Open-ended question

If you have a moment, then write down your personal answer to the following question. We'll be using this later.

"What is ESTICT most valuable to you for (in your opinion right now)?."

Ways to improve learning with EVS:

Some deep procedures for teachers
and what software features matter for these

Steve Draper, Glasgow University

Assisted by: Ben Watson, WordWall

www.psy.gla.ac.uk/~steve/talks/evs2.html
(EVS = Electronic Voting Systems)

Today's menu

A. Evidence of learning success with EVS
B. Catalytic assessment: some successful designs, all around provoking learning (deep) thinking
C. Jaye Richards: new use of EVS as stimulus for student generated content
D. Bowskill: new use of EVS not for teaching but reflection
E. Taking contingent teaching seriously
F. Palette vs. slideshow style of support
G. A demo of open-ended voting

But first ... the moral of this tale

For learners:

Are they trying to memorise (shallow)

Or are they trying to understand? (deep)

For teachers:

It's not the technology stupid, it's the learning design that most affects learning outcomes.

But what is it that good designs are doing?

And what kind of software support fits that?

These are the mysteries this tale is about ....

Part A.

Some evidence about EVS

Hake

Hake (1998) published a survey of 62 courses (6,542 students) all studying the same subject, all using the same standardised test, and using it both pre- and post-.

He graphed the mean gain on each course against whether or not it had used the method of "Interactive engagement".

See fig. 1 in:

Hake,R.R. (1998) Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses Am.J.Physics 66(1), 64-74

Hake's results

Mazur

Crouch & Mazur (2001) published an analysis of 10 years of Mazur's MIT course.

Again, the standardised pre- and post-test.

He concludes he has doubled the amount of learning, but the graph suggests that really, he tripled it.

See fig.2 in:

Crouch, C.H. and Mazur, E. (2001), "Peer Instruction: Ten years of experience and results" American Journal of Physics 69, 970-977

Mazur's gains

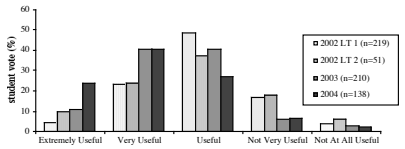
Does EVS work? Evaluation overview

Exam results: At Strathclyde in Mechanical Engineering, first year dropouts were 20% in 1998, but since using EVS are 3%.

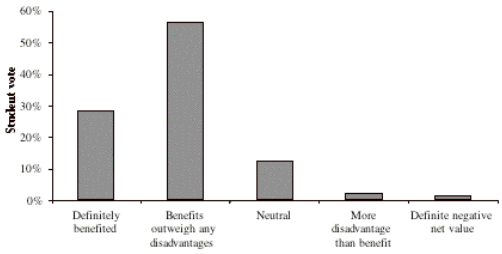
Attendance (when voluntary): in Glasgow Statistics large group tutorials for level 2: rose from roughly 20 to 80 (out of 200) when EVS introduced.

Attitude data: over all the applications at Glasgow, in all cases except one, a large majority of students said it was of overall benefit.
The same is true of teachers.

Simple "how useful?" question



Net benefit as judged by students



So

So more effective teaching can be achieved.

"Interactive engagement" and "peer instruction" are usually delivered using Electronic Voting Systems (EVS).

But it isn't the technology, stupid;
it's the teaching method, the learning design that makes the difference.

Hake and Mazur don't mention voting technology and some of the results predate it.

Part B:

Catalytic assessment

"Catalytic assessment" is a catch phrase for questions that may look like tests, but whose important mathemagenic (learning generating) effect is hidden in the learner.

Questions, which questions?

So more effective teaching can be achieved.

"Interactive engagement" and "peer instruction" revolve around asking students questions.

But what kind of questions?

Assertion-reason questions

Asking not about the truth of facts, but the reasons for a true fact.
- The question states a fact
- The response options list reasons
- All of these should be true
- All should have been in the course being tested
- => Then recognition will not help the student.

CAAC (Computer Assisted Assessment Centre) website advice on MCQ design:
http://www.caacentre.ac.uk/resources/objective_tests/index.shtml

Questions about reasons (nucleus)

Trivia quiz questions will only elicit learning random facts, not reasons. So a good first step is to ask directly about reasons. E.g.:

In an atom, electrons do not spiral into the nucleus despite the strong electrostatic attraction. Is this due to?:

1. The Pauli exclusion principle
2. Heisenberg's uncertainty principle
3. Planck quantization
4. de Broglie's wave-particle relation

Questions about reasons (sky)

The night sky is dark because:

A. The Universe is infinite in size

B. The Universe is expanding

C. The Universe is made up of, mostly, Dark matter

D. The Universe only existed for a finite amount of time

Asking about confidence

Hunt (1982) (in an artificial experiment) showed that participants who first chose an answer and then had to indicate a confidence level learned about 20% faster than those who just chose an answer.

(This general issue is sometimes called "metacognition": when the learner isn't just a recorder of information but reflects on their learning and may modify their learning activity because of this.)

Gardner-Medwin's CBM (confidence based marking) is a direct application of this.

Mazur's Brain teaser questions

The point is to provoke debate, internal and between peers.
Cf. Socratic questioning, and "catalytic assessment"

Remember the old logo or advert for Levi's jeans that showed a pair of jeans being pulled apart by two teams of mules pulling in opposite directions. If one of the mule teams was sent away, and their leg of the jeans tied to a big tree instead, would the force (tension) in the jeans be:

- half
- the same
- or twice what it was with two mule teams?

Peer Instruction: Mazur Sequence

1. Concept question posed (brain teaser)
2. *Individual Thinking*: students given time to think individually (1-2 minutes)
3. Students provide individual responses
4. Students receive feedback – poll of responses presented as histogram display
5. *Peer Discussion*: students instructed to convince their neighbours that they have the right answer.
6. Retesting of same concept
7. Students provide individual responses (revised answer)
8. Students receive feedback – poll of responses presented as histogram display
9. Lecturer summarises and explains 'correct' response

Miyake and "constructive interaction"

We can understand Hake's and Mazur's demonstrated practical educational successes in terms of the theory developed in developmental psychology of how peer interaction promotes individual's conceptual advances.

Miyake (1986) got researchers round her lab to discuss their understanding of sewing machines.

Detailed analysis of the conversations showed that this was NOT teaching, yet both did advance their conceptions.

Christine Howe's work (1)

Long series of studies on peer interaction causing conceptual development.

Good selected paper:
Howe, C.J., Tolmie, A, and Rogers,C. (1992)

To get the effect, you need to work on the setup:

Peers with different prior beliefs
Elicit commitment to their personal view in advance e.g. write their view, then show peers this opinion.

Christine Howe's work (2)

- Benefit is delayed (e.g. 4 weeks)
- Final conceptions are different in solo than group interviews
- More advanced child ALSO advances still further I.e. it is NOT information transmission
- "not agreement but private conflict resolution"

⇒ Mechanism is metacognition
(Howe, McWilliam, Cross 2005)

Learner authored questions

This is another powerful teaching tactic.

Basic idea:
Students have to design a test MCQ (best in a small group) complete with reasons why each response option is right or wrong.

Have to aim for questions that discriminate (splits class).

Why is this effective? Same underlying reason as Mazur: the factual question requires them to generate reasons ....

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Catalytic assessment

"Catalytic assessment" is a catch phrase for questions that may look like tests, but whose important mathemagenic (learning generating) effect is hidden in the learner.

(For the full argument see my paper on this.)

"Catalytic assessment: understanding how MCQs and EVS can foster deep learning" British Journal of Educational Technology vol.40 no.2 pp.285-293

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So

So more effective teaching is achievable.

And it can be achieved with EVS, asking questions of various types.

But it isn't the technology.

It isn't even really the format of the question (e.g. Bloom category / level), but what kind of thinking it elicits in the learner.

However what is very often important is the "learning design" in the sense of what the teacher does with, or rather, in response to, the answers that come back to questions....

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Part C:

Learner authored answers (not qus) / Student Generated Content

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Jaye Richards' new L-design

(being trialled with 12 year olds in a general science course)

- Start each block with a set of MCQs designed to:
  - ❑Get them interested in what they are about to learn
  - ❑To act as learning goals: what they must find out
- Don't tell them the right answers
- Apportion the MCQs (and response options) among the groups
- Each group, over next few periods, researches & creates a presentation (learner authored answers / SGC) on:
  - ❑what the right answer is,
  - ❑why each response option is right or wrong
  - ❑Physical demonstrations
- Presentations by each group to whole class (Jigsaw)
- Retest on the original MCQs

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The weatherman on the news predicted that thunder and lightning was on its way. Why would it be a better idea to put your hood up to keep yourself dry than to use an umbrella?

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a) It might be windy so the umbrella could break.
b) The metal on the umbrella's handle and spokes could conduct electricity if lightning struck it.
c) The metal on the umbrella handle could rust in the heavy rain.
d) The umbrella could block your view from any potential hazards

Bedroom window 1

Why is it that sometimes on cold mornings when you wake up there are droplets of water on your bedroom window?

Bedroom window 2

1. The wet air outside means the air is also wetter than on other days.
2. It is wet or humid outside and some water vapour enters your room.
3. It is wet or humid weather outside, and water vapour in your room loses energy as it hits the cold windows.
4. The cold air outside is at a lower temperature than your room, and the water vapour in your room loses energy as it hits the cold windows.

You must be careful to keep a can of deodorant away from fire because it can explode. This is because:

1. the heat from the fire increases the pressure in the can by giving the atoms more energy.
2. the heat from the fire decreases the atoms' energy, also decreasing the pressure in the can.
3. If the can leaks, the chemicals react badly with the fire.
4. the aerosol's particles join together and solidify so there is no longer enough room in the can.
5. The can contains liquid, and when liquid boils the pressure and/or volume increases enormously.

What's powerful in Jaye's design?

- As in learner authored questions, it effectively gets them to give reasons, not rote memory
- Getting students to teach each other, and not the teacher doing exposition. (Jigsaw design. Betty Collis' Student generated content)
- Using (EVS) questions to define the learning agenda for these student-teachers (EBL)
- Using (EVS) questions to motivate the learning agenda Cf. "pre-lab, pre-lect" methods; constructivism, ...

Part D:

Bowskill: new use of EVS not for teaching but reflection

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Student generated induction

At the start of this academic session, we did an induction session for all the new students in one faculty to a novel recipe.

Big success with the students.

- Asked them about their concerns about being a student here
- Got them to discuss it
- Assembled a representation (using EVS) of the groups' concerns as a whole
- Got older students to comment on how they addressed each concern

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Overall recipe, linking sessions

1. Level 2 session: elicit their retrospective and prospective concerns (about the year they just completed, and the new year starting); and their ideas about solutions.
2. Keep a few volunteers on to orient them for meeting level 1 students.
3. Level 1 session: elicit their prospective concerns, and possibly thoughts on finding solutions.
4. Joint meeting: go over the concerns, and the level 2 mentors comment on the solutions they favour for each.

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Recipe within one session

Snowballing:

- Ask students to write down what their chief concern is
- Get them to discuss this with the 3 nearest people
- Get each group to text in their joint chief concern
- The presenter groups these into top 6?, 9? Concerns
- Get everyone (EVS) to rate amount of concern they personally have for each of the shortlisted ones
- Sort them by accumulated concern levels: show that display

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Nick Bowskill's L-design

http://www.psy.gla.ac.uk/~steve/bowskill/

What to call it?

- Student generated PDP
- BIRP: Bowskill's Induction through Reflection Process
- BITRAMP: Bowskill's Induction Through Reflection And Mentoring Process
- Group construction of common ground on group-relevant and significant matters.

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Part E:

Taking contingent teaching seriously

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Basics underlying EVS use in class

You have to be ready with a plan of what you will do with the different possible response patterns from your questions. If you do nothing with them, you'll look, and be, stupid (unless you really are doing catalytic tactics).

Newcomers think you use EVS to get "student engagement".
But experienced users see the chief benefit as feedback to the presenter on that audience.
Why? Because that lets them do things differently depending on the audience.

Contingent teaching

The essential thing that EVS does is allow the presenter (and audience) to see at a glance what the spread of opinion in the room is: the favourite opinion, the degree of consensus or lack of it. And to do it for huge audiences too.

This is the fundamental functional advantage EVS gives.

Furthermore, what is the point of face to face meetings? Only if what the presenter says depends on that audience is it actually worth meeting.

I.e. the teacher's actions must be contingent on the audience's (just previous) actions.

Ben's 2 challenges to me

Apparently without meaning to, Ben and Josh delivered two shocks to my tacit assumptions about EVS, talks, ...

A. (When we said they must support powerpoint for HE customers) "Why would you want to give a slideshow?

B. How teachers actually really do re-use of colleagues' good teaching.

Challenge 1: Slideshows

People use ppt to pre-plan the sequence of their talk
The worst just read out their slides
Most use the slides as planning prompts and then ad-lib from their heads about them.

For workshops, people plan say 3 activities; produce paper materials for the activity e.g. discussion, and report.
They have a plan, but ppt is useless for representing it.

What is the same is:
- The existence of a plan;
- The preparation of some materials
- But much remains only in the head of the presenter.

-

Slideshow	Palette
Narrative	LBE
Transmission	Constructivism
Telling	Teaching
HE	Schools

-

Presentation Delivery

External storage Human memory

Challenge 2: re-use

How teachers actually re-use of colleagues' good teaching.

- Borrowing the ppt doesn't do it: they want to steal the learning activity
- But actually even that doesn't do it: they want the general idea/resource, and to set their own activity and questions based on it.
- This is only how HE people re-use textbooks.

What is wanted then is a toolkit allowing dynamic creation of questions and activities on the spot. The content might need preparing, not what is done with it in the session.

Part F:

Palette vs. slideshow style of support

Both the challenges imply we don't want a slideshow support like ppt but a palette-like toolbox for creating activities on the spot.

Flexible visual layout

(EVS) Questions don't have to be formatted all the same

The alternative responses can be set out in 2D, or all over the place.

The question may be simple: just speak it

OR the question may be complex, and the responses unwritten ("answer 1-9 ...")

Do the chemical example

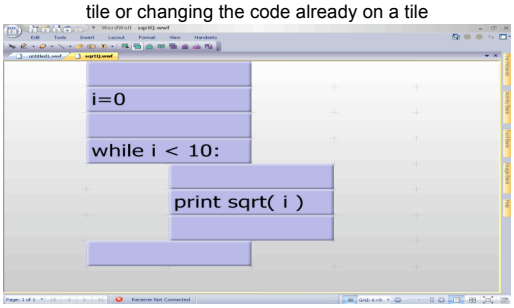
Question:
Which of these is copper?

Pick a MCQ question style linking 2 of: Picture of the metal, name of the metal (e.g. copper), symbol (e.g. Cu)

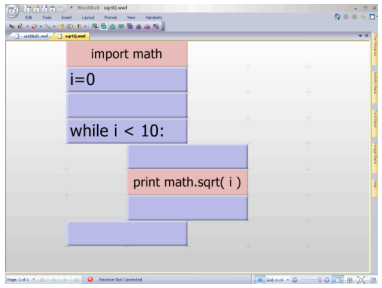
Do Quintin's programming example

xxx

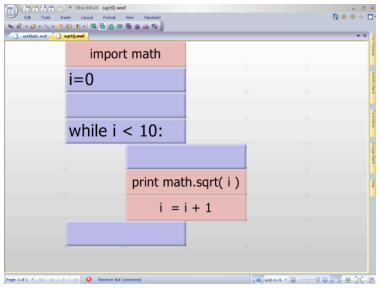
The problem is to write out the square roots of the numbers 1 to 10. The students can vote on any of these tiles to indicate something that should be different – either adding code to a blank tile or changing the code already on a tile



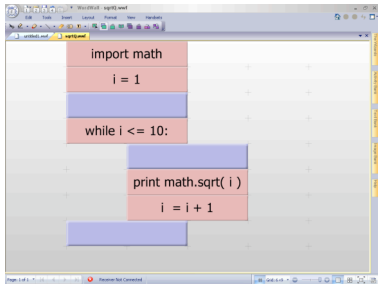
The students picked the *print sqrt(i)* as the first error (ie this tile got the most votes). In discussion in the class, we came to the code on the pink tiles as the solution. These were hidden on the back side of the tiles.



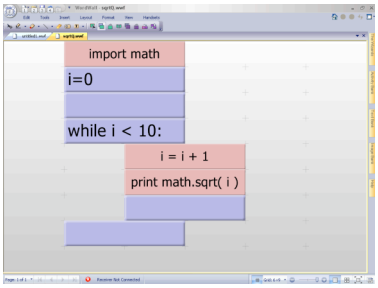
The students then voted the blank tile below *print math.sqrt(i)* as the next tile to change. Again, in discussion, we opted for the new line of code. I ran this in a Python window, and of course it didn't work, since the first value of i is 0.



So this is one solution – setting i to 1 to start with and changing the test on i to stay in the loop



and this is another – moving the position of i's increment and leaving the original test.



- There was a fairly easy/fluid interplay between class and teacher with the combination of the Word Wall, enabling me to flip over tiles easily to show different options, and the handsets, which allowed the students to direct the exploration, and also the use of Python to execute bits of code to validate or otherwise the students' answers.

Reprise: the moral of this tale

<u>For learners:</u>

Are they trying to memorise (shallow)

Or are they trying to understand? (deep)

<u>For teachers:</u>

It's not the technology stupid, it's the learning design that most affects learning outcomes.

But what is it that good designs are doing?

And what kind of software support fits that?

These are the mysteries this tale is about ....

Part G:

Open-ended question demo

Open-ended demo

Why am I doing this last?

Because the real demo requires a topic that matters to you the audience, now, today: not as an artificial demo of what mattered to the induction students on that day.

So here's the ESTICT question ...

Open-ended question

What is ESTICT most valuable to you for (in your opinion right now)?.

A place to stop

For the slides, handout etc. see:

http://www.psy.gla.ac.uk/~steve/talks/evs2.html