Mastery Learning in University Education

A Teaching Enhancement Grant (TEG) Project

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Outline

1. Student – Instructor Relation
2. Mastery Learning (ML)
3. Exam Library Folder (ELF)
4. NUS Integrated Virtual Learning Environment (IVLE) Secure Exam Browser
Students-as-Consumers Model

- Over-emphasizes only one aspect of the student’s role (customer) and of the university’s mission (vendor); thereby de-emphasizing the student’s role in learning; encourages passivity on the part of the student;
- Discourage students from deep learning;
- Implies that students possess a level of knowledge, which they do not have;
- Serves to de-professionalize the academic roles and encourage the ‘entertainment’ model of teaching, which may degrade education to ‘edutainment’;
- Compartmentalizes the educational experience as ‘product’ rather than ‘process’.

Collaborative Nature of Learning

- Active learning occurs when the students are fully engaged with the content, the instructor and other students.
- Students and instructors work towards the same goal, each playing a different role.

Bloom’s 2 Sigma Problem - The Search for Methods of Group Instruction as Effective as One-to-One Tutoring

- **Conventional Classroom Learning**: group-based, no feedback, summative assessment
- **Mastery Learning (ML)**: group-based, feedback & correctives, formative & summative assessment
- **Individual Tutoring**: individualized instruction with good tutor, immediate feedback and correctives, formative & summative assessment
- Tutoring: 2 SD higher (above 98% of control), ML: 1SD higher (above 84% of control)
- All students have the potential to learn well.

Benjamin Bloom (1913 — 1999), American educational classificationist and psychologist

Essential Features of Mastery Learning

- Formative assessment aligned with learning goals;
- Feedback to be paired with specific corrective;
- Enrichment to expand learning;
- Various ways: quizzes, essay, projects, report, etc.

Assessment is the Centerpiece

- Student assessment is a means of setting targets for students;
- Students’ expectations of the type of exam you’ll give greatly influence how they study;
- If students expect a demanding exam then they study harder;
- If students expect an exam emphasizing understanding instead of memorizing, they learn deeper;

Teaching  
Continuous Assessment  
Learning

Final Exam
Bloom’s Taxonomy

Remember

Understand

Apply

Evaluate

Analyze

Create

ELF Overview

- Exam Library Folder (ELF) is programmed by using the Microsoft Visual Foxpro language.
- The courseware consist of 3 parts:
  - A database which contains test questions designed by users,
  - Basic tools to manage these questions, and:
  - A graphic interface to generate exam papers from the database

for m.i=1 to m.num
  select 1
  use xztpart
  m.recno=int(m.total*rand())+1
  go m.recno
  scatter memvar memo
dele
pack
  m.total=m.total-1
select 2
  use xztst
  append blank
  go bottom
  gather memvar memo
endfor
Which of the following descriptions of pH is correct?
(A) There are more H+ in a solution of pH 1 than that of pH 7
(B) The addition of NaCl into pure water (pH = 7) will not affect its pH
(C) The addition of NaCl into pure water (pH = 7) will increase its pH
Generate a Set of Questions

Table of Content

- Chapter 1 Partition
- Chapter 2 Mass transfer
- Chapter 3 Dispersed system
- Chapter 4
- Chapter 5
- Chapter 6
- Chapter 7
- Chapter 8
- Chapter 9
- Chapter 10
- Chapter 11
- Chapter 12
- Chapter 13
- Chapter 14
- Chapter 15
- Chapter 16
- Chapter 17
- Chapter 18
- Chapter 19

No. Selected Questions

- Multiple Choice: 0
- Short questions: 0
- True or false: 0
- Matching: 0
- Fill-in-blank: 0
- Long questions: 0
- Calculations: 0

Difficulty:

- 1
- 2
- 3
- 4
- Any

Buttons:

- Cancel
- OK
An In-class Quiz

1. The electromagnetic wave in red color has a wavelength of: A) 600 nm, B) 600 µm, C) 600 mm
2. Hydrogen atom has only one electron, so it has only one energy state. A) Right, B) Wrong
3. Mercury atoms emit many different wavelengths, all visible to human eye. A) Right, B) Wrong
4. Zinc atoms only absorb photons of 218 nm in flame. A) Right, B) Wrong
5. Ions already lost electrons, so they cannot emit electrons. A) Right, B) Wrong
6. Inside hollow cathode lamp, inert gases emit photons. A) Right, B) Wrong. [Both inert gases and metal emit photons in the lamp; the photons from metal atoms are needed.]
7. Inside hollow cathode lamp, electrons were emitted and pass through the flame. A) Right, B) Wrong
8. Solid samples cannot be introduced directly by ultrasonic nebulizer. A) Right, B) Wrong
9. Inside pneumatic nebulizer, the baffles prevent evaporation. A) Right, B) Wrong
10. Inside ultrasonic nebulizer, water is evaporated first and then condensed. A) Right, B) Wrong
11. During atomization, NaCl becomes Na⁺ and Cl⁻. A) Right, B) Wrong
12. In a graphite atomizer, there is no nebulization. A) Right, B) Wrong
13. In an inductively coupled plasma atomizer, ions will not form. A) Right, B) Wrong
14. Gratings can _____ light. (A) Diffract (B) Refract (C) Emit
15. Photo-electric effect describes the phenomenon that ____ are emitted. (A) electrons (B) photons
16. In photomultiplier tubes, many ____ strike the anode. (A) electrons (B) photons (C) atoms
17. Chemical interference happens when many atoms are ionized. A) Right, B) Wrong
18. An ionization suppressor decreases the extent of oxidation of analyte. A) Right, B) Wrong.
19. If a metal atom is oxidized, its emission spectra will not change. A) Right, B) Wrong.
20. Compared with acetylene flame, plasma offers higher temperature. A) Right, B) Wrong.
21. Green light has a higher frequency than red light in vacuum. A) Right, B) Wrong.
22. Green light travels faster than red light in vacuum. A) Right, B) Wrong.
23. If green light was absorbed by a solution, the solution will appear green. A) Right, B) Wrong.
24. Atomic spectroscopy can be used to measure most drugs' concentrations. A) Right, B) Wrong. [For metal drugs only, most drugs do not contain metal elements]
1. In total 24 questions (number of questions for each type: 13 knowledge, 8 comprehension and 3 application;
2. It is a closed-book test;
3. 138 students took the test in a lecture theater;
4. After the test, the question papers were collected and marked and the results were input and analyzed manually.
Student Feedbacks

1. Generally, students gave positive comments to this approach. Typical ones from NUS student feedback system:
2. “He gives ample questions for us to practice on.”
3. “The short quiz he gave at the end of the Atomic Spectroscopy lecture really helped in checking my understanding.”

Any other comments:

I don't like Math 😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞😞�

I only understand +/- x / ;

Do we have to derive mathematically during exam??
Dear NUS Students,

Instructions for NUS e-Exam (Part 1)

For e-Exam on IVLE, you must have a NUS LockDown Browser installed on your laptop.

For Windows

A. If this is the first time you are running e-Exam on this machine, please follow the steps below

1. Download the Windows setup.exe file from the link: [WINDOWS OS](#)
2. "Open" or "Run" the exe file
3. Follow the instructions provided in the InstallShield setup.

B. Click the TEST BROWSER link to confirm your installation was successful.

If the installation was successful, a new window should appear with the text "NUS LockDown Browser is installed and working." If the installation was not successful, an error message will be displayed. Please e-mail to the NUS e-Exam Team for assistance.

C. To start your e-Exam [CLICK HERE](#)

References

[INSTALL, TEST AND TROUBLESHOOTING] [GETTING READY FOR THE E-EXAM] [FINISHING THE E-EXAM]
A Quiz in IVLE Secure Browser

2. NUS CIT staff were informed a week prior to the test, to set up extra routers in the test venue.
3. Students were informed to bring laptops, fully charged. (At the date of the test, CIT staff brought 20 extra laptops as backup).
4. The actual test is 30 minutes while the preparation took 45 min.
5. Many technical issues encountered by the students (computer hang/cannot leave the error web pages / program does not run/…), to be solved by CIT staffs only.
6. Some students take photos of their screens. So phones must be banned from the test completely.
7. Pads running windows are ok, but ipad / android cannot work.
8. Students who finish early must leave classroom to avoid talking.
9. ‘End assessment’ does not mean the students leave the secured IVLE page. One way to enforce all students leave the page is not to tell the exit password and the lecturers will exit for the all students after they raised their hands.
### Poll After IVLE Secure Browser Test

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<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Tests under the secured IVLE.</td>
<td>6.7%</td>
<td>5</td>
</tr>
<tr>
<td>Conventional paper-based tests.</td>
<td>72.9%</td>
<td>54</td>
</tr>
<tr>
<td>Test format does not matter.</td>
<td>20.2%</td>
<td>15</td>
</tr>
<tr>
<td>Total Responses</td>
<td></td>
<td>74</td>
</tr>
</tbody>
</table>
Summary

- Informative assessments are the core of mastery learning. Frequent feedbacks given to students are important in the learning process.
- Courseware, such as ELF and IVLE Secure Browser can be useful giving feedbacks to students but their implementation can be challenging.
Thank You!