Automatic Assessment and Feedback

Learning and Teaching Day Conference
Session on E-Learning

Thomas Prellberg

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Introduction

E-learning for Calculus I: a web-based platform for
  - self-paced student learning,
  - on-line assessment, and
  - immediate feedback.
E-learning for Calculus I: a web-based platform for

- self-paced student learning,
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- immediate feedback.

For details of the general set-up: poster on

“Improving Student Performance . . .”
E-learning for Calculus I: a web-based platform for
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- on-line assessment, and
- immediate feedback.

For details of the general set-up: poster on

“Improving Student Performance …”

This talk will focus on the interplay of formative and summative assessment mechanisms
General restructuring of first-year mathematics due to
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- dropping A-level standards
A New Approach to Calculus

General restructuring of first-year mathematics due to
- dropping A-level standards
- poor retention of learning outcomes
A New Approach to Calculus

General restructuring of first-year mathematics due to
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- doubling of student numbers
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General restructuring of first-year mathematics due to
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- stretching of resources
A New Approach to Calculus

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Suitable for e-learning: Calculus I and Calculus II
Choice of Platform

Selection of Thomas’ Calculus together with CourseCompass / MyMathLab (Pearson Education)
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- Established product (no pilot scheme)
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- Availability of more than 2000 exercises
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Similar products: Maple T.A., WileyPLUS with Webassign, ...
CourseCompass

Automatic Assessment and Feedback

Prellberg

Introduction
Background
Choice of Platform
Features
Implementation
Feedback for the Lecturer
Calculus and Beyond

Welcome, Thomas Prellberg (not you?)

Welcome to CourseCompass - My CourseCompass.

October 20, 2007 - October 27, 2007

MAS115 Course Web Page
Please check for MAS115 Calculus details on the course webpage.

Thu, Oct 04, 2007 -- Online Coursework
Please note that coursework sets have to be worked on in one sitting and have to be SUBMITTED explicitly. Otherwise you risk being blocked out of the system.

If this happens, please contact Henrik Baarnhielm at hb@maths.qmul.ac.uk.
Features

All the usual features (like in e.g. WebCT)
Features

All the usual features (like in e.g. WebCT) plus plenty of online content (too much?):
Features

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- Multimedia textbook
- Video lectures
- Java-based animations
- Powerpoint slides
- Maple/Mathematica worksheets
- Revision help: flashcards/reviewcards
- ...
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But more importantly

- Exercises with integrated support/feedback
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- Several environments: homework/quiz/test
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- …

But more importantly

- Exercises with integrated support/feedback
- Several environments: homework/quiz/test
- Personalised study plan
Features of Exercises

- Intelligent, Mathematica-based engine: more than multiple-choice questions!
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- Algorithmic questions (randomized numbers)
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- Question pooling possible for more randomness
- More than 2000 exercises available
- Fully integrated help available
- You can also design your own questions
Homework environment: sample problem

Find the value or values of c that satisfy the equation \( \frac{f(b) - f(a)}{b - a} = f'(c) \) in the conclusion of the Mean Value Theorem for the following function and interval.

\[ f(x) = 2x^2 + 5x - 3, \quad [-1, 1] \]

The value(s) of c that satisfy the above equation are 0.

(Type a simplified fraction if needed.)

Enter any number or expression in the blue-outlined box, then click Check Answer.
Exercise-specific support and help

- “Help Me solve This”: a step-by-step guide through the solution requiring the student to provide the result of intermediate calculations
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- “Textbook Pages”: leads to the relevant section in the textbook
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- “Textbook Pages”: leads to the relevant section in the textbook
- “Ask my Instructor”: enables the student to email the lecturer
Demonstration
Find the value or values of c that satisfy the equation \( \frac{f(b) - f(a)}{b - a} = f'(c) \) in the conclusion of the Mean Value Theorem for the following function and interval.

\[ f(x) = 4x^2 + 4x - 3, \quad [-3, 3] \]

The value(s) of c that satisfy the equation \( \frac{f(b) - f(a)}{b - a} = f'(c) \) is/are \( \boxed{1} \).

(Type a simplified fraction. Use a comma to separate answers as needed.)

Enter any number or expression in the edit field, then click Next Question or Previous Question.
Quiz/test environment

Help switched off, several options
  • limit total time allowed
Quiz/test environment

Help switched off, several options
- limit total time allowed
- limit number of attempts
Quiz/test environment

Help switched off, several options

- limit total time allowed
- limit number of attempts
- block other features
Quiz/test environment

Help switched off, several options

- limit total time allowed
- limit number of attempts
- block other features
- allow/disallow review
Help switched off, several options

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- block other features
- allow/disallow review
- password protection (proctor mode)
Quiz/test environment

Help switched off, several options
- limit total time allowed
- limit number of attempts
- block other features
- allow/disallow review
- password protection (proctor mode)
- scramble question order
Demonstration
Students get their personal study plan generated:
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- Start by taking a sample test or assigned test
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- Now the study plan indicates areas that need more practice...
Study Plan

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Students can monitor their own progress (and so can the lecturer)
Automatic Assessment and Feedback

Prellberg

Introduction

Background

Choice of Platform

Features

Implementation

Feedback for the Lecturer

Calculus and Beyond

Study Plan - Thomas Prellberg - Windows Internet Explorer

MAS115 QMUL 2007/8 [325] > Back to Gradebook

Previous Student

Study Plan

Click a chapter below to start practicing, or follow these steps to create a personalized study plan.

1. Take a sample test or an assigned test or quiz. Then return to this page.
2. Practice the topics you need to study.
3. To prove mastery, take another sample test or an assigned test or quiz.

Show All | Show What I Need to Study

Jump to where I worked last

Book Contents for All Topics

<table>
<thead>
<tr>
<th>Book</th>
<th>Correct</th>
<th>Worked</th>
<th>Available Exercises</th>
<th>Time Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ch 1: Preliminaries</td>
<td>31</td>
<td>31</td>
<td>79</td>
<td>4h 16m 27s</td>
</tr>
<tr>
<td>Ch 2: Limits and Continuity</td>
<td>29</td>
<td>30</td>
<td>116</td>
<td>2h 15m 37s</td>
</tr>
<tr>
<td>2.1 Rates of Change and Limits</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>10m 20s</td>
</tr>
<tr>
<td>2.2 Calculating Limits Using the Limit Laws</td>
<td>16</td>
<td>16</td>
<td>18</td>
<td>48m 19s</td>
</tr>
<tr>
<td>2.3 The Precise Definition of a Limit</td>
<td>7</td>
<td>8</td>
<td>13</td>
<td>56m 31s</td>
</tr>
<tr>
<td>2.4 One-Sided Limits and Limits at Infinity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5 Infinite Limits and Vertical Asymptotes</td>
<td>2</td>
<td>2</td>
<td>18</td>
<td>20m 27s</td>
</tr>
<tr>
<td>2.6 Continuity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.7 Tangents and Derivatives</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Central question:

“How do we get students to embrace this new technology to maximise their learning?”
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- To encourage practice, multiple coursework submissions are allowed.
- Only the final submission counts.
Implementation

- Mid-term and End-of-term tests are also done online as proctored time-limited tests
Implementation

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- 50% of the questions involve material not suitable for online assessment: definitions, theorems, simple proofs, etc.
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The final exam paper is a conventional paper exam.
- 50% of the questions are similar to online exercises.
- 50% of the questions involve material not suitable for online assessment: definitions, theorems, simple proofs, etc.

Conventional exercise classes are used to prepare for these.
Data on Student Performance

### Item Analysis

**Name**: Midterm Test  
**Date Due**: 11/09/06 5:10pm  
**Results View**: All Scores

Results submitted by an instructor are not included in this data.

<table>
<thead>
<tr>
<th>#</th>
<th>Question ID</th>
<th>Objective</th>
<th>Correct</th>
<th>Partial Credit</th>
<th>Incorrect</th>
<th>Incomplete</th>
<th>Avg Time Spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.2.31</td>
<td>Find the limit.</td>
<td>234</td>
<td>0</td>
<td>45</td>
<td>9</td>
<td>3m 14s</td>
</tr>
<tr>
<td>2</td>
<td>2.3.11</td>
<td>Find delta.</td>
<td>242</td>
<td>0</td>
<td>36</td>
<td>10</td>
<td>1m 55s</td>
</tr>
<tr>
<td>3</td>
<td>2.4.29</td>
<td>Find the limit involving (\sin x/x).</td>
<td>249</td>
<td>0</td>
<td>24</td>
<td>15</td>
<td>2m 7s</td>
</tr>
<tr>
<td>4</td>
<td>2.4.61</td>
<td>Find the limit with noninteger or negative powers.</td>
<td>215</td>
<td>0</td>
<td>62</td>
<td>11</td>
<td>2m 30s</td>
</tr>
<tr>
<td>5</td>
<td>2.5.33</td>
<td>Find the equations of the asymptotes. Then graph the rational function.</td>
<td>185</td>
<td>92</td>
<td>5</td>
<td>6</td>
<td>4m 3s</td>
</tr>
<tr>
<td>6</td>
<td>2.6.21</td>
<td>Determine where a function is continuous.</td>
<td>215</td>
<td>0</td>
<td>61</td>
<td>12</td>
<td>1m 46s</td>
</tr>
<tr>
<td>7</td>
<td>3.1.33</td>
<td>Solve applications.</td>
<td>243</td>
<td>0</td>
<td>44</td>
<td>1</td>
<td>1m 11s</td>
</tr>
<tr>
<td>8</td>
<td>3.2.29</td>
<td>Find the derivative of all orders of the function.</td>
<td>227</td>
<td>59</td>
<td>1</td>
<td>1</td>
<td>3m 45s</td>
</tr>
<tr>
<td>9</td>
<td>3.6.13</td>
<td>Find the derivatives of rational powers.</td>
<td>178</td>
<td>0</td>
<td>105</td>
<td>5</td>
<td>5m 29s</td>
</tr>
<tr>
<td>10</td>
<td>3.6.45</td>
<td>Find the slope, the tangent line, or the normal line at the given point.</td>
<td>230</td>
<td>0</td>
<td>45</td>
<td>13</td>
<td>3m 51s</td>
</tr>
<tr>
<td>11</td>
<td>4.2.1</td>
<td>Find the values of (c) that satisfy the conclusion of the Mean Value Theorem.</td>
<td>188</td>
<td>0</td>
<td>88</td>
<td>12</td>
<td>4m 50s</td>
</tr>
<tr>
<td>12</td>
<td>4.2.33</td>
<td>Find the function from a given derivative whose graph passes through a given point.</td>
<td>241</td>
<td>0</td>
<td>41</td>
<td>6</td>
<td>2m 32s</td>
</tr>
</tbody>
</table>
Data on Student Performance

Two types of data available:

- **Statistical data on performance, broken down by individual problems**
  - very useful to monitor student learning in a timely way
  - ability to identify and respond to specific difficulties
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- **Statistical data on performance, broken down by individual problems**
  - very useful to monitor student learning in a timely way
  - ability to identify and respond to specific difficulties

- **Individual data on performance for each student**
  - ability to see precisely when and for how long a student has been online: “Big brother is watching”
Demonstration
The use of MyMathLab for Calculus has been a success.

- Usefulness of MyMathLab for other mathematics modules?
- Similar environments, e.g. MyStatLab for statistics modules?
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All this is relatively new, even in the US. About one month ago the American Mathematical Society solicited comments about online grading:

http://firstyearmathematics.blogspot.com