

4th Irish Workshop on Maths Learning and Support Centres

*“Using Technology to Increase Active
Engagement with First Year Maths”*

David Doyle

Learning Outcomes – Mathematics for Science

Learning Outcomes

On successful completion of this module the learner will/should be able to...

1. Perform calculations involving molar concentration and serial dilution type problems.
2. Use the three laws of logarithms to solve pH and dB related problems.
3. Draw and mathematically analyse max/min curves and solve optimisation problems.
4. Evaluate basic definite and indefinite integrals and determine the area under a curve.
5. Identify different types of data and use appropriate tables and curves to analyse data sets.
6. Communicate mathematical data individually and in teams in an appropriate format

Coursework Assessment Breakdown	%
Course Work / Continuous Assessment	30%
End of Semester / Year Formal Examination	70%

What does Moodle do?

Typical Topic

2 Logarithms and Exponents

Lecture notes



History of logarithms



Logs, Decibels and pH 2009



log problems solved

Quizzes



Logarithms quiz



Exponential Growth and Decay



decibels, pH, exponential growth and decay

Webpage



Interactive webpage to help solve decibel problems

You  Tube



You tube video - solving log equations

Moodle Quiz?

9 -11 quizzes in the module ***“Mathematics for Science”***

Each Quiz has a bank of 50 - 80 questions

All either MCQ or numerical answers

For each quiz attempt the student is presented with 5 - 10 random questions from the question bank

“There is no failure except in no longer trying. “

Elbert Hubbard

Example of a typical quiz

1 🚩

Marks: 1

A sound pressure is measured as 150 mPa. Calculate the decibel level using the formula $dB = 20 \times \log \frac{\text{measured pressure}}{\text{reference pressure}}$. Take the ref pressure to be 2×10^{-5} and round your answer to the nearest full dB.

Answer:

2 🚩

Marks: 1

The sound pressure level in an industrial environment is 71 dB. what will be the new decibel level if the sound pressure is doubled?

Choose one answer.

- A. 81 dB
- B. 77 dB
- C. 75 dB
- D. 142 dB
- E. 72 dB

3 🚩

Marks: 1

The hydrogen ion concentration of a particular solution is

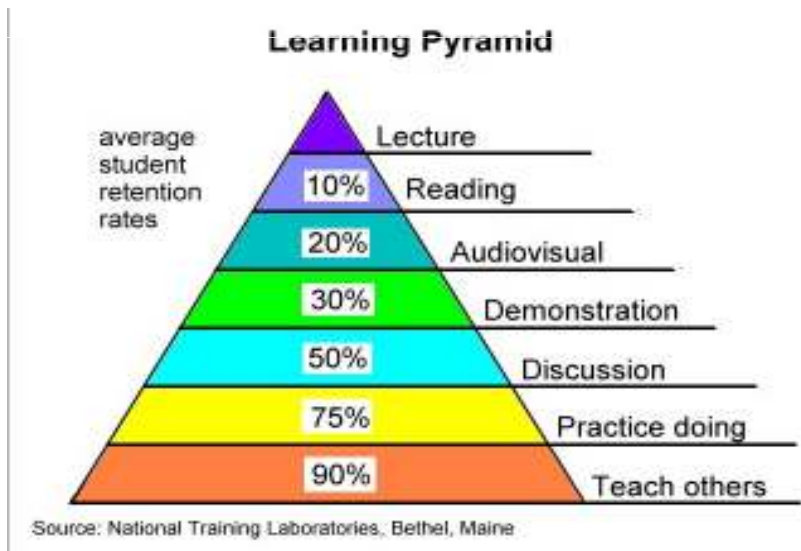
$$[H^+] = 7.8 \times 10^{-11} \text{ mol L}^{-1}.$$

Calculate its pH value, to two decimal places.

Answer:

Space to fail

*Space to practice and make mistakes without penalty
is essential to building confidence*



**"All my successes have been built
on my failures."**

Benjamin Disraeli

Limitations of these quizzes

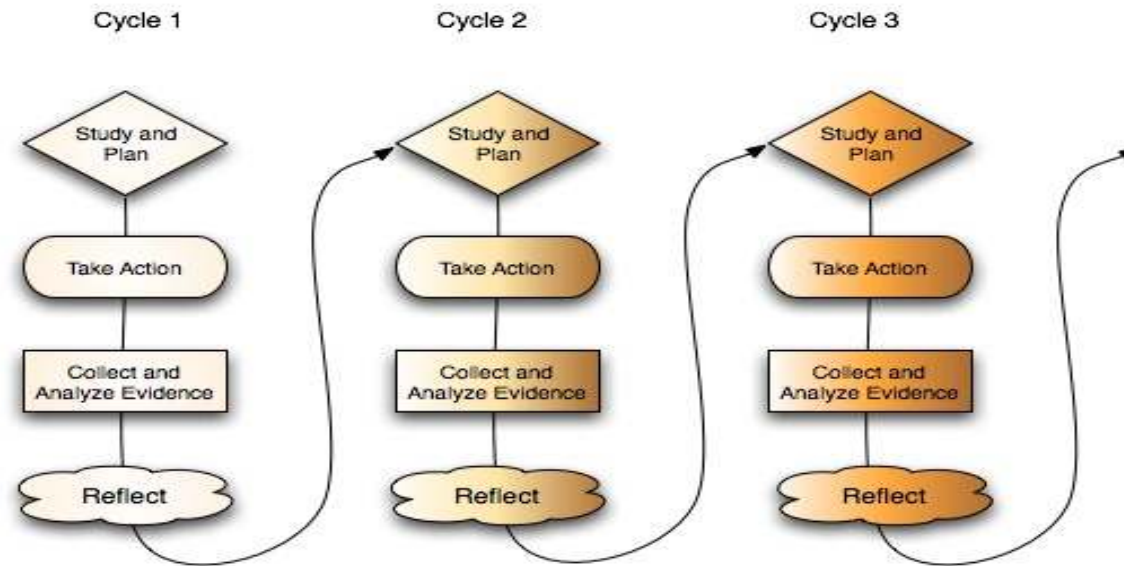
- LaTeX – needed for complex expressions

$$\frac{\sqrt{3261} \times 625^2}{2250 \times 320} = [\frac{\sqrt{3261} \times 625^2}{2250 \times 320}]$$

- This also limits the types of responses allowed to students.
- Developing and testing question banks quite time consuming!
- Limited format of assessment as the student's work is unseen.

Action Research

The action-research spiral cycles



Progressive Problem Solving with Action Research

Source: <http://academics.georgiasouthern.edu/>

"Failure is only the opportunity to begin again, only this time more wisely."

Henry Ford

2007 – Cycle 1 approx 133 students

Continual Assessment - 20% written exam
10% online exam

Quizzes used as formative assessment

- no marks awarded
- immediate feedback

Used to practice for the exams

2007 – Cycle 1 reflection

- Relatively poor engagement with quizzes
Average attempts per quiz per student = 1.2
- Generally, mature and “good” students tried the most
- Most attempts were in the days preceding the exams
- Significant numbers (>25%) didn’t make any attempt

2008 – Cycle 2 approx 128 students

Continual Assessment - 15% continual improvement in quizzes
(no deadlines – unlimited attempts)
15% online exam via Moodle

Quizzes used as formative assessment – providing continual feedback without marks

Also used as summative assessment – once students showed improvement up to at least 80 -100% in all quizzes they got 80-100% of the marks

2008 – Cycle 2 reflection

- Increased engagement with the quizzes

Average attempts per quiz per student = 3.4

- Attempts focussed mainly about the online exam and final deadline.
- > 90 % participation

2009 – Cycle 3 approx 142 students

Continual Assessment - 10% online exam

20% full marks in all quizzes

(unlimited attempts, 2 wk deadline)

Each quiz was only open for 2 weeks after the lectures finished.

Students had to get 100% in each quiz within the deadline to get the marks.

2009 – Cycle 3 reflection

- Significantly improved engagement

Average attempts per quiz per student = 7.6

- > 95% participation
- Student attitude “shifted” – they were now in complete control of their CA mark and quite enthusiastic about “getting 100%”

Overview – total attempts from 3 cycles

1	Quiz - Using a Scientific Calculator	Attempts: 935 ← Cycle 3 only
2	Logarithms quiz	Attempts: 2889
	decibels, pH, exponential growth and decay	Attempts: 2471
3	Test on Parmaceutical Units	Attempts: 1976
	Moles ,Molarity and ppm test	Attempts: 2472
	Dilutions test	Attempts: 1841
4	Differentiation Problems	Attempts: 2565
5	Max/ min quiz	Attempts: 1679
	Rate of change Quiz	Attempts: 1722
6	Integration quiz	Attempts: 95 (0 ← Cycle 1 only
	area under a curve quiz	Attempts: 71 (0 ←
8	Continual Assessment Exam April	Attempts: 155 (0

Other Observations

- Mature Students consistently (>60%) amongst top 10 users of quizzes
- Useful for “drilling” techniques through repetition of similar problems.
- Helped emphasise accuracy in expressing results and units (significant figures, SI units etc.)
- No penalties for mistakes – helps dispel wariness and encourages reattempts
- ***Students never complained about the workload !!***

Future Ideas



- Limit number of attempts to prevent fishing for “nice” quizzes.
- Use maths journals to test “worked out” solutions to more complex problems – already tried successively in Module 3
- Examine correlation between quiz engagement and performance in final exam.
- Phd investigating some of the themes explored ? ?

Student comments – Reflective journal

“Moodle test are a great thing, its annoying when you get it wrong but it makes u want to get it right so u can say you got a 100% 😊😊😊.”

Student 1

The good points from first year maths were definitely the moodle quizzes. They were brilliant as I became very confident wit the topics we were doing and I got plenty of practice. You needed to get at least 80 percent so it forced you to go over the stuff and get competent in it!!

Student 2

Student comments – Reflective Journal

“As for the good points to last year.....were moodle exams. It gave me more confidence knowing that I didn’t have to have the correct answer the first time”. *Student 3*

“I love moodle it’s a great resource for us as the maths change every time you try a new quiz!” *Student 4*

Student comments – final thoughts

“From secondary school, I liked maths and I thought I knew how to do it, but then in my first year in college, I realised that I didn’t know maths at all.

I was so used with the calculator, letting it doing every sum for me hence rendering my brain lazy.

Doing maths without calculator was a night mare, but now I’ll say I’m very proud of myself. I don’t always need a calculator to do the maths for me, I can use my brain.”

Student 5

Thank You

Any Questions?