The AI Revolution in Learning
Why Edinburgh matters

Kobi Gal
Course Forums Yesterday

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And Today
[Yogev et al., 17]

Make a note.
Draw others’ attention to something interesting. Click & drag to highlight.

Ask a question.
Don’t understand something? Highlight the text and ask your class about it.

See trouble spots.
Know which parts of the material need more attention by seeing where students are confused.

Answer a question.
If you see a question and you know the answer, just right click it to answer it.
Labs yesterday
Labs today

[Yaron et al. 17]
[Drysdale et al. 18]
The Teacher in the Loop

- Inferring Student Engagement
- Collaborative Group learning
ICAP framework

[Chi and Wylie 16]
ICAP framework

[Chi and Wylie 16]
ICAP framework
[Chi and Wylie 16]

Reading
Underlying, highlighting
Summarizing
ICAP framework
[Chi and Wylie 16]
Research Question

Cognitive Engagement can be a useful tool for teachers.

Approach: Combining **automatic classification** with **visualization** and **interacting with stakeholders**.

Contribution:
- Classifying CE (Manual and Automatic),
- Visualization Tool
Example Active Reasoning

Interactive

Constructive

Active

Off Topic

What is an isoelectric point of an amino acid?
Yes, I agree with you, if the interactions between the sheets change, it may cause the protein’s overall structure to change.
The Power of Context

Constructive

Active

Off Topic

Wild Type is seen as the natural, normal genes of an organism, whereas a mutation is a type of change to these normal genes that can either provide a good or bad trait...

Cell division in the bacteria and archaea

Bacteria and Archaea

Like all other life forms, bacteria and archaea have one key evolutionary driver: to make more of themselves. Typically, bacterial and archaeal cells grow, duplicate all major cellular constituents, like DNA, ribosomes, etc., distribute this content and then divide into two nearly identical daughter cells. This process is called binary fission and is shown mid-process in the figure below. While some bacterial species are known to use several alternative reproductive strategies including making multiple offspring or budding - and all alternative mechanisms still meet the requirements for cell division stipulated above - binary fission is the most commonly laboratory-observed mechanisms for cell division the bacteria and archaea so we limit our discussion to this mechanisms alone.

(Aside: Those who want to read more about alternatives to binary fission in bacteria should check this link out.)

Wild Type is seen as the natural, normal genes of an organism, whereas a mutation is a type of change to these normal genes that can either provide a good or bad trait...
Manual CE Classification

1) Does the post talk about content that is related to the course? This includes both teaching content and logistics such as: lecture videos, quizzes, grades and assignments.

2) Does the post display reasoning. For example by:
   - Not only repeating or paraphrasing content.
   - Making a cause and effect relationship.
   - Comparing or distinguishing between two or more conditions.
   - Adding information to one of the previous posts or content around the marked text (not only repeating or paraphrasing).
   - Giving a statement and justifying it with evidence.
   - Scientific evidence, marked text, specific personal experience, etc...
   - Giving a statement or asking a question and giving reasons why the commenter thinks this way.
   - Drawing a conclusion based on the marked text.

3) Is this a response to a message in the thread?

4) Does the post address any of the previous discussions of the posts in the thread explicitly or implicitly?

5) Does the post introduce something new (not just paraphrasing), whether in a statement or a question, without reasoning about it. For example:
   - A new idea.
   - An answer to a question (in the marked text) but without an explanation.
   - A question or comment about content that is related to the context/document but goes beyond what’s covered in it.
   - Referring to documents or resources other than the current document.

6) Is this a response to a message in the thread?

7) Does the post affirm what a previous user said? (e.g., an agreement or thank you)

8) What is the label of the previous message?

9) Does the post address any of the course subject matter.
   For example:
   - Paraphrases or repeats any course content.
   - Requests an example even without details.
   - Expresses confusion or interest or asks a question.
   - Maps any of the course content and talk about it.
   - Mapping content is any of the following: marking a text, giving references, quoting, etc.

10) Does the post shows any sign that that user is engaged with course materials without mentioning the content?
    (E.g. “I’ve watched the videos”, “I’ve read in the book”, “The teacher said”, etc.)
CE behavior

Biology

Physics
Insights

Low CEs

- Definitions, questions, short comments, first posts,

While the buffer system is effective, if too much base or acid -- that is particularly strong -- is introduced it will overpower the buffer and equilibrium will be thrown off. That is presumably why it is so dangerous to consume cleaning supplies or strong acids since they are so high and low, respectively, in pH.

Artificial Intelligence and its Applications Institute
Amino Acid Structure

Amino acids are the monomers that make up proteins. Each amino acid has the same fundamental structure: a central carbon atom, also known as the alpha (α) carbon, bonded to an amino group, a carboxyl group (COOH), and to a hydrogen atom. Every amino acid also has another atom or group of atoms bonded to the central atom known as the R group (Figure). For an introduction on amino acids, click here for a short (4 minute) video.

Figure 2. Amino acids have a central asymmetric carbon to which an amino group, a carboxyl group, a hydrogen atom, and a side chain (R group) are attached.

Possible Discussion:
Recall that one of the learning goals for this class is that you (a) be able to recognize in a molecular diagram the backbone of an amino acid and its side chain (R-group) and (b) that you be able to draw a generic amino acid. Make sure that you practice both. You should be able to recreate something like Figure 2 from memory.

Using figure 2, which of the following is true about amino acids:
- amino acids contain polar functional groups
- amino acids contain basic functional groups
- amino acids contain acidic functional groups
- amino acids contain a variable group that can be either polar or nonpolar
- all of the above
User Study Findings

CE heat map
1) helps instructors make sense of student's interaction with the material.
2) facilitates class design.
3) saves instructors time and effort.
Facilitating Group Work

[Segal et al. 17, Shwarz et al. 19]

Dillenbourg (2013)
VMT [Stahl 2012]
To use student group learning, a teacher needs to...

“Temporarily clone myself”

“Have eyes in the back of my head”

“Help me to intervene where, when, and with what I’m most needed”
Table 1. Examples of communication message categories

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<th>Category</th>
<th>Sample Messages</th>
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| On-task    | “Do we all agree that the answer is a parallelogram?”,
              “We also have to justify the answer”,
              “You are correct, I did not pay attention to the third item in the question.” |
| Technical  | “Please release the control”,
              “Where is the diagram?”,
              “The Drawing Tool is not operating” |
| Off-task   | “How are you?”,
              “I am finding it hard to focus”,
              “I have to leave” |
SAGLET Pipeline

Chat Messages

Supervised Learning

Alerting Rule Engine

Alert Types:
- Technical
- Idleness
- Off Task
- On Task
- Wrong Solution
- Correct Solution
- User Joined
- User Left

Predict

Alert

Visualize
Supporting the group
Teacher’s Testimony

Without SAGLET:
• unable to visit groups more than once
• unable to remember state of each group

With SAGLET
• Able to track 5 groups with minimal burden
• Able to quickly decide on appropriate intervention
• Able to identify “group reached solution” & verify
Future directions

Invest in instructional design
Student support
Engage faculty
Ethical reasoning