WHAT IS THE VALUE OF MATHEMATICS?: ENCOURAGING MEANINGFUL PARTICIPATION IN MATHEMATICS FOR ENGINEERING COURSES

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Background

Engineering mathematics course: students unmotivated, strategic in engaging with learning and assessment activities

Lecturer had introduced mathematical modelling approach with "realistic" problems … but little change in student behaviour or understanding

What to do?

Understand students' motivations:
What is the "value" of mathematics?

➢ Pais (2013) – Critique of the use-value of Mathematics

"Mathematics is important because it allows students to accumulate school credit and achieve higher social positions"; or "mathematics is important because it gives credibility to the course"; or even "mathematics is important because it allows reproduction of social inequalities" (a certain amount of failure is necessary to maintain the status quo)

People know this is the case but it is never stated explicitly in public discourse.

Understand students' motivations: What is the "value" of mathematics?

➤ Pais (2013) – Critique of the use-value of Mathematics

The discourse of mathematics as important for everyday use conceals its real importance as "a testing and grading device. What is seen as direct property of object mathematics – its utility – is indeed the result of the place mathematics occupies within the structure of capitalist economics"

Understand students' motivations:
What is the "value" of mathematics?

➢ Williams (2012) – Cultural Historical Activity Theory meets Bourdieu

"The purpose of schooling for the adolescent is to lead their development through engagement in new, more culturally advanced, collective activity, engaging with new more developed, social motives that transform school actions into more socially and culturally meaningful activity".

Mathematics education has a use-value in the "cultural development of the mind", providing a "tool for the critical, scientific examination of society"

Understand students' motivations:
What is the "value" of mathematics?

Exchange value

- Exchanging grades for access to highly valued university courses and careers

- Teaching and learning oriented towards practising and testing of procedures

Use value

- Developing culturally valued practices and advanced (scientific) thinking

- Teaching and learning oriented towards understanding and practising in a profession

Teaching approach:
Solving the "value" contradiction

- Guest speaker – a practising engineer – on mathematical skills needed for the profession
- Develop employability skills via problem-solving, pair and group discussion, presenting and explaining solutions to the class and in written reports
- Lectures merged with tutorials: flexible use of teacher explanation and worked examples, individual and collaborative work on exercises and problems, informal student presentations
- Explicit teaching of modelling processes

1. What were students' perceptions of the teaching strategy?

2. What was the impact of the strategy on students' participation in mathematically meaningful activity?

Developmental design research and collegial peer observation
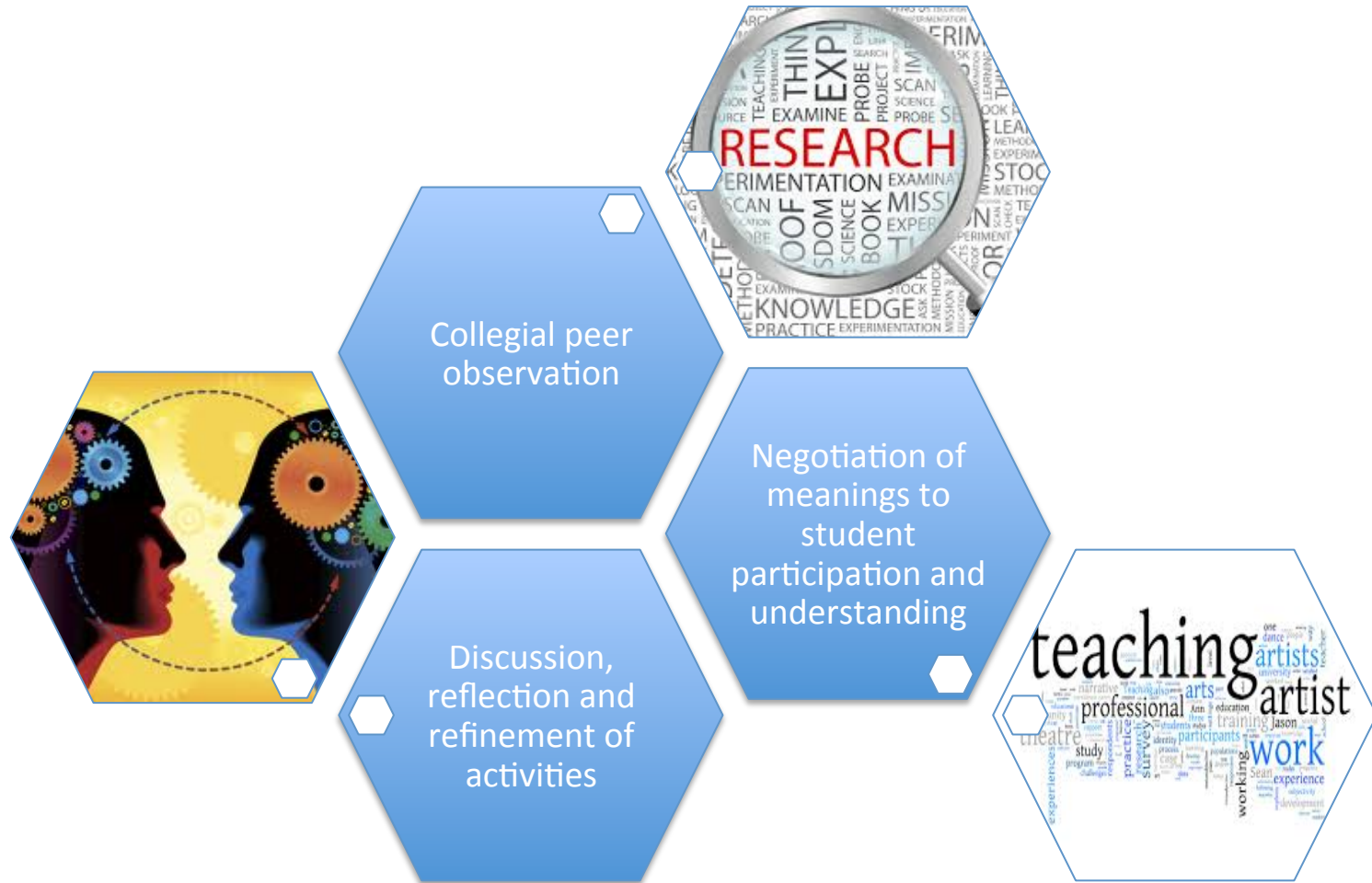
Data collection and analysis

Lecture/tutorial observation and field notes
(5/12 weeks)
Lecturer-observer discussions
before and after classes
Student written feedback (weeks 4 and 11)
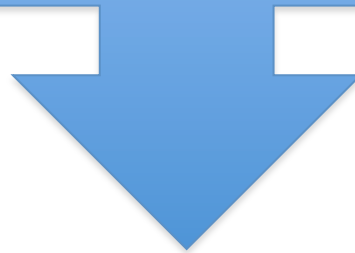
Learning as changing participation in socially situated practices

Student perceptions of the teaching strategy

What have I learned?

No. responses	Type of response
18	Content-related (how to solve differential equations)
9	Mathematical modelling: how to create mathematical models of real world situations
3	How I learn (improved teamwork skills, transfer to new contexts)

"I have learnt how to solve inhomogeneous second order ODEs and have improved my team work skills".

"I have learnt how to properly apply models to solve situations. Although my understanding needs improving I can apply myself better and draw from other areas".

Student perceptions of the teaching strategy

What do I like about this course?

No. responses	Type of response
12	Teaching approach (examples worked on the board while we work through them ourselves; interactivity of classes; group work; thorough explanations)
5	Content-related
4	Structure, simplicity, clarity of PowerPoint slides
3	Feedback (solutions to worksheets provided; online tests)

Student perceptions of the teaching strategy

What would I like to change about this course?

No. responses	Type of response
10	Make more time in class to work on problems; more worked examples
6	Provide print outs of ppts; more time to copy ppts in class
4	Give more explanation of calculation steps on whiteboard (e.g., have a column explaining the steps); more explanation of how to go from a word problem to an equation; more focus on key types of equations
3	Don't change anything
2	I don't like group work
1	More background on why we are doing this maths
1	Ensure that everyone has to present from their group

Impact on student participation

"I like how the report is set out line by line which makes the working easier to follow. Also, notes appear on the right side of the page where appropriate which makes any potentially complex parts much more straight forward. In contrast, I think that the addition of units on some parts of the various equations could make an improvement, although not essential. To conclude, this report is very well thought out, and primarily, correct."
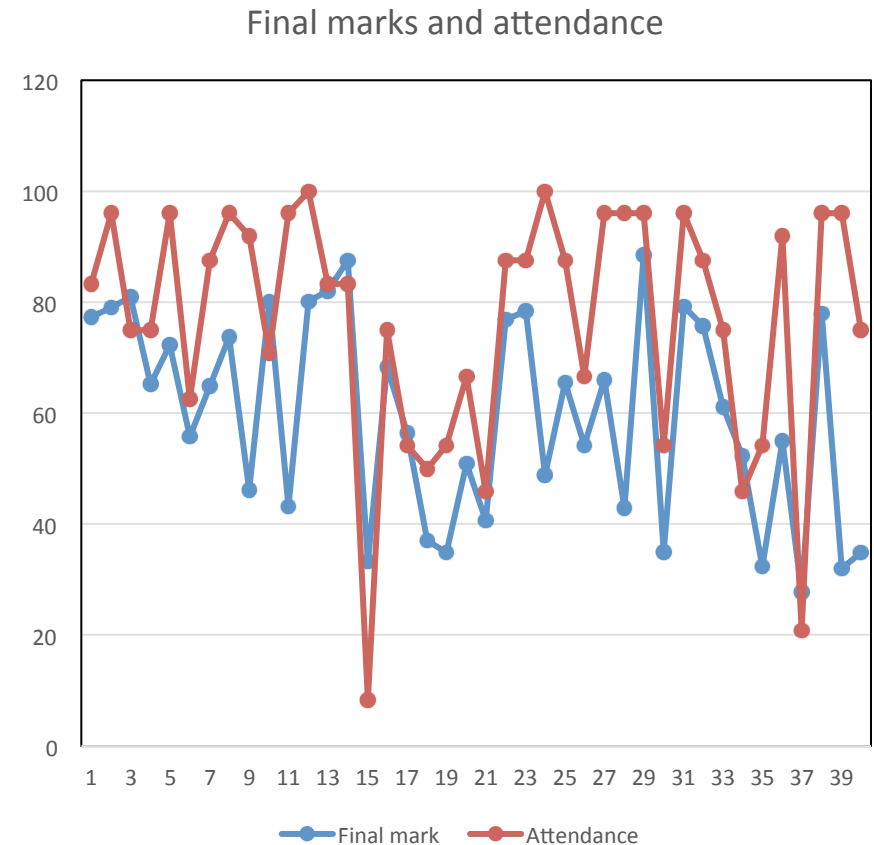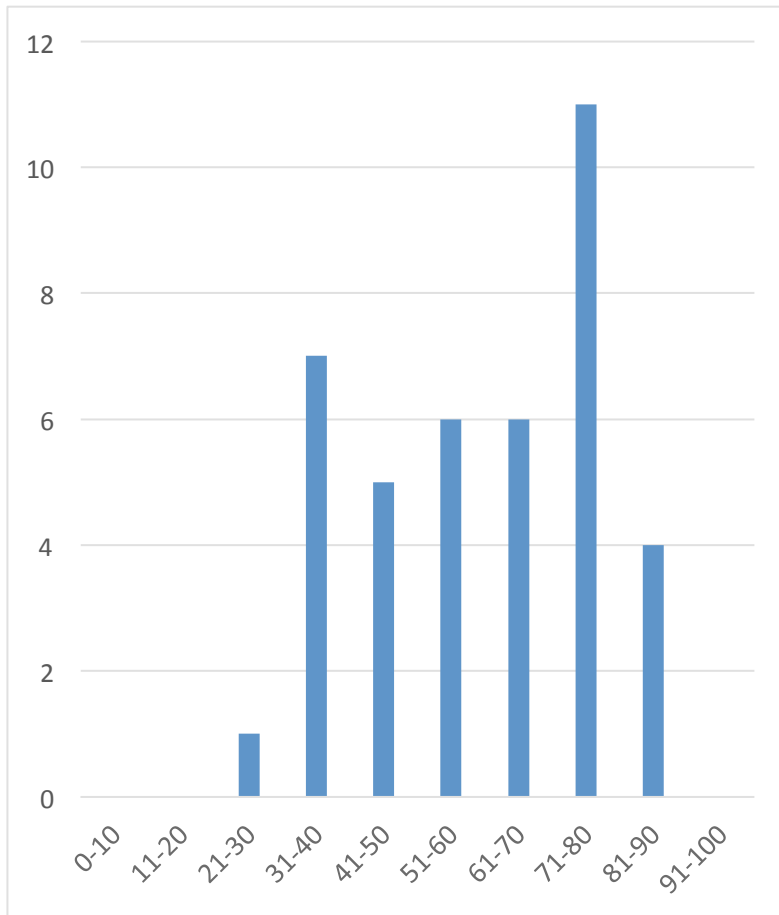
Impact on student participation

- Attendance remained high (>75%) for the whole semester (previous two years attendance was <50%)

- Almost all students participated willingly in class activities (group discussion, presenting solutions to class)

- More than half completed optional group modelling investigation outside class time and submitted individual reports

And what about student achievement?

- On average, substantially higher achievement compared with previous offerings of this course. (previous two years average final marks were 45 and 51, this year was 60)

And what about student achievement?

Implications

- Student participation is shaped by the values they ascribe to learning mathematics.

- Practices should aim to show most students that mathematics can have both use-value and exchange-value. These values can co-exist without contradiction.