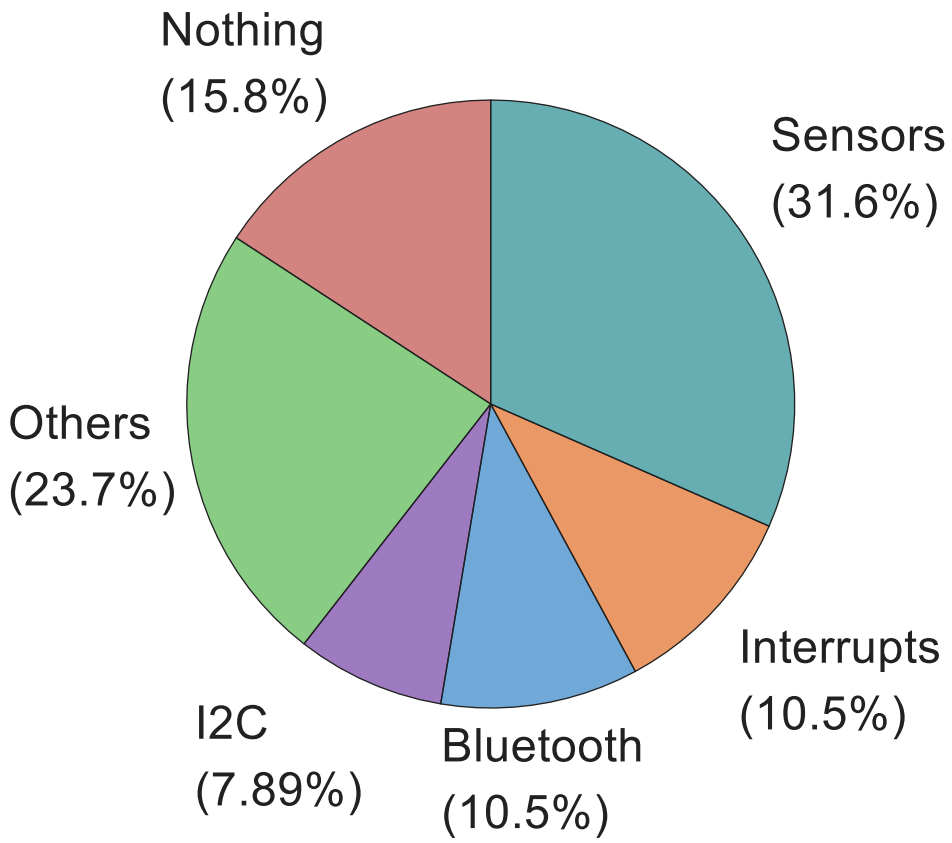
- Did the teaching sessions made it easier to learn on your own?



  - 85% found self-learning easier
  - 84% self-learned new topics in project phase

Survey — Self-Learning During Projects

- What did you learn by yourself?



04

Discussion

What the results tell us

1. Foundations Drive PBL Quality

- Engineering knowledge is hierarchical
  - Strong base → deeper engagement
- More teaching → better project
  - Despite 60% shorter project window

2. Confidence Enables Ambition

- Self-Efficacy Theory
  - Mastery experiences → belief in own capabilities
- Evidence from our study
  - More than 80% felt confident enough to take on harder projects
  - 84% voluntarily explored advanced topics
  - Better grades despite 60% shorter project time

05

Conclusions & Future Work

Conclusions

- Doubling teaching sessions
  - B or more rate doubled
  - Quality improved despite shorter project window
  - Students more confident & self-directed
- Instruction design is more important than project duration
  - Structured teaching = effective PBL

Implications & Future Work

For Educators	For Curriculum	For Research
Invest in foundational sessions before project phases	Design cross-topic assignments that build connections	Larger cohorts Longitudinal study needed

For more information:

www.ntnu.edu

Thank you

Questions & Discussion

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