Refreshing change: innovating with no guarantees

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Asking questions
iClickers

5. Learning with clickers improves my understanding of the course content

Anonymous questions

https://forms.gle/dX1zp8EnRqHeB4o4A

Shaun MacLean
Teaching Assistant (2015)
“very thorough, I LOVED THE LIVE ONLINE QUESTION THING, literally solves all of universities problems where kids are too afraid to ask questions, or profs don’t have time (this should be used in every other class- PLEASE BIOLOGY 186 NEXT SEMESTER PLEASE PLEASE PLEASE PLEASE PLEASE, and high schools-honestly best idea ever.) I didn’t ask tooooo many questions through that just because Scott taught it so well, but for biology and other science courses please tell them to do that anonymous online live question thing.”

“He was readily available for questions/help, if needed, and the online question board was an excellent idea. Often I am intimidated speaking in front of a lot of people, but have questions.”

“The in-class question asking link as well as the Q&A on coursespaces was fantastic, sometimes a question got answered I didn’t even know that I wanted to ask. :))”

*Instructions for implementing*

Get (use) a Google account.
Go to Drive and click “New”.
Select “More… Google Forms… Blank Form”.
Title the form “<Course Name>”. Add a form description if you like.
Call the first question “Ask <your name> a question”.
Choose answer type as “Paragraph”.
Click on “Send… Send via link”
Copy the URL (web address)
Go to https://www.qr-code-generator.com/ and paste in the URL.
Copy the resulting QR code to share with your class.
Click on responses, and click on the white-on-green cross (“Create Spreadsheet”).
Give it a name. You can now check responses to the form on your phone using the Google Sheets app!
Where did you get your shoes from?
A. My dad took me to R&M Williams

What a fantastic idea! How do I do this in my class?
A. See previous slide!

Do you find apps like Kahoot! as effective as iclicker?
A. Not used it myself but have seen it many times. iClicker enables us to measure participation, for which we assign grades (3% of the final grades). Not sure if that would work with Kahoot!

How do you make the image that I just scanned? / How do you get the square to set this up?
A. https://www.qr-code-generator.com/

Cats or dogs?
A. We have one of each

What is your middle name
A. Scott! My initials are J. S.

How do you improve student engagement?
A. This is one such effort. I also run my office hours in a lecture theatre, and get 30-100 attendees at each.

Do students abuse the anonymous nature? / This is cool. Did you ever get questions that abused the anonymity of this?
A. Much less than I expected. But they see me as a geeky dad figure, so I am probably insulated from the worst of it as a result.

How do you make this tech magic happen? / Where do I get this software to use in class
A. Instructions now included in this presentation.

Which part of NZ are you from?
A. I was born in Rotorua and grew up on a farm.

Does this create (more) problems with cell phone use during class?
A. Not noticeably, no.

Do any students complain it doesn’t work?
A. Never.

Do you answer in real time?
A. No. I check them while they are answering clicker questions, and probably only answer half during class.
Have you ever had to moderate your response to an inappropriate question?
A. Yes. I don’t answer them in class and tell them I will not answer them online afterwards either.

Is this technology compliant with BC privacy guidelines? (I would like to use this, but I am not sure what is okay with regards to the cloud, servers in the US, etc.)
A. Because I collect no information on them and no one is required to participate I think it is OK.

How do you handle students who repeatedly ask questions beyond the scope of the course?
A. I ignore them.

Do you just show the QR code at beginning of the class?
A. Not every class, but yes I do remind them periodically.

You can use bitly to make a short link
A. Yes!

Do you ever fake a question that you wanted someone to ask?
A. Ha! No. I am a terrible actor and I would find it really hard to do that authentically.

The light will break. / It will Break the light.
A. Luckily, no! But that will probably happen one day.

Colour change
A. Great guess!

No idea!
A. Unfortunately, that is what most of my class has when I ask the same Q!

Magic!!!
A. No, science!

Can I ask you about your TopHat experience? I’m using it this year. Perhaps I could email you about it.
A. Not great to be honest, but we were doing something non-conventional. As a company, they are trying very hard but suffering from growing pains. They wanted it to work but we had to deal with too many different people who really didn’t know what was going on.
**CourseSpaces Q&A**

Early days: used Blogger to answer questions online instead of via email. Now easily implemented in CourseSpaces:

In 2017, 855 of 866 Chem101 students visited the forum. The average student visited 43 times (total >37,000), and over 600 questions were asked.

**Solving problems**
First-year science textbooks have converged on a problem-solving approach loosely based on the method suggested by Hungarian mathematician George Pólya in his 1945 book “How to Solve It”.

“Mathematics, you see, is not a spectator sport. To understand mathematics means to be able to do mathematics. And what does it mean [to be] doing mathematics? In the first place, it means to be able to solve mathematical problems”

Pólya suggests the following steps:

1. Understand the problem = **READ**
2. Make a plan = **PLAN**
3. Carry out the plan = **SOLVE**
4. Look back on your work = **CHECK**
1. Photodissociation of O₃ is a known atmospheric process which is required for the formation of ozone in the upper atmosphere. The ΔH for the reaction is 4098.0 kJ per mole of dioxygen decomposed:

   \[ O_3(g) \rightarrow O_2(g) \]

   Assuming that a single photon causes conversion of a single O₃ molecule, calculate the longest wavelength (in nm) of radiation that would provide the necessary energy for conversion of a molecule of O₃ according to the above equation.

2. An argon laser emits blue light with a wavelength of 488.0 nm. How many photons are emitted by this laser in 2.00 seconds, operating at a power of 5.15 x 10⁴ W?

3. Consider the energy levels in the hydrogen atom (right).
   A) Will light be emitted or absorbed for the two transitions A and B?
   B) What frequency of light is involved in transition B?
   C) Which transition has the longer wavelength?

4. A student wanted to excite a ground state hydrogen atom to an electronically excited state with \( n = 3 \) and \( \ell = 1 \) using a laser that emits at a wavelength of 355 nm but was not successful. Explain.

5. Consider the energy levels in the hydrogen atom (right).
   Calculate the energy change corresponding to the transition labeled A. Express your answer in kJ mol⁻¹.

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**READ PLAN SOLVE**

Consider the set of \( p \) and \( d \) orbitals (8 in total number) with respect to their most probable electron density distribution. Although there are a total of 8 such orbitals, there are only 3 that are distinctly different with respect to overall shape in space. Sketch these on the sets of coordinates below. **NOTE:** You do not need to show any nodes that might be “buried” inside the orbital. LABEL your drawings as \( p \) or \( d \). Your label has to match your sketch in name but you do not need to show the subscripts of the orbitals.

= sketch and label 3 different shapes of \( p \) and \( d \) orbitals

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Krista Kobylianskii (PhD 2011)
Teaching Professor, Rice University
How can the narrated examples be improved?

“How can the narrated examples be improved?

“Only in scope and scale - that is to say more on a broader range of subjects.”

“Maybe more questions like a 2nd example of each just make sure you know.”

“Change voice... get someone with a voice like Morgan Freeman [in] March of the Penguins... Less talking.”

“Maybe a bit lighter, the tone is a bit serious. Add a joke once in a while like NaOH’s ark.”

Make them... “more practical” “more detailed” “more varied” “to the point” “faster” “slower” “holographic” “more concept[ual]” “[less] wordy” “[with] more styles” “harder” “easier”

*See examples

All on CourseSpaces and YouTube now, but see early web implementation at

http://web.uvic.ca/~mcindoe/rpsc.html
Delivering content

Lecture books

Lots of components to first year chemistry that make traditional note-taking a challenge:

- Many figures
- Clicker questions (2-4 per class)
- Problem-solving
- Demonstrations
- Videos

2011-2018: Lecture books produced with Pearson content
2018/9: Lecture books produced in house with Top Hat content
2019-: Lecture books produced in house with our own content and open-source textbook
The hydrogen molecule

When \( n \) AOs overlap, \( n \) MOs form. For \( \text{H}_2 \), \( 1s \ (\text{H}) + 1s \ (\text{H}) \) must result in 2 MOs:

A molecular orbital energy level diagram:

Both bonding and antibonding molecular orbitals have electron density centered around the internuclear axis → \( \sigma \) bonds
*Want to see a lecture book?

Send Scott an email (mcindoe@uvic.ca) – I have about a dozen spare from previous years and I will send you one through campus mail.

Conveying geometry
2D representations of 3D objects can be confusing

the3doodler.com
Feedback

“I found it very helpful to draw the molecules and make them into the molecular shapes because it was easier to conceptualize the angles. I think it would be a good aspect to have added to the lab portion of this class since it is an area that needs to be understood quite well in order for other concepts to make sense”

“I thought it was a very interesting and engaging way to learn about molecules. I found that something about creating and constructing them myself really helped my understanding of the configurations. I think it would be a very worthwhile lab”

“My experience with the pen was that it was slow going and unintuitive. Although by the end we were able to recreate the little machine printed ones, it took a lot of time for little reward. During the actual lab, it took most people almost the entire 3 hours to complete it, and I think without revamping the lab itself, people would run out of time trying to use the pens”

Faster fabrication
Interlocking transparent acrylic models


13 geometries in 5 colours for ~$3/kit

Complete set of laser cut acrylic pieces, color coded by number of electron domains (nED). (a) Red (2ED): linear. (b) Yellow (3ED): bent (120°), trigonal planar. (c) Green (4ED): bent (109.5°), trigonal pyramidal, tetrahedral. (d) Blue (5ED): linear, T-shaped, seesaw, trigonal bipyramidal. (e) Purple (6ED): square planar, square pyramidal, octahedral.
Unexpected bonuses

“I found the models useful for comprehension of the different electron domain and VSEPR configurations; they were effective for learning the spatial concepts in the place of 3D images and made discussing questions much easier with peers and instructors.”

- Quote from visually impaired student in my 2017 class

Mobile made by Chem101 student from models

Miscellany
Graduate modular courses
- 12 lectures, 0.5 credits, instructor specialist subject
- 16 different modules offered to date

Undergraduate research participation
- two Chem361 lab classes performed experiments for two projects (both since published in primary literature)

Wikipedia articles
- As a small-group project, 4th year and graduate students wrote Wikipedia articles for niche topics in organometallic chemistry

Professional development for high school teachers
- planning and preparing safe class experiments

YouTube standard operating procedures
- students are filmed executing experimental techniques and narrating them for preservation of expertise

*See examples

All on CourseSpaces and YouTube now, but see early web implementation at

http://web.uvic.ca/~mcindoe/rpsc.html
Lifelong learning
Consult professionals. Do not try at home.
3D periodic table
*See tutorials*

All of Scott’s maker projects are available on instructables.com – see

https://www.instructables.com/member/makendo/

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