

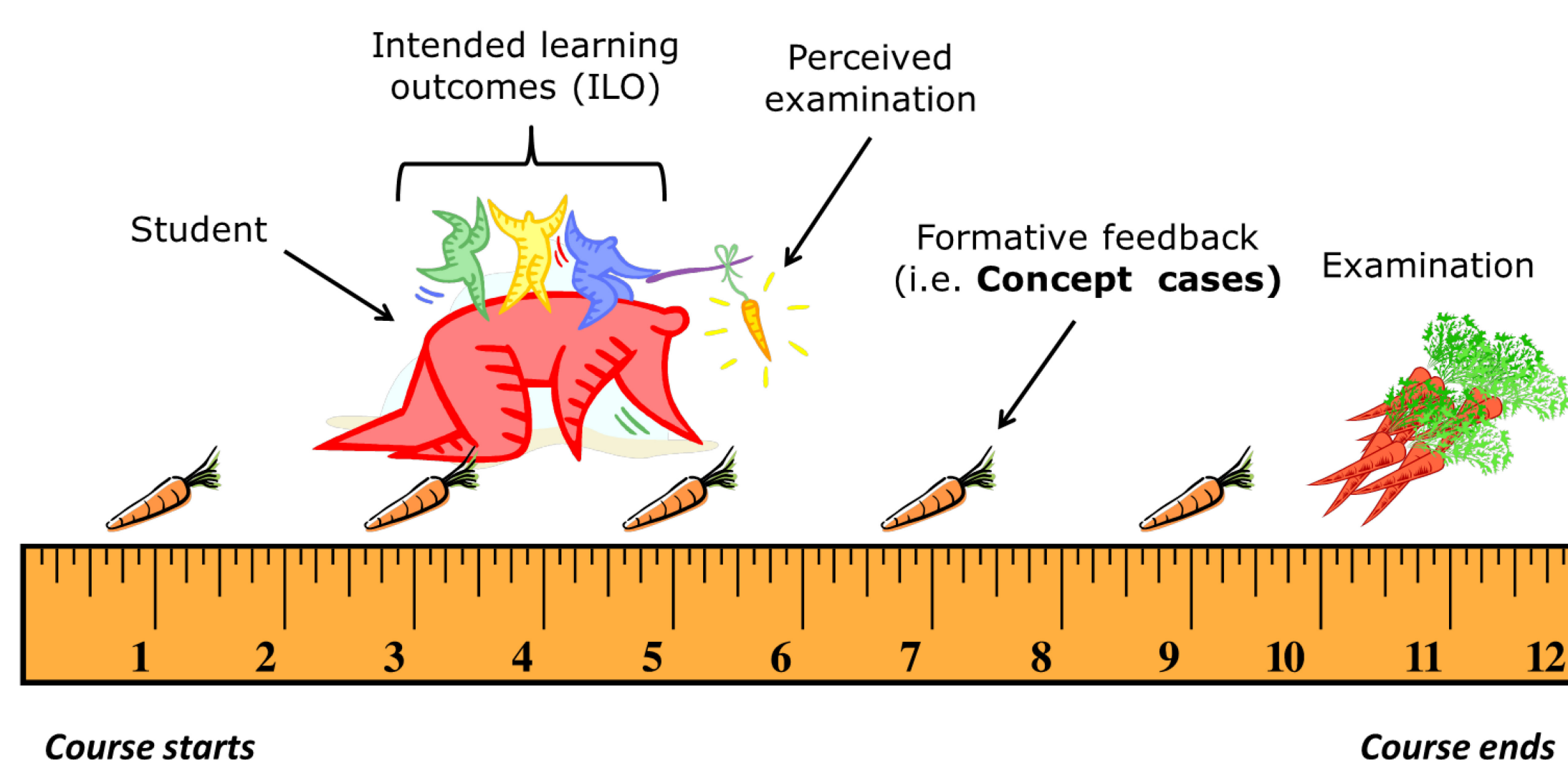


A short Note on the Experience of Using Concept Cases in a Master Level Course

DANIEL MÅNSSON

School of Electrical Engineering, Electromagnetic Engineering Lab

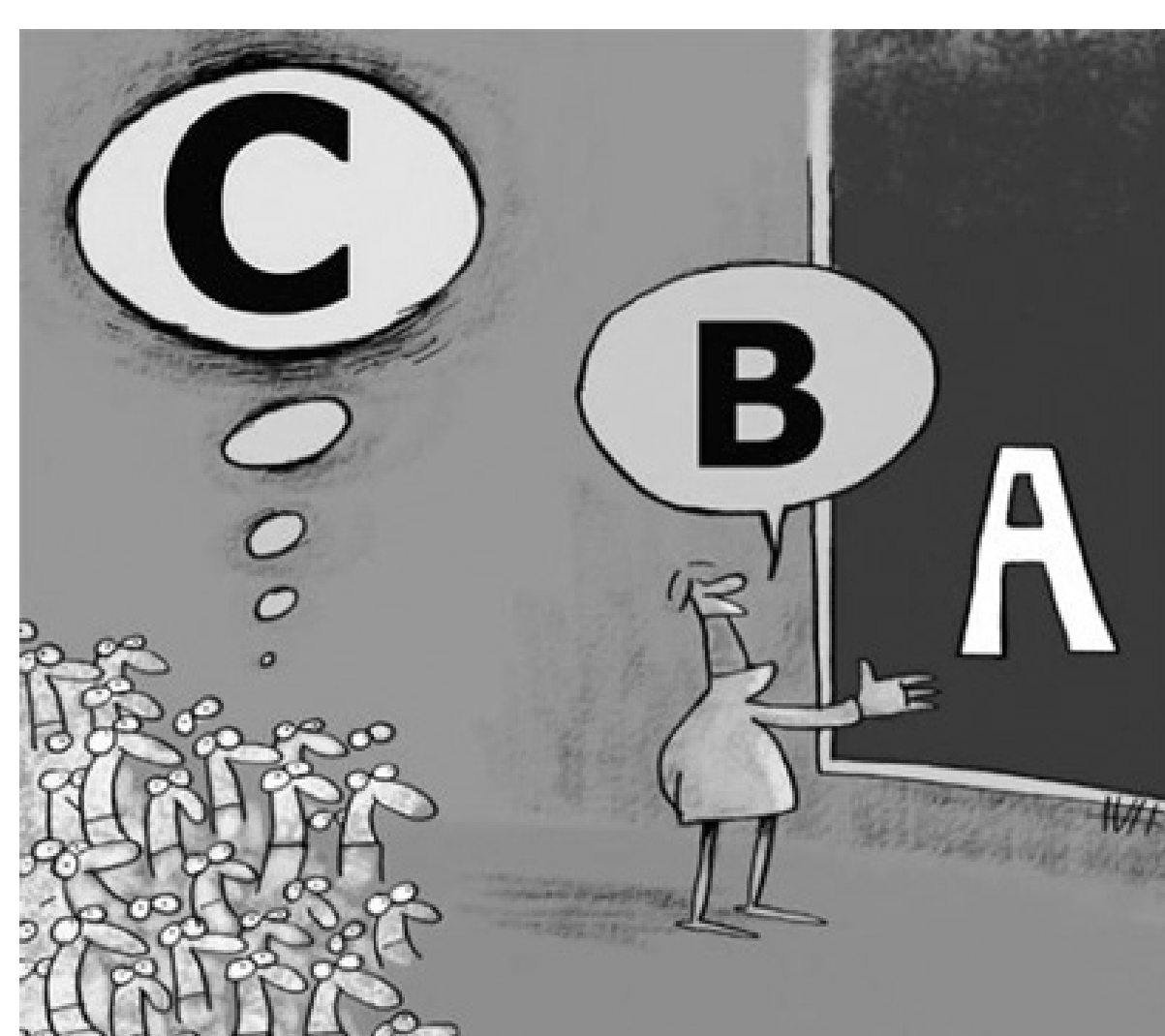
Why use concept cases?



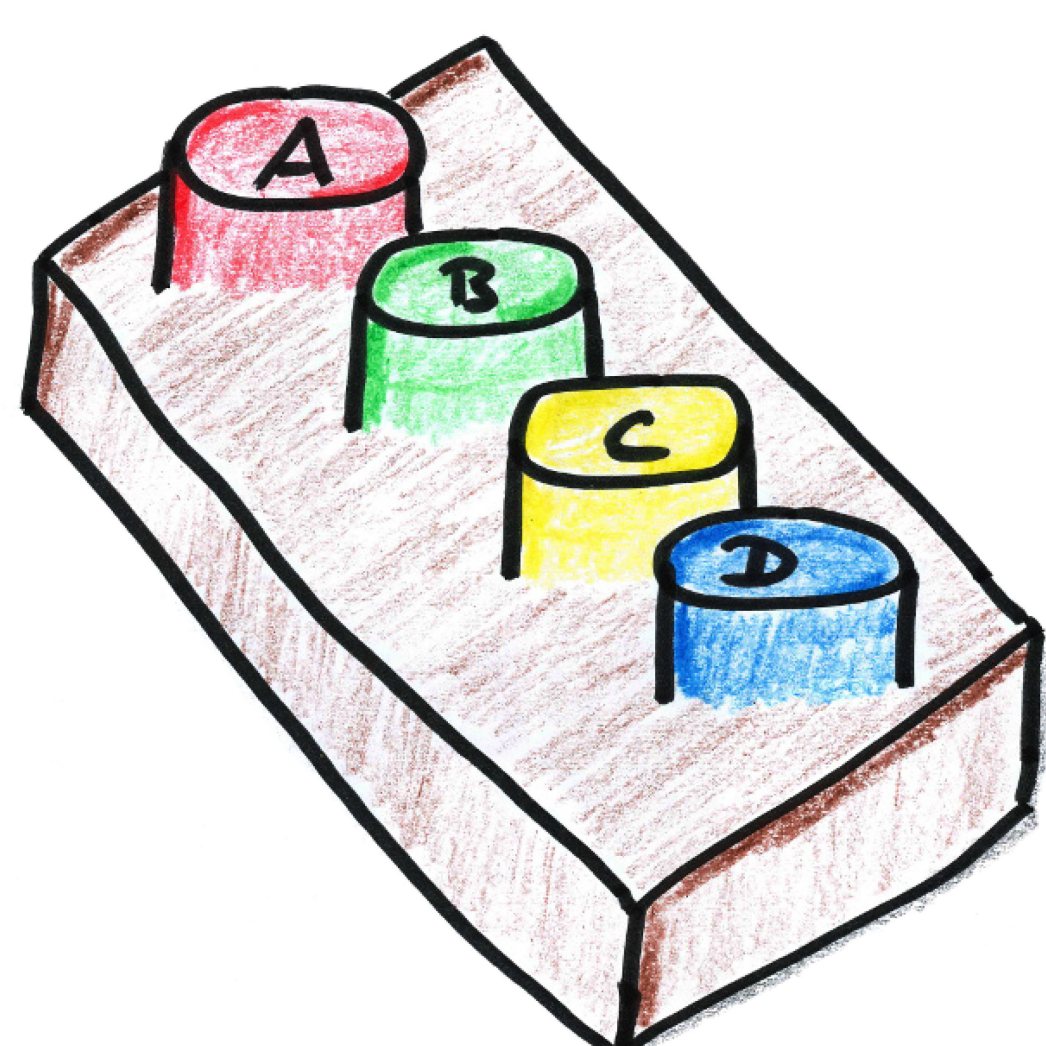
The student is guided forward by the ILO [1]. Formative feedback helps to create an accurate image of the final examination. Concept cases, used mid-lecture for adaptive teaching, give room for some more complexity than “traditional” concept questions [2]. However, this small expansion was found to bring design needs.

Key design issues found.

1) Clear introduction to correctly present the background situation and minimize misconceptions.



2) Rational multiple choice questions which would otherwise lead the students in some directions.



- A) No.
- B) Yes.
- C) ~~Banana.~~
- D) Sometimes...

3) An open discussion amongst the students will reveal misconceptions to them and the teacher can adapt content accordingly.



4) Clear and distinct presentation of the answer and a class wide discussion followed by an **adapted lecture**.

Example of a concept case.

The case of ...the dangerous toy race.

Lightning strikes close to a house. Inside the house two electrical toy cars are racing. One car drives much faster than the other (although the internal design is the same). How are the cars affected and do it differ between them?

A. They are equally affected.
B. The slower cars is affected more.
C. The faster care is affected more.

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The cars have internal conductors that form loops and can therefore be seen as a collection of loops that speed around. Some loops will be orthogonal to the magnetic flux density (B) and some will be parallel. But the two sets of loops will both have the same directions (over the course of the tracks). Also, the B-field is varying over the track.

Therefore in some internal loops more emf will be induced ("more" orthogonal to B) and some will have emf = 0 (// to the direction of B). However, as the emf is affected by the speed of the loop, more emf, and thus, current will be induced in the fast car!

$$\epsilon = -\frac{d\Phi}{dt} = -\frac{d}{dt} \int \vec{B} \cdot d\vec{a}(t) = \int (\vec{v} \times \vec{B}) \cdot d\vec{l} = \epsilon \int \vec{v} \cdot d\vec{l}$$

Observe that, if the loops are rigid ($da/dt=0$) and stationary ($v=0$) or the $d\vec{B}/dt=0$ then the emf = 0. In reality, however, the B-field from lightning is always highly time and space dependent and, thus, the flux through the loop is non-zero and an emf induced.

This is not only a hypothetical concept. It has been suggested (due to EU regulation on possible health effects due to B-field) that people that work with MRI (Magnetic Resonance Imaging) move slowly in the rooms to minimize the flux and induced current in their bodies!

Conclusion

Conceptual learning activities are well suited for engineering classes but can require serious design decisions to be successful. It was seen that it otherwise could, due to confusion, hinder the learning environment.

References:

- [1] J. Biggs and C. Tang, "Teaching for Quality Learning at University, 3rd ed.", 2007.
- [2] E. Mazur, "Peer Instructions – A user's Manual", 1997.

Daniel Månsson, manssond@kth.se