Changing Assessment Methods: New rules, new roles

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Summary

1. Mathematics and Computer Algebra Systems

2. Two Experiences

3. Conclusions
Mathematics and Computer Algebra Systems

- History
- Here comes the futures: EHEA
- New rules-New roles
1.1 History: Twenty years Teaching Mathematics in a CAS environment

- From 1992 to 2012
- Traditional model: CAS has been used as an effective tool in supporting teaching
- Restricted use of the CAS in exams
1.2 Here comes the future: EHEA

- New attitude of teachers and students
- New learning scenarios
- Learning based on competencies
- New methodology
- New material
- New model of assessment
- Long-life learning
- E, b and u-learning
1.3 New rules- New roles

- Mathematical competencies for long life learning
- Collaborative learning
- Integrated use of the CAS
- What is assessed strongly influences what is learned
- New assessment methods, with free use of the CAS
Competencies and learning outcomes

**Meta competency**: To solve engineering problems with mathematical methods

- Gather and organize relevant information
- Modelling
- Separate data from aims and choose an effective strategy
- Use mathematical knowledge and adequate tools for solving the problem
Student´s aims

The student controls his own learning and his strategy for problems solving

- Mathematics are important (everywhere and every time)
- Teachers define objectives. Students choose tools and strategies
- Use of algorithms and the own toolbox
2. Two experiences
2.1 Linear Algebra

- A first-semester course of Linear Algebra for Mechanical Engineers
- 6 ECTS = 156 h student work
- Moodle for teacher-student communication
- A formative assessment model based on different learning activities
## The Experience

<table>
<thead>
<tr>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>47 students</td>
<td>49 students</td>
</tr>
<tr>
<td>Traditional teaching</td>
<td>CAS (Maxima) integrated in all learning activities</td>
</tr>
<tr>
<td>4 lab sessions with DERIVE</td>
<td></td>
</tr>
</tbody>
</table>

20/07/2012 Technology and its Integration into Mathematics Education.
TIME 2012
Choosing the CAS

For the Experimental Group (EG), we propose free and open source software, which offers:

- Freedom to use it anywhere and for any purpose
- Freedom to study and adapt it to our needs
- Freedom to distribute it to students, which working at home

20/07/2012 Technology and its Integration into Mathematics Education. TIME 2012
Materials for the EG

- Textbook
- Learning guide
- Maxima files
- Tutorials
- Worksheets
Use of Maxima

- Tutorials and files with solved problems are provided to the students.
- Problems for solving through teamwork
- One hour per week for answering questions concerning Maxima, in a traditional classroom with laptops
- Students can freely use Maxima for doing exercises and problems
### Assessment

<table>
<thead>
<tr>
<th>Control Group</th>
<th>Experimental Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>80%: Three traditional written exams with “paper and pencil” (*)</td>
<td>80%: Three written exams with free use of Maxima (*)</td>
</tr>
<tr>
<td>10% DERIVE lab sessions</td>
<td>10% Team work with Maxima</td>
</tr>
<tr>
<td>10% Quizzes</td>
<td>10% Face to face problem solving with Maxima</td>
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</tbody>
</table>

(*): Last exam was the same for both groups
# Results

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Experimental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>47</td>
<td>49</td>
</tr>
<tr>
<td>Does not complete the course</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td>activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Successfully complete the</td>
<td>40</td>
<td>33</td>
</tr>
<tr>
<td>course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not pass the course</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Efficiency rate</td>
<td>85%</td>
<td>67.3%</td>
</tr>
<tr>
<td>Success rate</td>
<td>87%</td>
<td>91%</td>
</tr>
</tbody>
</table>

Technology and its Integration into Mathematics Education.

TIME 2012 20/07/2012
Students feeling (EG)

- A survey with students opinion about the provided documents: tutorials files and solved problems files
- A survey with general questions
- Several items analyzed: Easiness, usefulness, adequate, etc.
- Perception concerning benefit-impact on competences
Survey: Tutorial of linear systems

- A: Easy to understand the document
- B: Usefulness of functions
- C: The document favours the understanding of concepts
- D: Proposed examples are feasible
- E: Usefulness of instructions in the solution of problems
- F: Using documents in exams

Rank: 0..4
The use of Maxima in exams is appropriated?

- **MUCH**: 52.63%
- **QUITE**: 31.58%
- **LITTLE**: 15.79%
- **No**: 0.00%
Impact on competences

Enhancing Self-Learning competence

- QUITE: 57.89%
- MUCH: 42.11%
- LITTLE: 0.00%
- No: 0.00%
Impact on competences

Enhancing Team Work competence

No 5.26%

MUCH 36.84%

LITTLE 26.32%

QUITE 31.58%
2.2 Methods for Signal Processing

- An optional subject for a continuing education course of Computer Engineering.
- Students are “workers who study”
- Mathematical Support for Signal Processing
- 3 ECTS = 78 h student work
- B-learning with Moodle: 30% face to face, 70% on line
Choosing the Mathematical Software

**MATLAB**

- The most widely used software for Signal Processing
- Students can define tools to be used in other subjects (Signal Processing, Systems Control, Robotic...)
- Industrial Applications
Materials

- Learning guide
- Presentations
- Documents
- Forum
- Online Quizzes with feedback
- Matlab Worksheets
- Projects
## Learning Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending Lectures</td>
<td>9h</td>
</tr>
<tr>
<td>Displaying online presentations</td>
<td>6h</td>
</tr>
<tr>
<td>Individual study</td>
<td>12h</td>
</tr>
<tr>
<td>Tutorials</td>
<td>3h</td>
</tr>
<tr>
<td>On-line quizzes (two attempts with feedback)</td>
<td>3h</td>
</tr>
<tr>
<td>Solving exercises with MATLAB</td>
<td>10h</td>
</tr>
<tr>
<td>Doing a Matlab toolbox</td>
<td>10h</td>
</tr>
<tr>
<td>Small Projects (team-work)</td>
<td>20h + 2h</td>
</tr>
<tr>
<td>Exams</td>
<td>3h</td>
</tr>
</tbody>
</table>
Assessment

- Exams (2), with free use of Matlab and the personal toolbox: 50%
- Team-Work Projects (2): 40%
- Online Quizzes: 10%
Results

- Students: Good marks and satisfaction with the assessment method
- GC: Team-work and self-learning competences has been developed
- SC: Teacher of Signal Processing appreciates the students' mathematical background
Conclusions (I)

- Students should be responsible for their own learning
- The use of Mathematical Software in the assessment activities is a crucial part in a learning framework based on competences, provides self-efficacy and promotes a way of working closer to the real work.
Conclusions (II)

- Students viewpoint:
  - Active learning helps to improve their competences
  - Good feeling about material and learning strategy
THANK YOU
GRACIAS
TÄNAN