Provision of personalized feedback at scale using learning analytics

Centre for the Enhancement of Teaching and Learning
Faculty of Education
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Abelardo Pardo (@abelardopardo)
Faculty of Engineering and IT
slideshare.net/abelardo_pardo
New Design Mindset

The role of data and feedback

Personalised feedback at scale
New Design Mindset
Simple information transfer is not working

Learning Theories

- ACT-R (John Anderson)
- Adult Learning Theory (P. Cross)
- Algo-Heuristic Theory (L. Landa)
- Andragogy (Malcolm Knowles)
- Anchored Instruction (John Bransford)
- Aptitude-Treatment Interaction (L. Cronbach & R. Snow)
- Attribution Theory (B. Weiner)
- Cognitive Dissonance Theory (L. Festinger)
- Cognitive Flexibility Theory (R. Spiro)
- Cognitive Load Theory (J. Sweller)
- Component Display Theory (M. David Merrill)
- Conditions of Learning (Robert Gagne)
- Connectionism (Edward Thorndike)
- Constructivist Theory (Jerome Bruner)
- Contiguity Theory (Edwin Guthrie)
- Conversation Theory (Gordon Pask)
- Criterion Referenced Instruction (Robert Mager)
- Double Loop Learning (C. Argyris)
- Drive Reduction Theory (C. Hull)
- Dual Coding Theory (A. Paivio)
- Elaboration Theory (C. Reigeluth)
- Experiential Learning (C. Rogers)
- Functional Context Theory (Tom Sticht)
- Genetic Epistemology (J. Piaget)
- Gestalt Theory (M. Wertheimer)
- GOMS (Card, Moran & Newell)
- General Problem Solver (A. Newell & H. Simon)
- Information Pickup Theory (J.J. Gibson)
- Information Processing Theory (G.A. Miller)
- Lateral Thinking (E. DeBono)
- Levels of Processing (Craik & Lockhart)
- Mathematical Learning Theory (R.C. Atkinson)
- Mathematical Problem Solving (A. Schoenfeld)
- Minimalism (J. M. Carroll)
- Model Centered Instruction and Design Layering (Andrew Gibbons)
- Modes of Learning (D. Rumelhart & D. Norman)
- Multiple Intelligences (Howard Gardner)
- Operant Conditioning (B.F. Skinner)
- Originality (I. Maltzman)
- Phenomenonography (F. Marton & N. Entwistle)
- Repair Theory (K. VanLehn)
- Script Theory (Roger Schank)
- Sign Theory (E. Tolman)
- Situated Theory (J. Lave)
- Soar (A. Newell et al.)
- Social Development (L. Vygotsky)
- Social Learning Theory (A. Bandura)
- Stimulus Sampling Theory (W. Estes)
- Structural Learning Theory (J. Scandura)
- Structure of Intellect (J. Guilford)
- Subsumption Theory (D. Ausubel)
- Symbol Systems (G. Salomon)
- Triarchic Theory (R. Sternberg)
- Transformational Theory (J. Mezirow)
Active learning increases student performance in science, engineering, and mathematics

Scott Freeman\textsuperscript{a,1}, Sarah L. Eddy\textsuperscript{a}, Miles McDonough\textsuperscript{a}, Michelle K. Smith\textsuperscript{b}, Nnadozie Okoroafor\textsuperscript{a}, Hannah Jordt\textsuperscript{a}, and Mary Pat Wenderoth\textsuperscript{a}

\textsuperscript{a}Department of Biology, University of Washington, Seattle, WA 98195; and \textsuperscript{b}School of Biology and Ecology, University of Maine, Orono, ME 04469

Active Learning Works

**Engage** students in the learning process

“... robust correlations between student involvement in a subset of ‘educationally purposive activities’, and positive outcomes of student success and development, including satisfaction, persistence, academic achievement and social engagement”

We, as learners may

• Not know how to promote comprehension, retention, transfer.

• Not assess properly our own learning

• Be biased when judging our learning

• Rely too much on social beliefs

Frontier between physical and virtual spaces is blurring
Beware of technology creating the illusion of rational thinking
“... teaching in higher education will necessarily **shift the balance of its efforts towards a greater investment in design** as a way of coping with otherwise intolerable pressures on staff and resources.”

"There is no such thing as a neutral design"

“People make good choices in contexts in which they have experience, good information, and prompt feedback"

Variables associated with achievement

“38 meta-analyses investigating 105 correlates of achievement, based on 3,330 effect sizes from almost 2 million students”

• The effectivity of courses is strongly related to what teachers do.

• The effectivity of teaching methods depends on how are implemented.

• Teachers can improve the instructional quality of their courses by making a number of small changes:
  - providing detailed task-focused and improvement-oriented feedback

• The combination of teacher-cantered and student-cantered instructional elements is more effective than either form of instruction alone.

New Design Mindset

The role of data and feedback
Students are less likely to engage in pre-class activities if they are not interactive, **do not provide formative feedback**, and not coherently linked with the face-to-face activities.

If you could choose one...

- Over 800 meta-analyses of student achievements
- 100 factors with potential influence
- Feedback in top five
- (74 meta-analyses) Most effective form: video, audio, computer-assisted instructional feedback, and/or related goals

“Feedback is a **process** whereby learners obtain **information** about their work **in order to** appreciate the similarities and differences between the appropriate standards for any given work, and the qualities of the work itself, **in order to** generate improved work.”

Innovations designed to strengthen the **frequent feedback** that students receive about their learning yield **substantial learning gains**.
Perceived as an administrative chore instead of a pedagogical necessity

How to scale sustainable practices?

- Multi-stage assignments
- Dialogic feedback
- Technology supported
- Self-evaluation

Instructors are informed about student engagement but it is up to them to decide if/when/how to act.
Learning Analytics: measure, collect, analyse data about learners to understand and improve their learning and the environment in which it occurs.

• Collect data about how students engage in a learning experience

• Interpret the observations in the context of the instructional design

• Translate knowledge into **personalised** student support actions
New Design Mindset

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Personalised feedback at scale
Example of Highly Instrumentalized Learning Design
### Week 8

**Your lecture preparation**

- **Watch the videos**
  - Your performance: 70%
  - Class average: 80%

- **Answer questions next to videos**
  - Your performance: 80%
  - Class average: 90%

- **Answer questions in notes**
  - Your performance: 60%
  - Class average: 70%

- **Score in the problem sequence**
  - Your performance: 80%
  - Class average: 90%

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**See dashboard?** Yes  Ok
No statistically significant difference in the rating of feedback (2013 edition, $M=3.25$, $SD=0.97$; 2014 edition, $M=3.35$, $SD=1.03$); $t(389.78) = -0.97$, $p < 0.17$
Q1: You should take a more careful look at how symbols are encoded in the video. Would you be able to encode/decode UAL symbols without looking at the video?

Q2: Good initial work. However, did you understand the trick to handle encoding with a variable number of bits? Would you be able to provide an example?

Q3: Good work. Would you be able to come up with your own machine language and your encoding scheme? Remember that it has to be unambiguous.

Q4: Thorough work with the task about machine language encoding. Give it a quick review before the midterm.
Hi {name}

Here are some comments about the tasks this week:

Regards
Hi,

Here are some comments and feedback about your lecture preparation in ELEC1601 during Week 2.

**Activity VIDEO: Encoding in base 2, 8 and 16**

- Make sure you review again the whole content explained *in the video of the activity*. You could use a piece of paper and try to replicate the developments that are explained in the video.
- Give another round to the questions next to the video in this activity until you answer all of them correctly at the first attempt and without looking at the solutions.

**VIDEO: Review of natural and integer number encoding**

- Make sure you review again the whole content explained *in the video in the activity*. Encoding naturals is a procedure that you will be using very frequently in the following weeks.

**VIDEO: Encoding Integers**

- Review again the 2s complement encoding explained in *the video in the activity*. Repeat the procedure until you are able to do it very fast.
- You should give it another try to the questions next to the video in this activity. Try to work in the encoding until you have no incorrect answers in a full round.

**Read about the floating point representation**

- Good work with *the questions in the section*. You may take some of them and create variations (change number of bits for example) to make sure you fully understand the concepts.
- You should give it another try to *the questions about range, accuracy and precision in section 2.7.2*.
- Good work with *the questions in section 2.7.3*.

**Sequence of problems about information encoding**

- Good work with *the exercises in the sequence*. You may want to review it in a few days, or perhaps before the midterm.

Regards
Helpful feedback

Effect size (Cohen’s d) = 0.49. Medium positive effect

Midterm Scores

Effect size (Cohen’s d) = 0.21. Small positive effect

Support instructors to create personalised feedback

Simple rule-base knowledge encoding

Provide appropriate view of data sources

Scale to large and highly diverse cohorts

Will be released as open-source project Q3/4 2017

First pilots in Q1/2 2017

Tutorial in LAK 2017

Contact us if interested

ontasklearning.org
Conclusions

• New L&T design mindset required
• Feedback is effective to promote student engagement
• Learning analytics has the potential to support students at scale
• Use data to provide personalised student support
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