Just how good are student-generated assessment questions?

Simon Bates

CWSEI Seminar Oct 16th 2012

Overview

I. About PeerWise

II. Pilot use at UoE 2010—

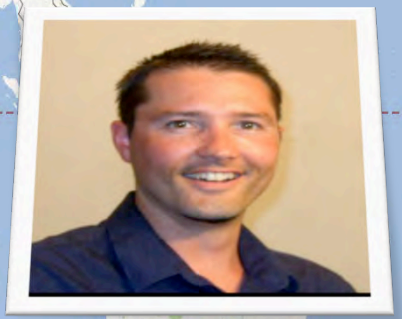
III. Question quality?

IV. Community, future research

2007 2008 2009 2010 2011 2012

Satellite

Traffic



Greenland
Iceland
Finland
Sweden
Norway
Russia
United Kingdom
Poland
Canada
Kazakhstan
Mongolia
China
Japan
South Korea
Afghanistan
Iran
Pakistan
India
Thailand
Saudi Arabia
Libya
Egypt
Algeria
Mali
Niger
Chad
Sudan
Nigeria
Ethiopia
Kenya
DR Congo
Tanzania
Angola
Namibia
Botswana
Madagascar
South Africa
Venezuela
Colombia
Brazil
Peru
Bolivia
Chile
Argentina
South Pacific Ocean
South Atlantic Ocean
Indian Ocean
New Zealand

2000 mi
2000 km

I. About PeerWise

The University of Edinburgh
Edinburgh, Scotland
5th July, 2010

PeerWise

bridging the gap between online learning and social media

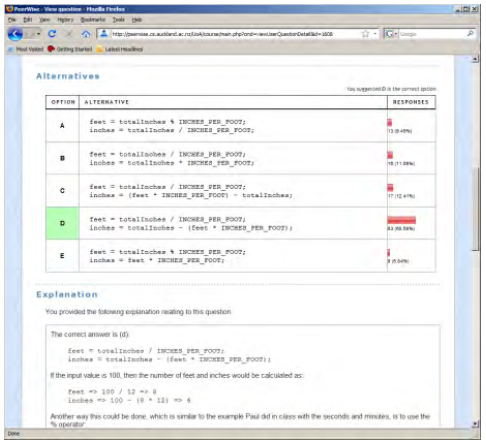
Paul Denny
Department of Computer Science
The University of Auckland
New Zealand

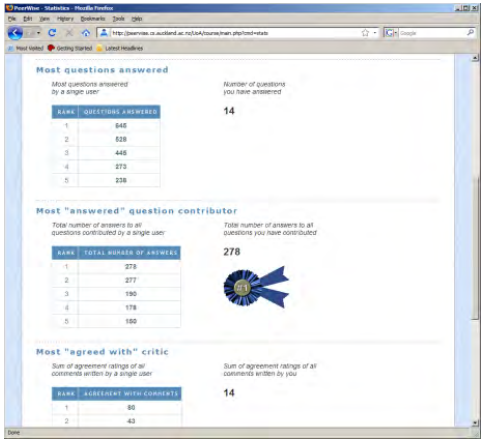
PeerWise

peerwise.cs.auckland.ac.nz

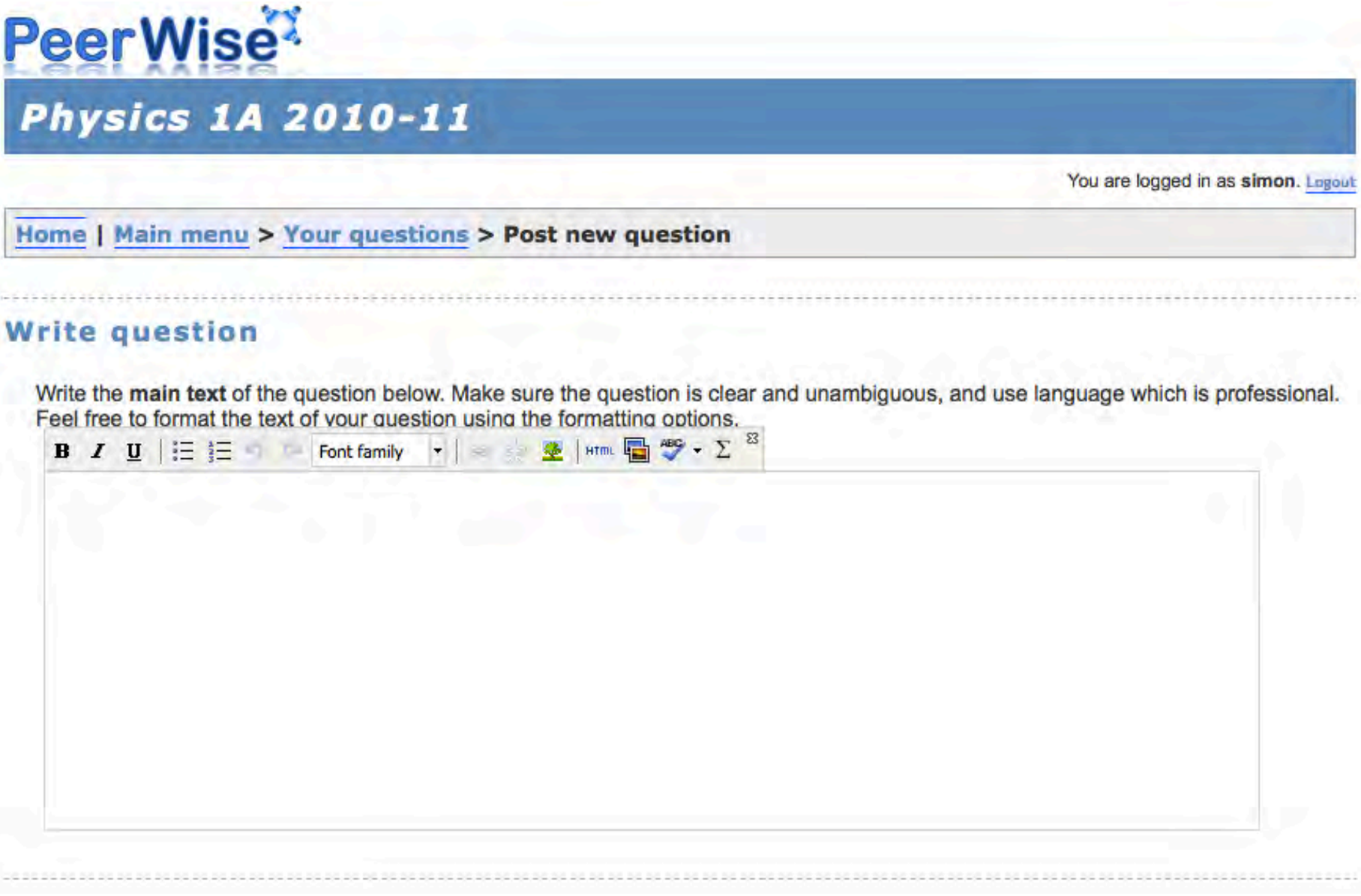
- Web-based Multiple Choice Question repository built by students

- Students:
  - develop new questions with associated explanations
  - answer existing questions and rate them for quality and difficulty
  - take part in discussions
  - can follow other authors





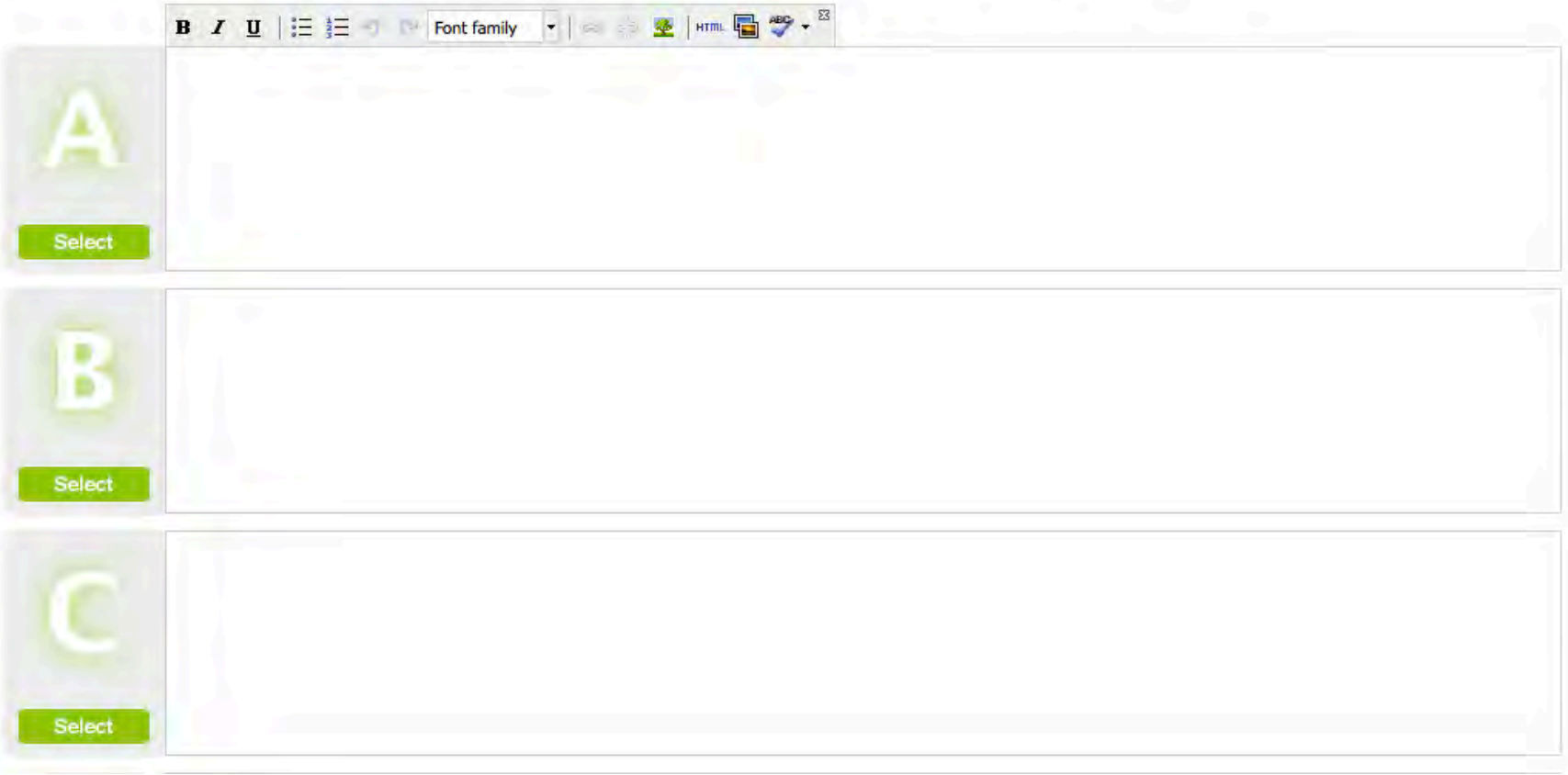
As a question author…..



Alternatives

Write **up to five** alternative answers for the question you have written above. Make sure each alternative is distinct, and of course, you must ensure that **exactly one** of the alternatives is the correct answer to your question. You may choose to define fewer than five alternatives (by simply leaving some of the text areas empty), but you must at least provide two alternatives.

You **must indicate** which of the alternatives is the correct answer to your question by selecting the letter to the left of the alternative.



Explanation

You should provide an explanation for your answer. This explanation will only be shown to people **after** they have selected what they think is the answer to your question, and may help to explain to them why the alternative you have suggested is indeed the correct answer.

Topics

You may define up to FIVE topics which are relevant to this question. These topic definitions will make it easier for everyone to find questions on certain topics.

Existing topics: You can select from the current list of topics:

- ☐ Acceleration
- ☐ Angular Velocity
- ☐ Balancing forces
- ☐ Basic Normal Force
- ☐ Beer
- ☐ Bugatti Veyron
- ☐ Centripetal Force
- ☐ Electrostatic forces
- ☐ Energy
- ☐ Fictitious Forces
- ☐ Forces and Motion
- ☐ Friction
- ☐ Galilean transforms
- ☐ Gravitational Force
- ☐ Kinetic Energy
- ☐ Momentum
- ☐ Newton
- ☐ Numbers
- ☐ Pendulum
- ☐ Periods of orbit
- ☐ Potential Energy
- ☐ SHM
- ☐ Science fiction
- ☐ Sound
- ☐ Space and Time
- ☐ Springs
- ☐ Tension
- ☐ Units

As a question answerer …..

PeerWise

Physics 1A 2010-11

You are logged in as **simon**. Logout

Home | Main menu > Unanswered questions > **Answer question**

Question stats

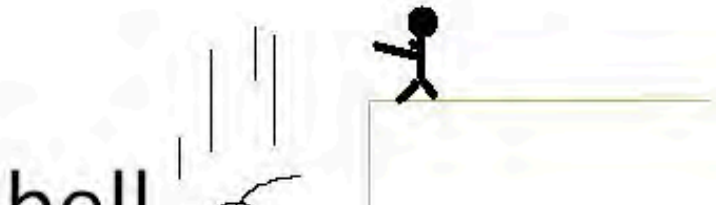
This question has been answered by 45 people and has an average rating of 4.00 (based on 33 ratings)

The answer suggested by the author of this question is the most popular answer

Answer the following question

A guy was standing on **a high cliff** in a very very cold winter.
(In that case, the speed of sound is nearly 320 ms^{-1})

He dropped 5 bells from the cliff to the ground in order to measure the height of the cliff.
(drop only **one bell each time**, and **initial speed** of the bell is **0** ms^{-1})



	Time taken
First time	8.8 s
Second time	9.5 s
Third time	8.7 s
Fourth time	9.2 s
Fifth time	8.8 s

Calculate the height of the cliff. (Take g=10 ms^{-1})

Select your answer:

Select your answer

OPTION	ALTERNATIVE
A	100 m
B	300 m
C	320 m
D	405 m
E	640 m

Alternatives

You selected C when answering this question
The contributor suggests C is the correct option

OPTION	ALTERNATIVE	RESPONSES
A	100 m	1 (2.17%)
B	300 m	1 (2.17%)
C	320 m	26 (56.52%)
D	405 m	16 (34.78%)
E	640 m	2 (4.35%)

Explanation

The following explanation has been provided relating to this question:

Calculate the average time taken

$$t_{average} = \frac{8.8+9.5+8.7+9.2+8.8}{5} = 9.0 \text{ s}$$

The total time taken is 9.0 seconds which includes t_{bell} and t_{sound}

Consider the bell:

Height=$\frac{1}{2}$ g t_{bell}^2+v_0 t_{bell} , where v_0=0 ms^{-1}

So, Height=$\frac{1}{2}$ g t_{bell}^2 = $\frac{1}{2}$ g $(t_{total}-t_{sound})^2$ = $\frac{1}{2}$ x 10x $(9.0-t_{sound})^2$.①

Now, think about the sound:

Height=V_{sound} t_{sound}=320t_{sound} .....②

Solve the equations ① and ②

①−②=0

$\frac{1}{2}$ x 10 x $(9.0-t_{sound})^2$ - 320 t_{sound} =0

t_{sound} = 1.0 s

Height= V_{sound} t_{sound}=1.0 x 320 = 320m

Request help

Improve explanation

Please rate this question:

*Please rate this question as **fairly** and **accurately** as you can - your rating will help others to find questions of interest.*

Difficulty  Easy Medium Hard

Quality 

very poor	poor	fair	good	very good	excellent
0	1	2	3	4	5

Comment 

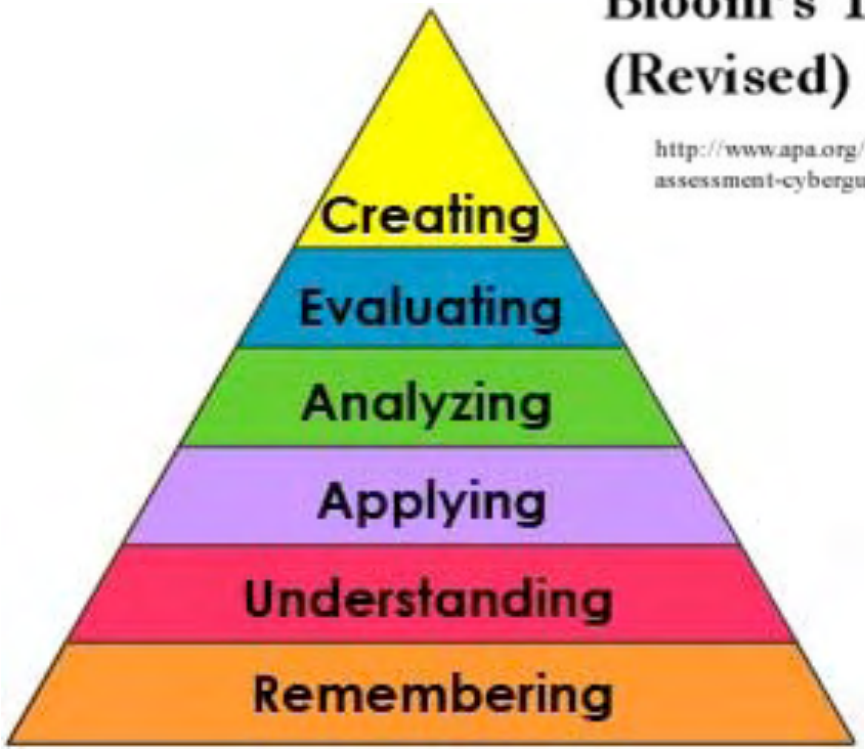
Previous comments  There are 25 comments written about this question.

All feedback

WHEN	COMMENT (SCORE OF COMMENT AUTHOR)	AGREE WITH COMMENT	DISAGREE WITH COMMENT
7:38pm, 20 Oct	★★★★ 1240 Nice problem, never done a question like this before. ***Author's reply:*** Thank you.... £º)	★ ○	✕ ○
	★★★		

Bloom's Taxonomy (Revised)

http://www.apa.org/ed/governance/bea/assessment-cyberguide-v2.pdf

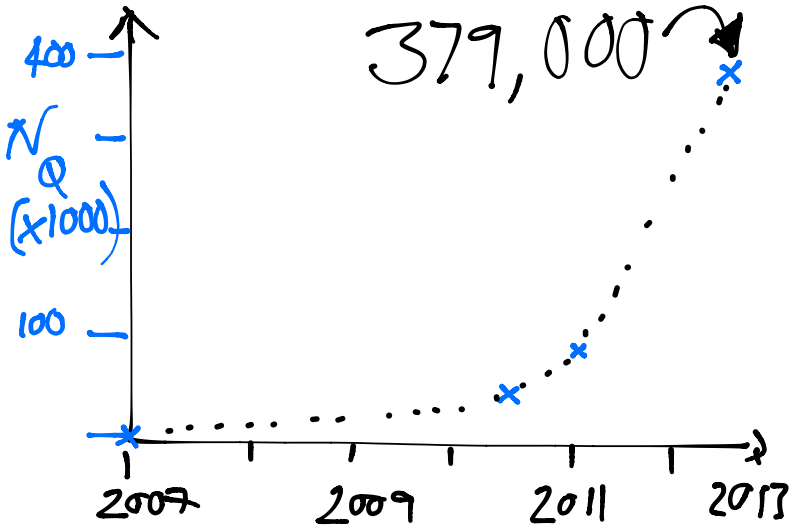


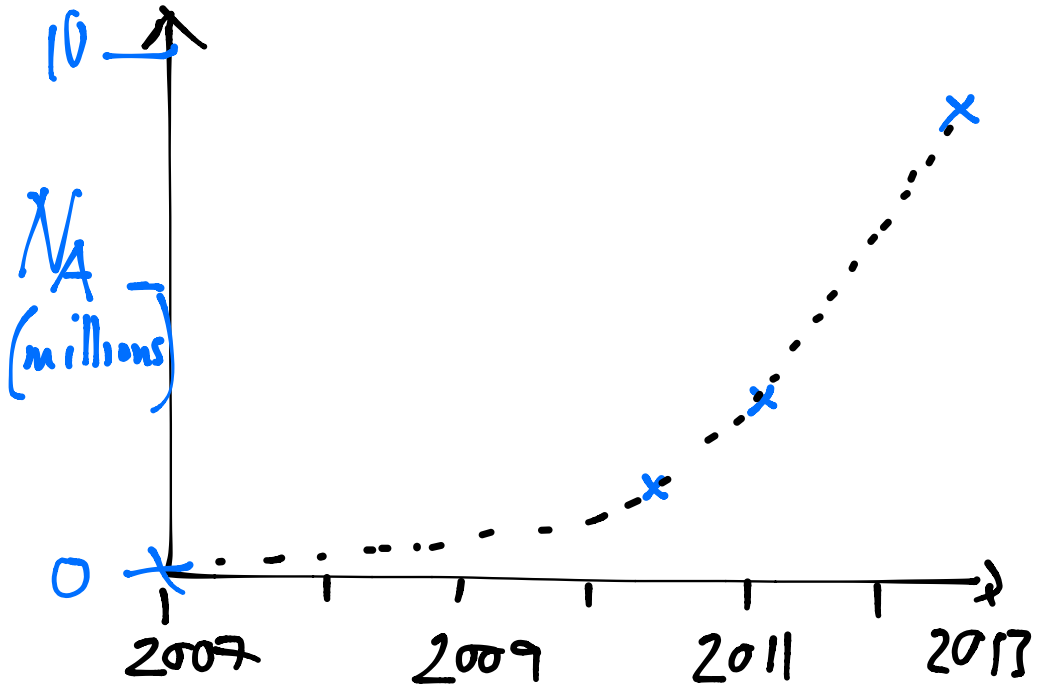
Based on an APA adaptation of Anderson, L.W. & Krathwohl, D.R. (Eds.) (2001)

- 2007-Summer 2010
  - 45 institutions
  - 260 courses
  - 20661 students have contributed
  - 57324 questions have been written
  - 1527574 answers have been submitted

- Feb 2011
  - 77 institutions
  - 557 courses
  - 33757 students have contributed
  - 94207 questions have been written
  - 2308854 answers have been submitted

- Oct 2012
  - 308 institutions
  - 1905 courses
  - 94961 students have contributed
  - 379464 questions have been written
  - 8172405 answers have been submitted


400
100
N_Q
(x1000)
379,000
2007
2009
2011
2013


10
0
N_A
(millions)
2007
2009
2011
2013

II. Use at UoE

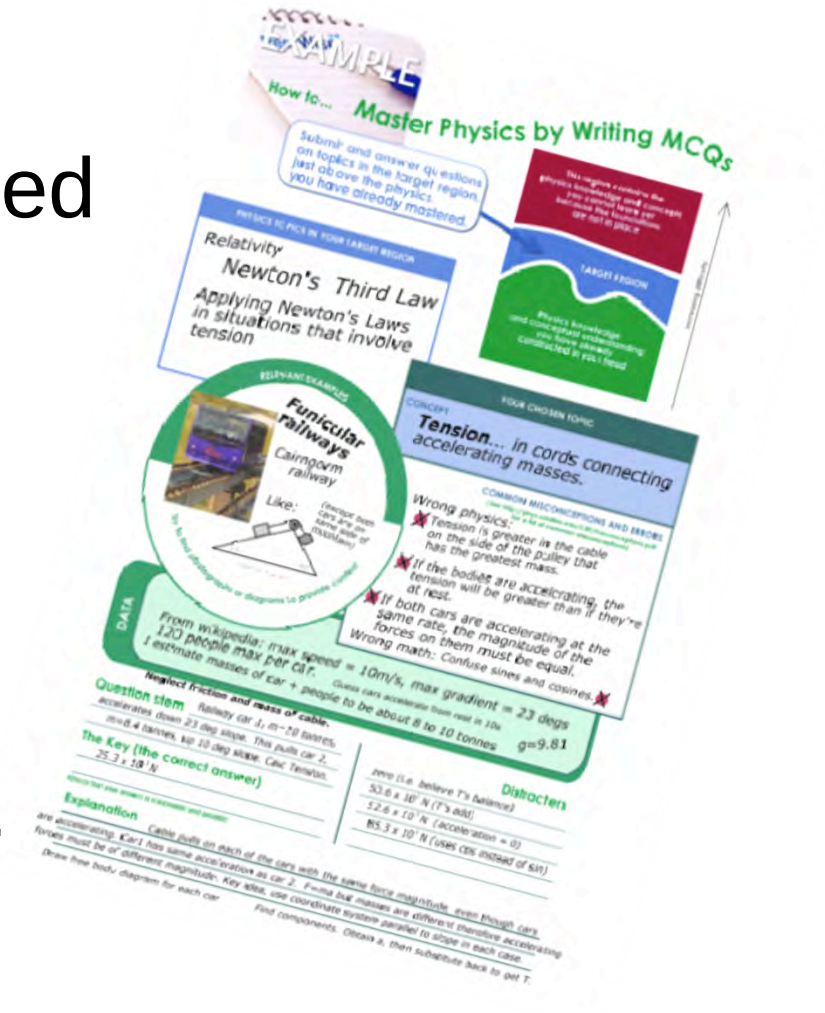
Use of the system at Edinburgh, 2010-present

- First-year, calculus-based introductory courses
- Semester 1:
  - Newtonian mechanics
- Semester 2:
  - Waves and modern physics
- Cohort:
  - Approx. 200-300 students
  - 75% male, 25% female
  - 50% majors, 50% non-majors

Pilot year (2010-11) – replace single handin

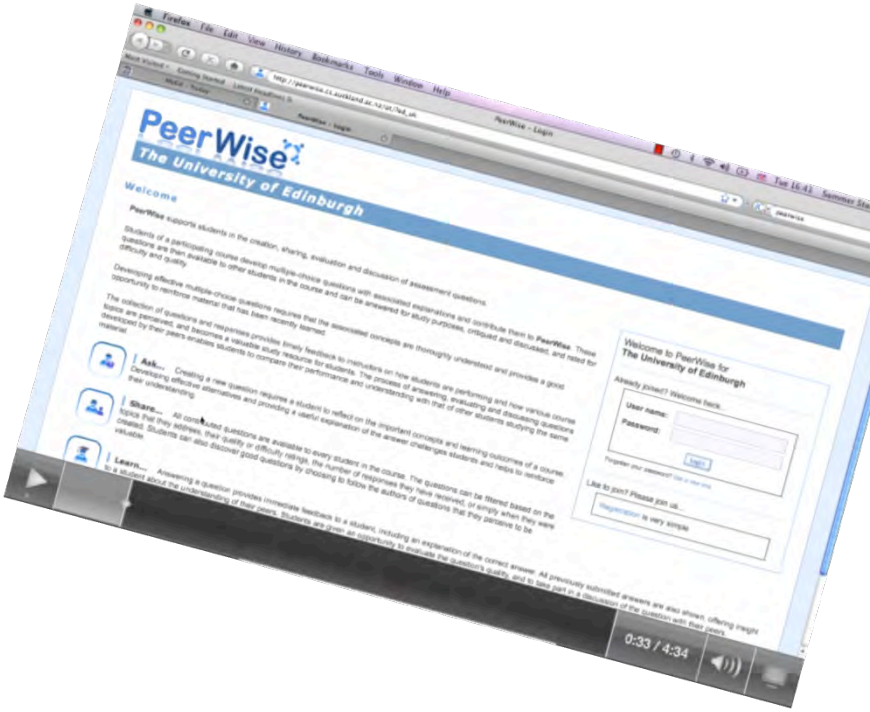
PeerWise was introduced
in workshop sessions
in Week 5

Students worked through
structured example task
and devised own Qs in groups.



All these resources are available online (see final slide)

An assessment was set for the end of Week 6:



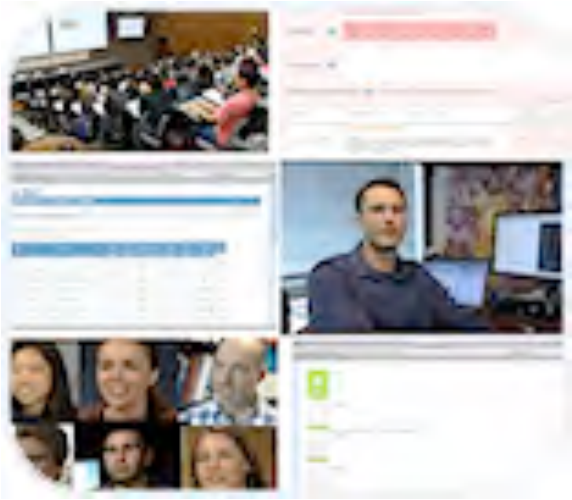
Minimum requirements:

- Write one question
- Answer 5
- Comment on & rate 3

Contributed ~3% to course assessment

Rollout year 2011-12: 3 hand-ins replaced

Same requirements each time (w1, a5, r&c 3)



- Activity 1: intro as before
- Activity 2: focus on distracters
- Activity 3: integrating diff. sections of course

Contributed ~7% to course assessment

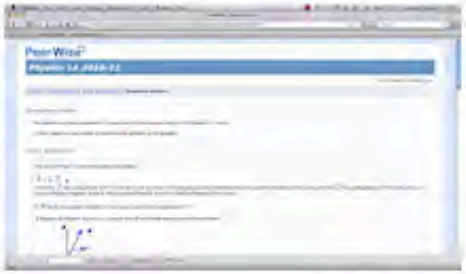
Screencasts

The following set of screencasts are provided courtesy of the Physics Education Research Group at the University of Edinburgh. Just select the screencast you would like to view from the list below:

Creating questions in PeerWise

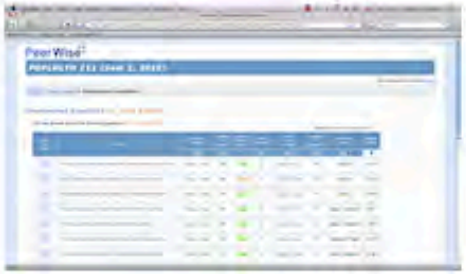
This screencast illustrates the process of creating a new question - writing the question stem and alternatives, selecting the correct answer, providing an explanation, and tagging the question with relevant topics

Editing questions in PeerWise



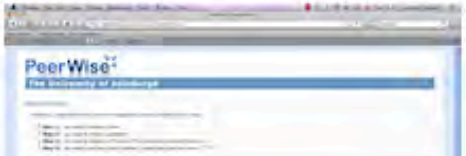
This screencast illustrates the process of making changes to an existing question, in response to feedback provided on the question

Searching for questions on PeerWise



This screencast illustrates the process of searching for questions of interest on PeerWise, including filtering by topic, sorting by quality ratings and following question authors

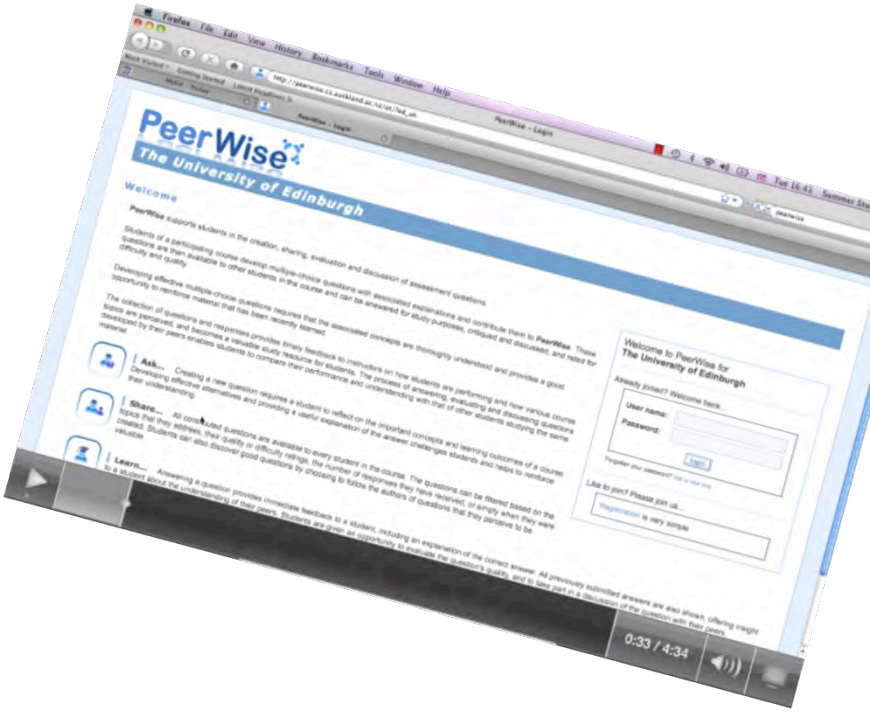
How to register and



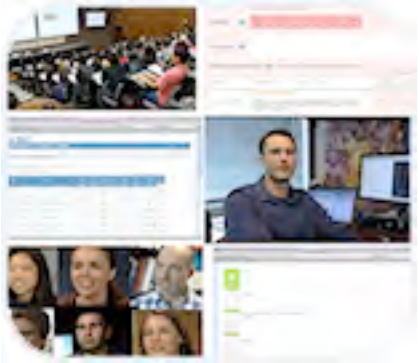
This screencast, shown from the perspective of a student at the University of Edinburgh, illustrates the process for registering a new PeerWise account and

We were *deliberately* hands off.

- No moderation
- No corrections
- No interventions at all



But we did *observe…..*



Generally, students did

- Participate beyond minimum requirements
- Engage in community learning, correcting errors
- Create problems, not exercises
- Provide positive feedback

James Bond (mass 70kg) is trying to escape a building by abseiling out the window of an office. He is tethered via a light inextensible rope to a baddie he just knocked out inside the office. The rope passes smo
over a rounded window ledge. The unconscious baddie is lying stationary on the office floor, with a static coefficient of friction of 0.7 between him and the floor.

Alternatives

The contributor suggests C is the correct option

OPTION	ALTERNATIVE	RESPONSES
A	0.3	1 (4.76%)
B	0.4	1 (4.76%)
C	0.5	8 (38.10%)
D	0.6	9 (42.86%)
E	0.7	2 (9.52%)

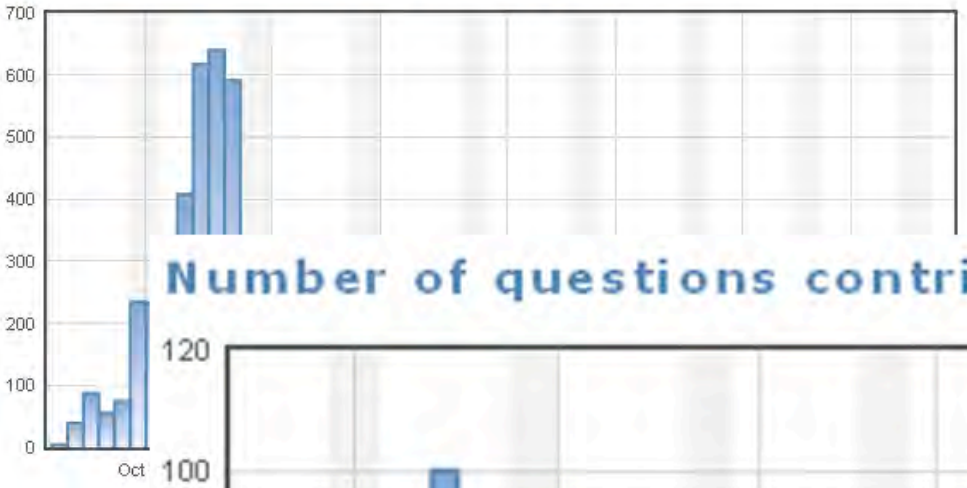
Explanation

Bond briefly tugs on the rope and begins accelerating vertically down the building at a constant $1ms^{-2}$, simultaneously dragging the baddie horizontally across the office floor in the process. What is the coefficient of kinetic friction between the baddie and the floor?

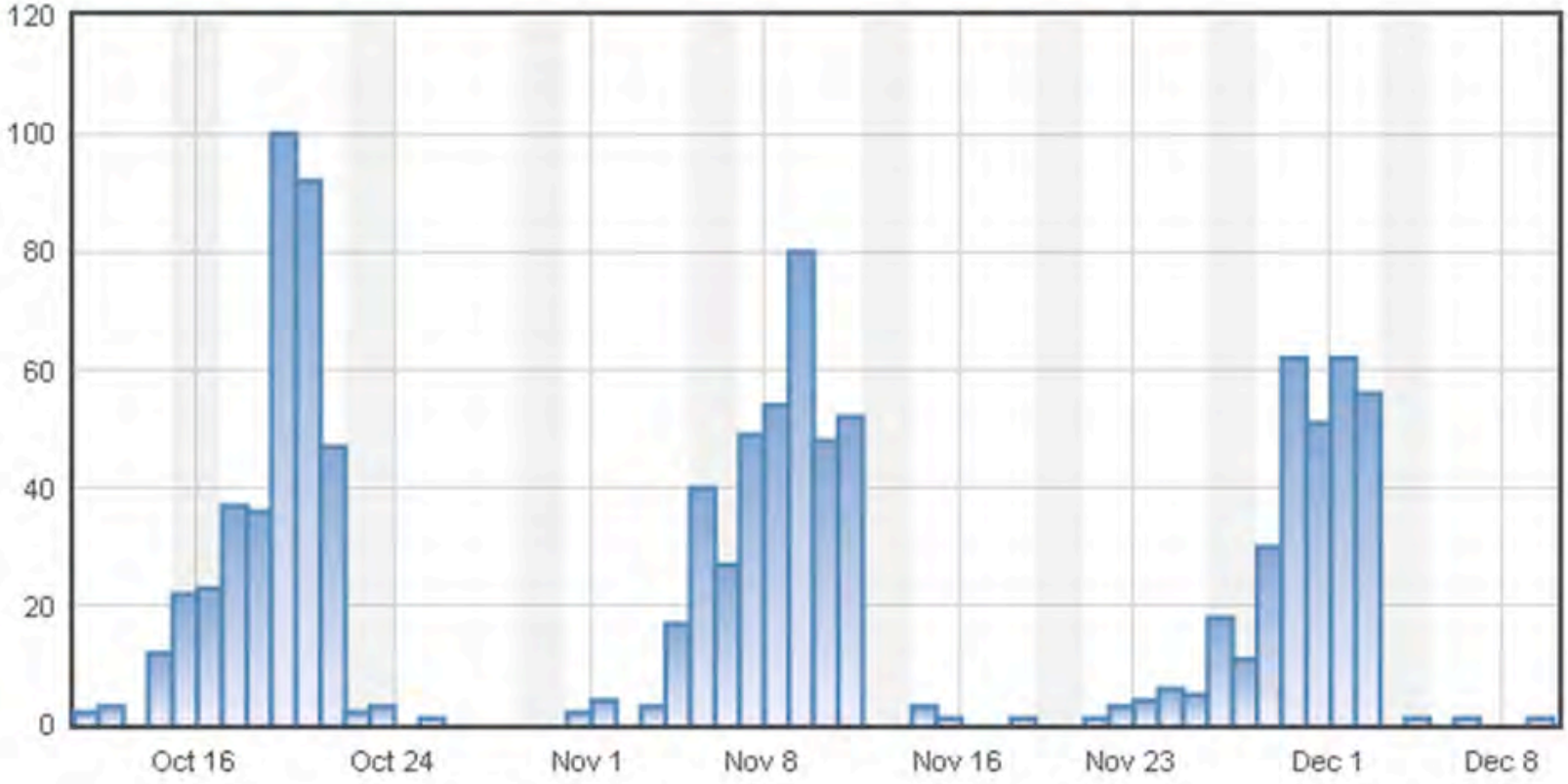
Generally, students did not

- Contribute trivial or irrelevant questions
- Obviously plagiarise
- Participate much beyond assessment periods
- Didn’t all leave it to the last minute

Number of answers submitted per day



Number of questions contributed per day

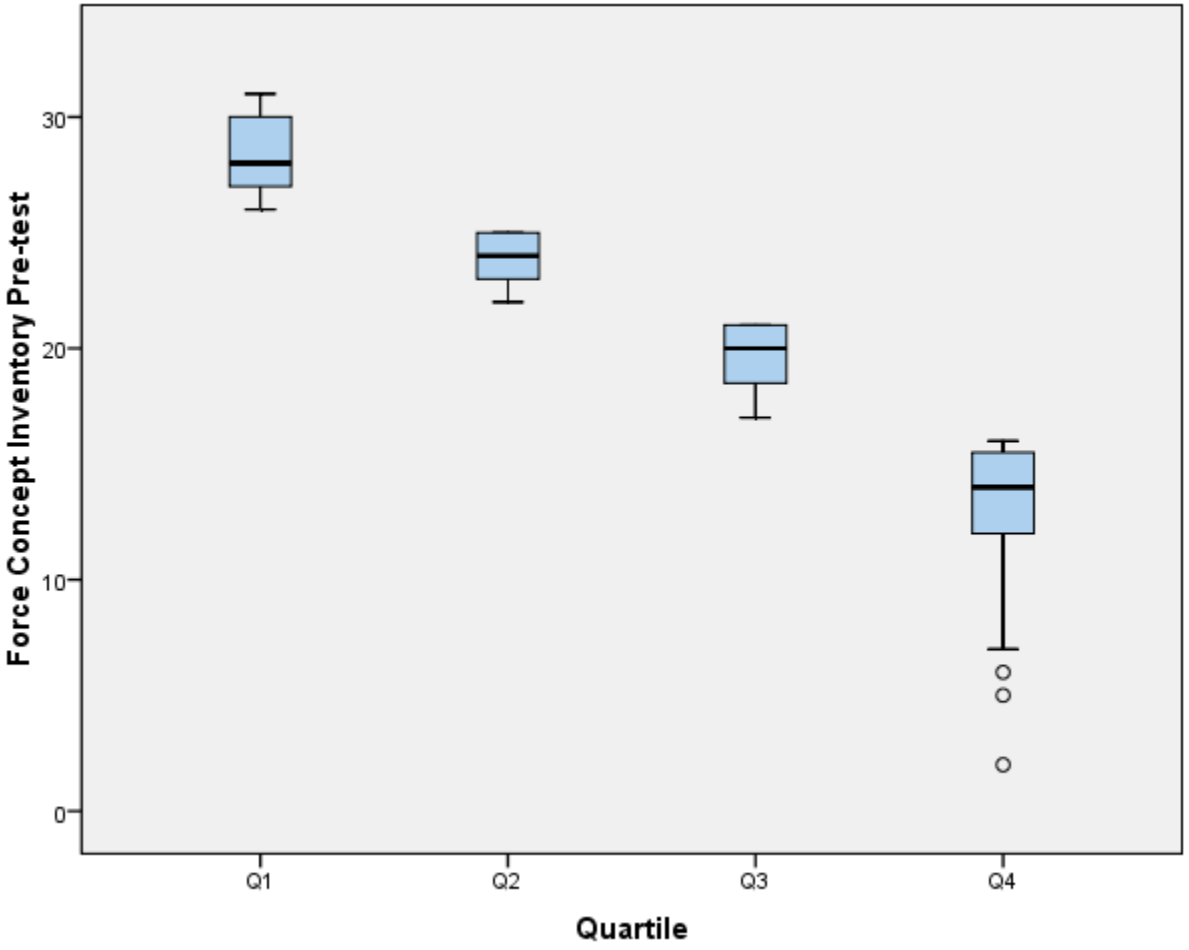


Correlation with end of course outcomes

Cohort	Number of students	Mean exam score*	Standard error	*p* value	Effect size
1A (*N*=193)					
HPA†	104	63.2	1.6		
LPA	89	53.6	1.6	<0.001	0.29
1B (*N*=182)					
HPA	94	61.9	1.8		
LPA	88	46.8	2.4	<0.001	0.36

* all scores expressed as percentages

† HPA / LPA denote higher / lower than median PeerWise activity



Quartiles

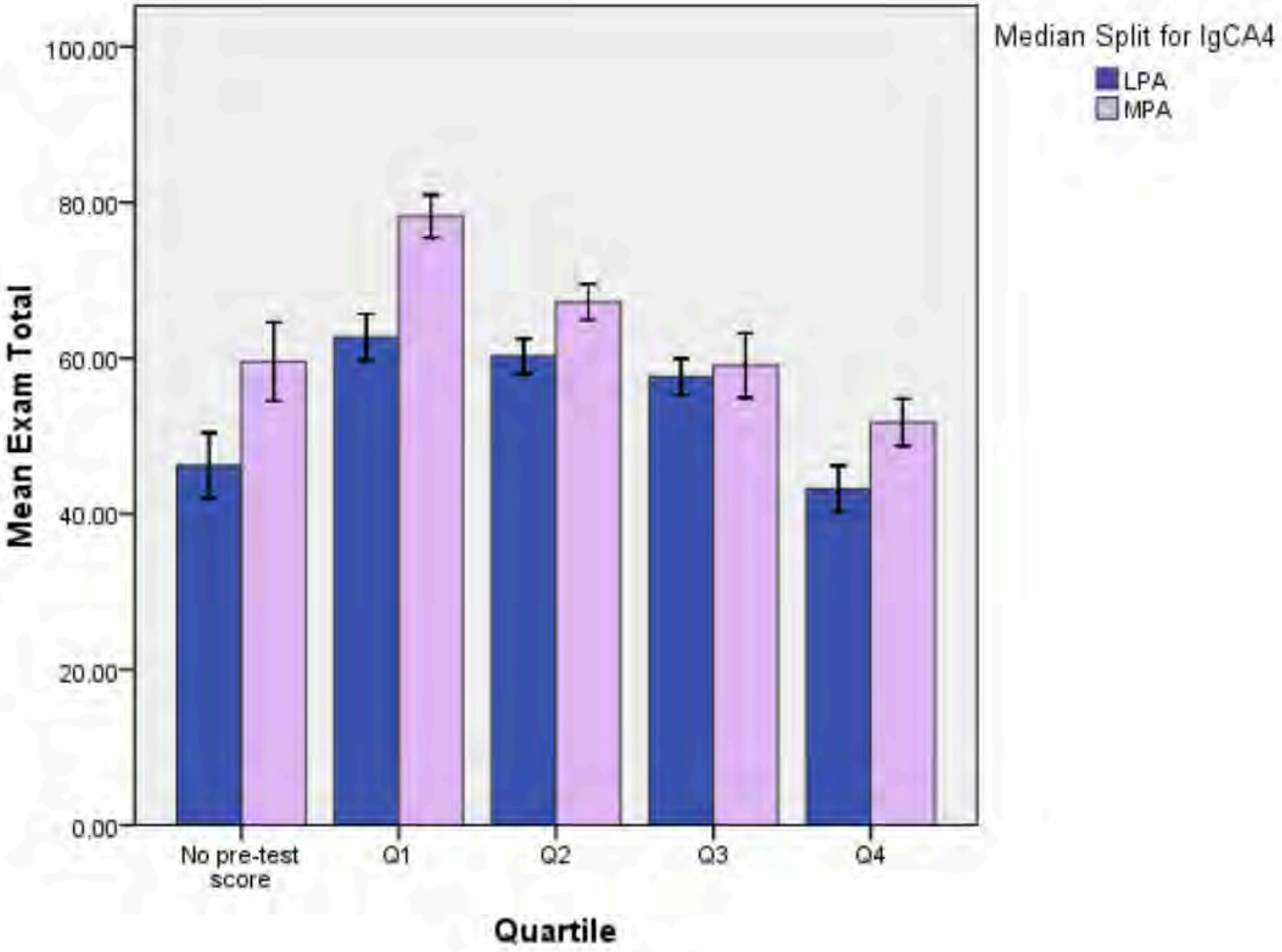
Q1 – top 25%

Q2 – upper middle

Q3 – lower middle

Q4 – bottom 25%

22 students did not take the FCI


Median Split for lgCA4
LPA
MPA
100,00
80,00
60,00
40,00
20,00
0,00
Mean Exam Total
No pre-test score
Q1
Q2
Q3
Q4
Quartile
Error Bars: +/- 1 SE

Activities by Topic

Programmes

e-Learning programme

Assessment & feedback programme

» Student-Generated Content for Learning (SGC4L)

On this page

Documents & Multimedia

Home » Projects, programmes & services » ... » Assessment & feedback programme » Student-Generated Content for Learning (SGC4L)

Student-Generated Content for Learning (SGC4L)

Summary

One of the key attributes that undergraduate study of a subject seeks to develop is an advanced level of problem solving ability within the discipline. This is particularly true in, although not restricted to, science disciplines. Although deliberate practice can develop these skills, it has been argued that a deeper understanding can be achieved by having students pose, as well as answer, problems. In cognitive terms, it is far more demanding to generate both correct and incorrect reasoning and answers to a problem than merely attempting to find a solution.

PeerWise (http://peerwise.cs.auckland.ac.nz/) is a freely available web tool that provides an online framework to facilitate student creation of problems as well as including much of the social functionality that increasingly forms the cornerstone of online interactions. Using the tool, students can create assessment questions (in the form of multiple choice questions, with associated explanations), answer each other's questions, rate and comment on questions, seek help from authors and follow their favourite question contributors. If embedded appropriately in course assessment design, use of the system offers tangible benefits to both students and staff, enabling valuable peer discussion, interaction and feedback outside timetabled class hours.

Summary

Start date
1 September

End date
31 July 2012

Funding pr
e-Learning p

Strand
Assessment
programme

Project web

Lead institu
The Universi
www.ed.ac.u

Topic
Assessment

Results – Second Year Physics, University of Glasgow

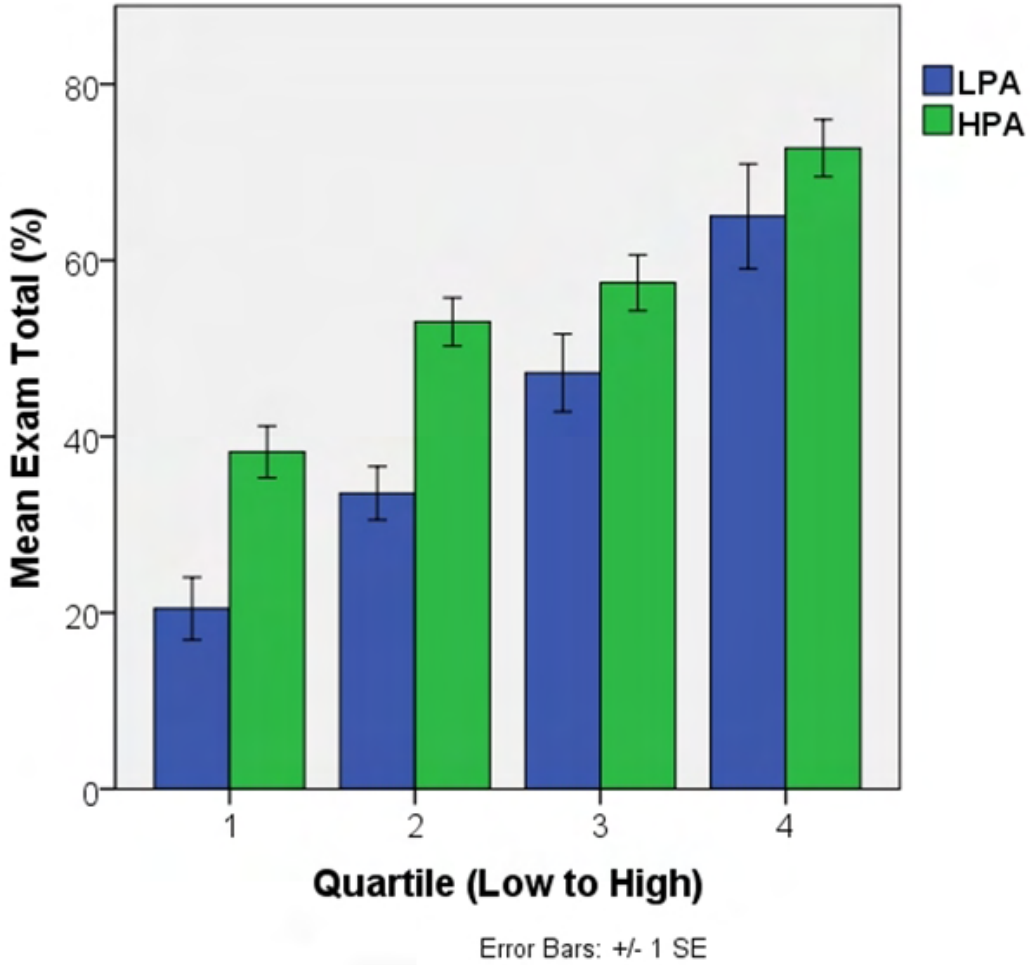
Cohort	Number of Students	Mean Exam Score *	Standard Error	*p* value	Effect Size **
Physics 2	(*N=152)*				
HPA ***	78	58.1	1.9		
LPA	74	38.0	2.7	< 0.001	0.45

* all scores expressed as percentages

** Pearson's *r*

*** HPA/LPA denote higher/lower PeerWise activity

Results – Second Year Physics, University of Glasgow



III. Question quality

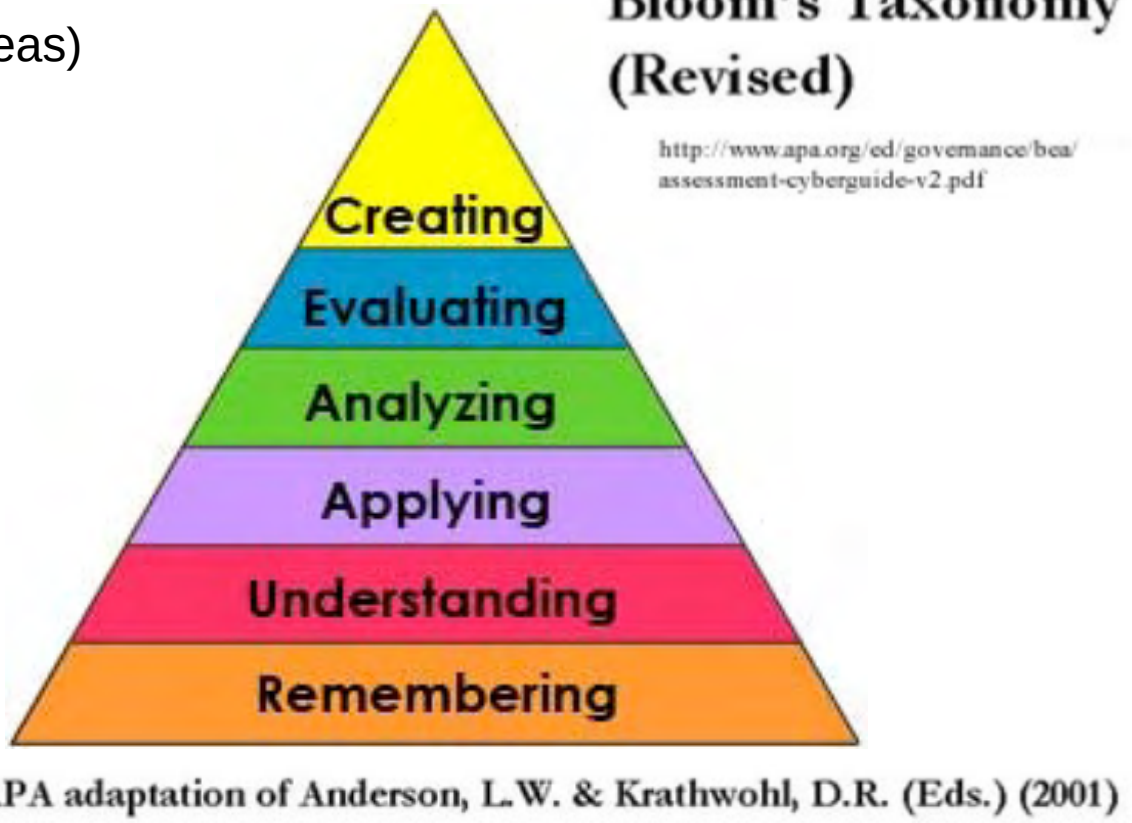
Comprehensive categorisation of >50% of repository for two successive academic years

Principal measures to define a ‘high quality question’

- cognitive level of question
- explanation quality
- other criteria

Cognitive level of question

Category	Description
6	Create (synthesise ideas)
5	Assess
4	Analyse (multi-step)
3	Apply (1-step calcs.)
2	Understand
1	Remember



Cognitive level of question

Rating:	Description:
1	Remember, Recognise or RecallOR just plugging in numbers
2	Understand, Interpret or predict (No calculation needed, such as understanding Newtons 3rd law)
3	Apply, Implement or Calculate (1 step calculation)
4	Analyse, differentiate or organise (multi-step calculation, higher analysis)
5	Evaluate, Asses or Rank (Evaluating various options and assessing their validity)
6	Create, Combine or Produce (Asked to combine various areas of physics, need to get a structure right to solve whole problem)

Explanation

0 – Missing

1 – Inadequate

(*e.g. wrong reasoning / answer, trivial, flippant, unhelpful)*

2 – Minimal

(*e.g. correct answer, but with insufficient explanation or justification, aspects may be unclear)*

3 – Good/Detailed

(*e.g. clear and sufficiently detailed exposition of correct method and answer)*

4 – Excellent

(e.g. Describes physics thoroughly, remarks on plausibility of answer, use of appropriate diagrams, perhaps explains reasoning for distractors)

‘High quality’ question

1. At least 2/6 on cognitive level (“understand” and above)
2. At least 2/4 on explanation (“minimal” and above)
3. Clearly worded question (binary)
4. Feasible distractors
5. ‘Most likely’ correct (binary)
6. ‘Not obviously’ plagiarised (binary)

Categorisation process

- 2 raters : categorise ~35 questions
- Initial inter-rater reliability check : refine
- Categorise further 22 questions

- IRR determined using Cohen’s Kappa.

- Agreement above 90% for taxonomic level and explanation.

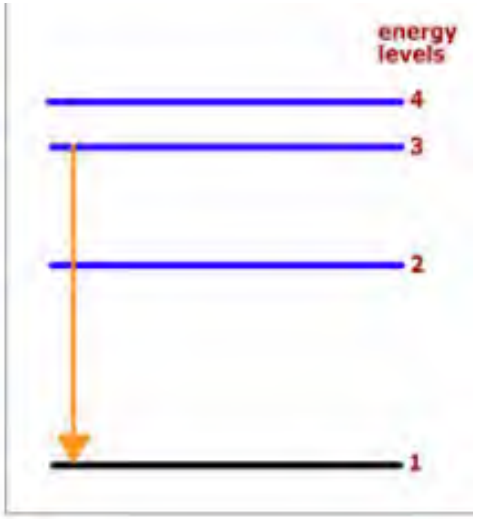
Example category 1 question

A spectral line is emittted when an electron in a hydrogen atom undergoes a transition from n=5 to n=3 state. State which series this line belongs to.

Alternatives

OPTION	ALTERNATIVE
A	Lyman
B	Balmer
C	Paschen
D	None of the above

Example category 2 question



The diagram shows four electron energy levels in an atom. The transition of an electron from level 3 to level 1 as shown in the diagram produces a photon in the visible light range. Which transition is most likely to produce a photon in the ultraviolet range?

lternatives

OPTION	ALTERNATIVE
A	Level 2 to level 1
B	Level 3 to level 2
C	Level 4 to level 1
D	Level 4 to level 3

Example category 3 question

The half-life of Po 210 is 138 days.
How long does it take 18g of Po 210 to decay to only 2.25g ?

Alternatives

OPTION	ALTERNATIVE
A	552 days
B	414 days
C	1104 days
D	276 days

Example category 6 question

fig. A

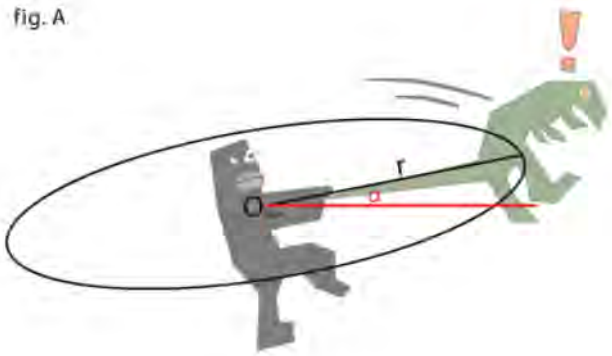


fig. B

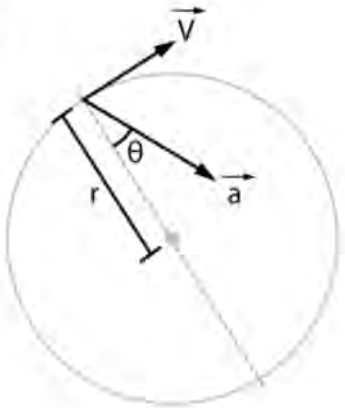
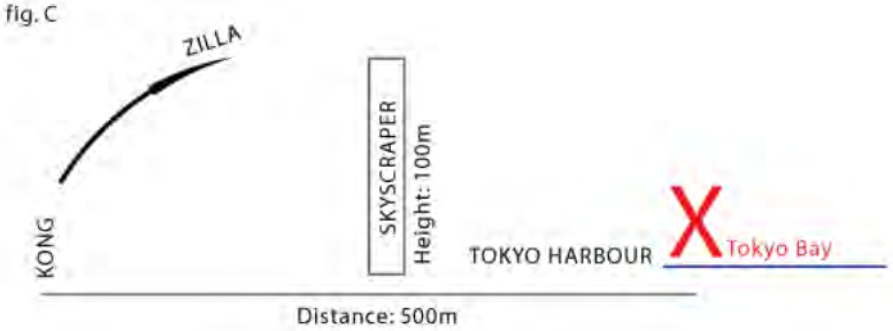


fig. C



King Kong and Godzilla are slugging it out in downtown Tokyo, as they are prone to do on quiet Sunday evenings.

Kong quickly gains the upper hand and catches Godzilla by the tail, spinning him in a tilted circle of radius r meters, in a clockwise direction, at and angle of α degrees to the horizontal. (fig. A)

Example 4/4 explanation

A The bloc can't be at rest. In fact, it expriences a net external force $\mathbf{F_{net}} = \mathbf{F} + \mathbf{W} + \mathbf{T}$ wh
Then, applying Newton's second law, we deduce the bloc is accelerated.

B You need to consider **F** as a sum of two vectors $\mathbf{F_N}$ and $\mathbf{F_F}$. $\mathbf{F_N}$ is the normal contact fo

C The horizontal component of **F** (so $\mathbf{F_F}$) is pointong to the left. But friction forces (in situa
motion. Thus, the bloc is moving towards right.

D The spring tension is in the opposite direction of motion (from the picture and **C**)

E Weight is constant. In addition, it is perpendicular to the direction of motion. It is not invo

I could not figure out how to do this but I figured it has to be either 600N or 700N as T has to be > 400N. Anyway after reading your explanation, I noticed something went wrong.

Quoted :

1) Mass m_1

$$G_{1x} - F_{f1} - T_1 = m_1 \cdot a$$

$$R_1 = G_{1y}$$

$$F_{f1} = \mu_k \cdot R_1$$

If we work out on the equations we get:

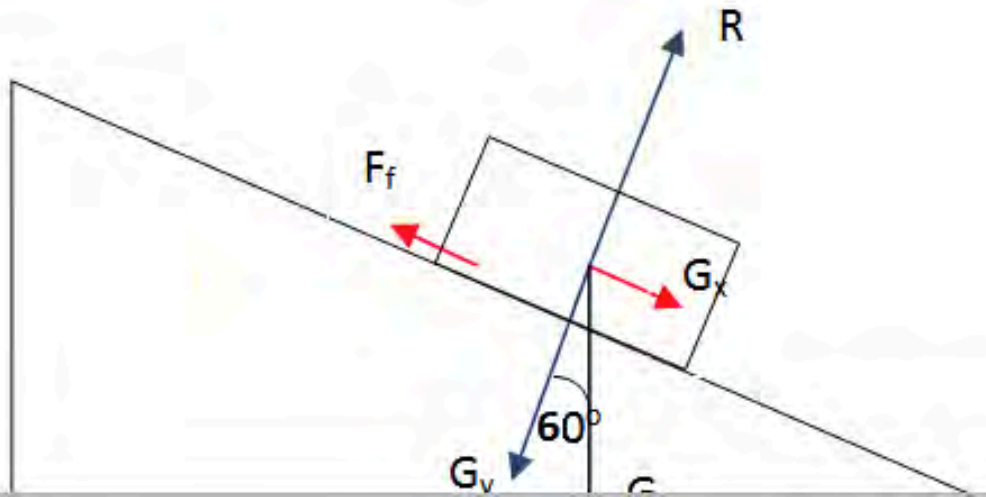
$$m_1 \cdot g \cdot \sin 60 - \mu_k \cdot m_1 \cdot g \cdot \cos 60 - T_1 = m_1 \cdot a \quad (1$$

As you can see you equated G1x = m1.g.sin60 when it meant to be m1.g.cos60. I think you got that one switched around with the R1 = G1y. Same thing happened with equation

I might also be wrong so do have a look at it.
(*by:* ***duckula***)

Author's reply
No, it is correct. G1x is m1*g*sin60. Think what happens when the angle is 0 (the mass is on the horizontal). G1x=m1*g*sin0=0.

Here is a sketch, to make things clear



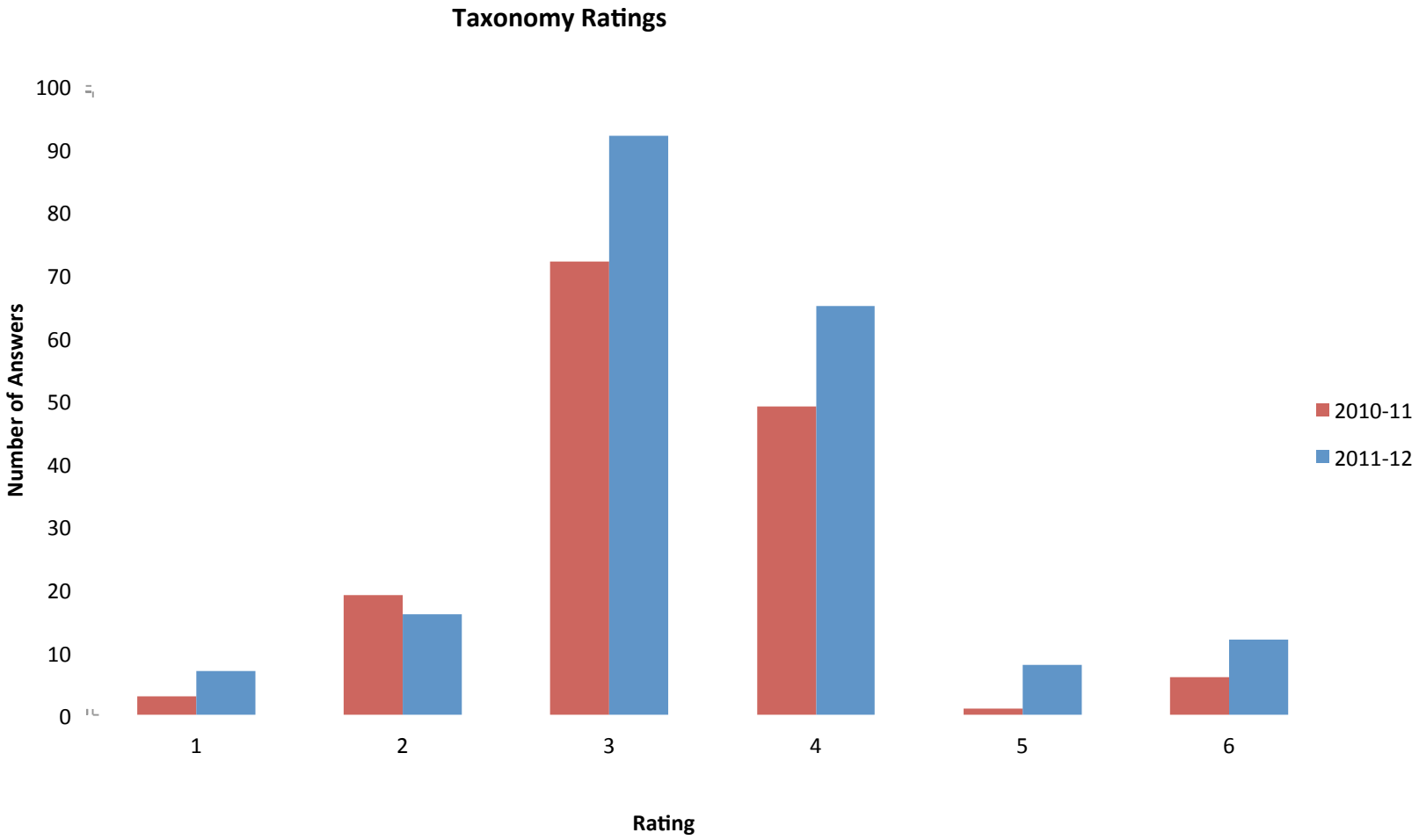
Comment 1

Results: Physics 1A 2010 and 2011

2 successive years of the same course (N=150, 350)

- ‘High quality’ questions: 78%, 79%
- Over 90% (most likely) correct, and 3/5 of those wrong were identified by students.
- 69% (2010) and 55% (2011) rated 3 or 4 for explanations
- Only 2% (2010) and 4% (2011) rated 1/ 6 for taxonomic level.

Results: Question level Physics 1A 2010 and 2011



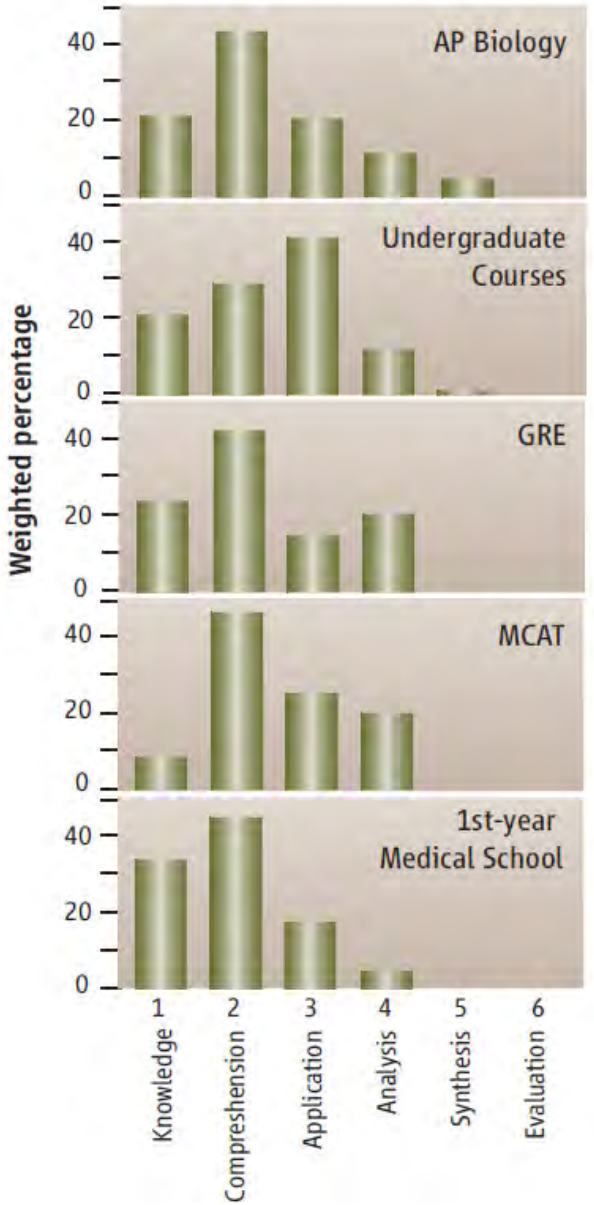
Literature

Bottomley & Denny Biochem and Mol Biol Educ. 39(5) 352-361 (2011)

- 107 Year 2 biochem students
- 56 / 35 / 9 % of questions in lowest 3 levels.

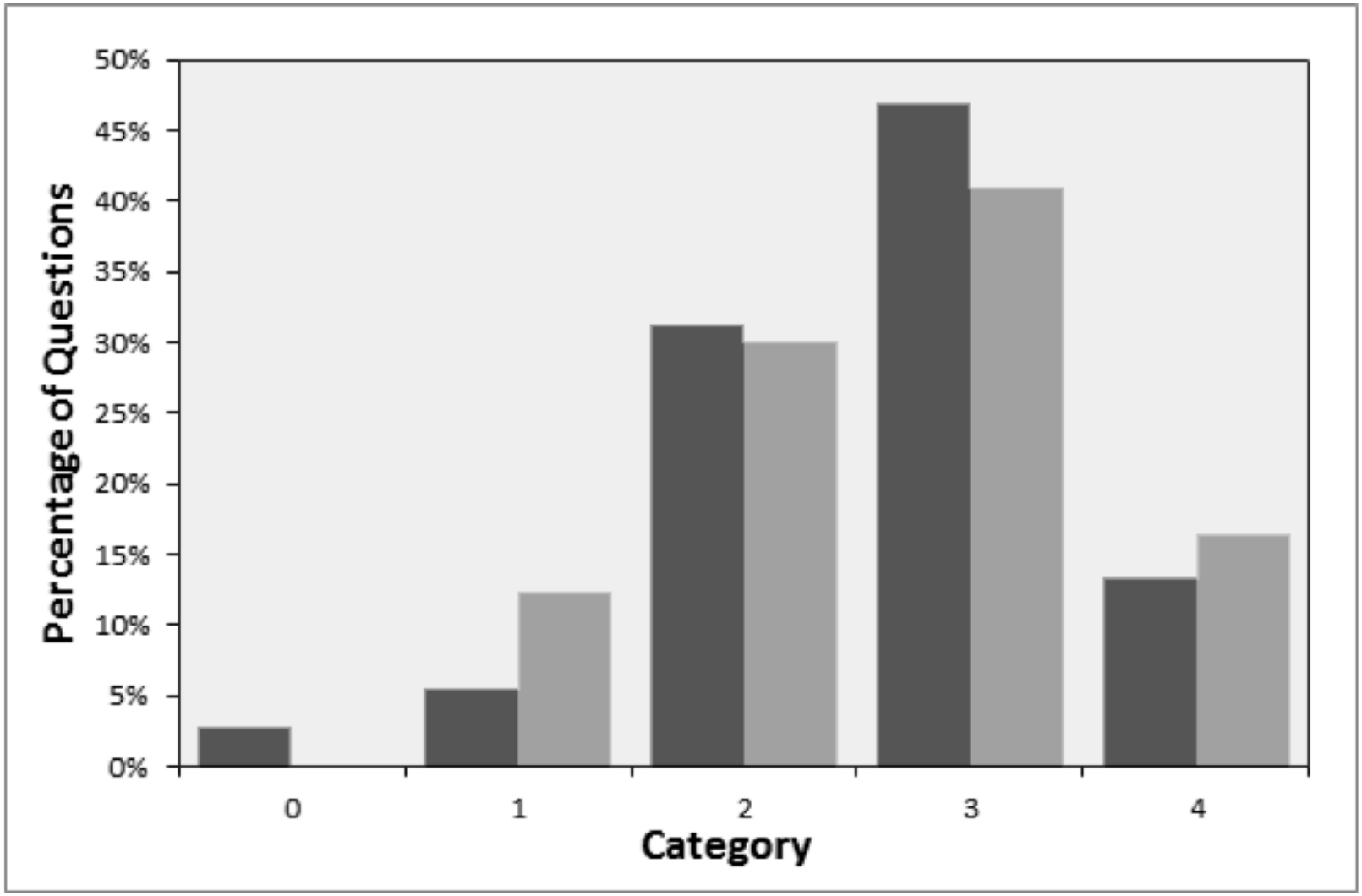
Momsen et al CBE-Life Sci Educ 9, 436-440 (2010)

“9,713 assessment items submitted by 50 instructors in the United States reported that 93% of the questions asked on examinations in introductory biology courses were at the lowest two levels of the revised Bloom’s taxonomy”

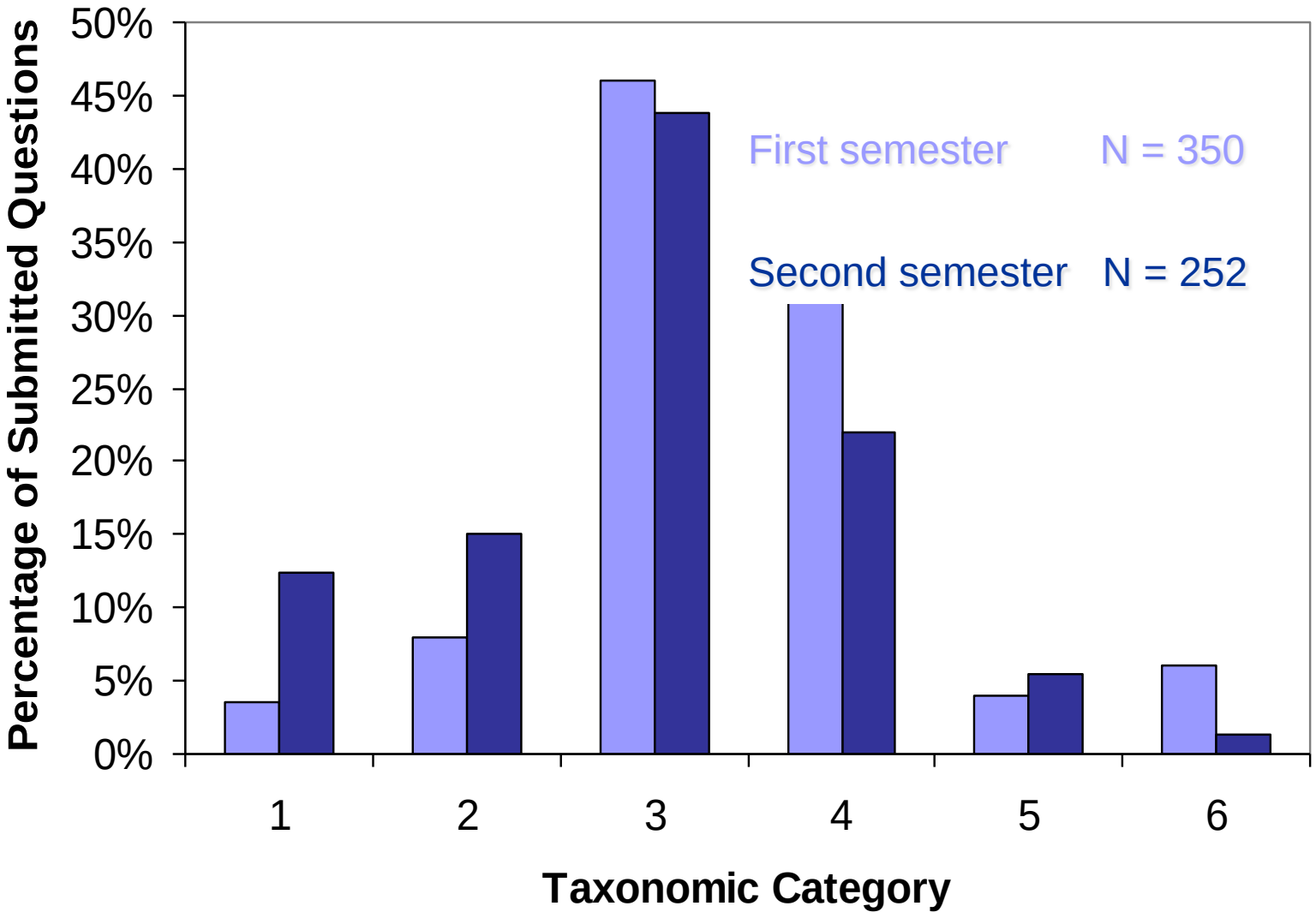


Zheng et al. (2008), *Science* 319, pp414-415

Results: Explanation Physics 1A 2010 and 2011



Results: Question level Physics 1A / 1B 2011



Summary

- High general standard of student-generated questions
- Relatively few basic knowledge questions
- Vast majority of questions require at least application
- Some questions at highest cognitive levels
- Appears not to be course or subject specific
- We hypothesise scaffolding activities may promote high level cognitive engagement

IV. Community, further research

Further work

- Controlled experiment for influence of scaffolding?

  3 groups:

  - control (no intervention)
  - partial (tool, no scaffolding)
  - full (tool, scaffolding)

Further work

- Other correlations:
  - Who answers what? (social network analysis)
  - What's the role / impact (if any) of comments?
  - Question quality ←→ academic ability?
- Crowd-sourced assessments? (appropriately validated)
- Multi institution course space?

PeerWise-Community

Quick links

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Recent Resources

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Info videos
In-class activities

Recent Publications

Paterson et al. (2012)
Mackey et al. (2012)
Hooper et al. (2011)
All Publications

Recent Posts

What does a typical PeerWise course look like?
Just how big is this thing…?

by *Paul Denny*

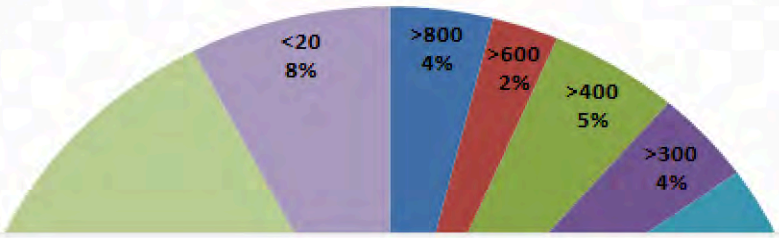
What does a typical PeerWise course look like?

October 12, 2012 *in* *Uncategorized*

If you have ever wondered whether your class is too small (or too big) to use a tool like PeerWise, you may be interested in the following data. To get a sense for both the typical size of a class on PeerWise, and the typical number of contributions made by students in each class, data from the last 1000 courses was examined.

While there are many examples of very large classes (>300 students), and even a few extremely large ones (>800 students), the majority of classes have fewer than 50 students. The breakdown is given in the chart below.

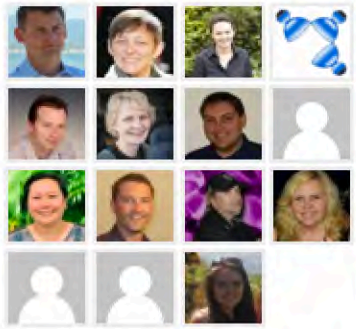
Typical class sizes - a summary of 1000 PeerWise courses



Welcome Back

Welcome to this online community of practice for educators everywhere who are using and investigating PeerWise in their classroom settings.

Recently Active Members



Who's Online Now

Acknowledgements

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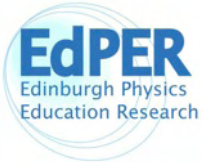

Ross Galloway
Judy Hardy
Karon McBride
Alison Kay
Keith Brunton
Jonathan Riise
Danny Homer

Chemistry – Peter Kirsop

Biology – Heather McQueen

Physics – Morag Casey

Comp Sci – Paul Denny

Resources

Community:

http://www.PeerWise-Community.org

JISC-funded multi institution study:

https://www.wiki.ed.ac.uk/display/SGC4L/Home

UoE Physics Pilot Study:

AIP Conf. Proc. 1413, 359 http://dx.doi.org/10.1063/1.3680069

UoE Physics scaffolding resources

http://www2.ph.ed.ac.uk/elearning/projects/peerwise/

a place of mind

THE UNIVERSITY OF BRITISH COLUMBIA