

## Using Feedback and Cognitive Research with CBL Materials to Respond to Students' Individual Differences

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## Broad Research Question

- ▶ Is the impact on learning of different forms of feedback during the learning process contingent upon individual differences of the learners?

## Cognitive Load Theory (CLT)

- ▶ Relates learning achievement and effort to human cognitive architecture
- ▶ Efficiency of learning conditions can be compared by combining performance and effort expended
  - Eg, Two-Dimensional instructional efficiency, E, can be defined by using standardised effort scores ( $Z_{\text{effort}}$ ) and standardised test scores ( $Z_{\text{test}}$ ) combined as

$$E = (Z_{\text{test}} - Z_{\text{effort}}) / \sqrt{2}$$

## Computer Based Learning (CBL)

- ▶ Used in an introductory accounting subject
- ▶ Chosen as delivery medium to assess feedback because it is recognised as an effective means of instruction (immediacy of feedback cited as a major benefit).
- ▶ Prior research has found that the performance of students using CBL compare favourably when analysed against other teaching methods

## Feedback and Individual Student Differences

- ▶ Jonassen and Grabowski (1993) found many studies where feedback made a difference to the learning outcomes depending on the individual characteristics of the learners.
- ▶ Major stream of such research has been the Aptitude-by-Treatment Interactions (ATI) school of research (see Cronbach & Snow, 1977)
  - From this work it has emerged that field dependence interacts with feedback.

## What Information is Provided by Feedback?

- ▶ *Verification*: is a simple judgement of whether an answer is correct or incorrect
- ▶ *Elaboration*: the informational component providing relevant cues to guide the learner toward a correct answer, or expand the correct answer when one is given. Types of elaboration –
  - (a) task specific, such as a restatement of the correct answer,
  - (b) instruction-based, such as explanations of why a certain item is correct, or a re-presentation of the instructional text in which the right answer was contained, and
  - (c) extra-instructional, being additional feedback from outside the immediate lesson environment that is relevant to learning or to clarify a meaning.

## Functions of Feedback

- ▶ Five functions of feedback (Butler and Winne (1995)):
  - Feedback can confirm a student's conceptual understanding;
  - feedback may help students add information thereby enriching prior information;
  - feedback may replace or overwrite information if prior knowledge is incorrect;
  - feedback may tune understandings even if understanding is correct, and
  - feedback may completely restructure schemata, particularly if students hold theories that are incompatible

## Experiment 1 – Structure

- ▶ Students given a lecture on one structured accounting topic,
- ▶ In the following tutorial they were asked to work through two alternative exercise formats – either worked examples (CBL only) or problem solving exercises (CBL or face-to-face).
  - Complete eight parts of a related accounting question. In the worked examples study condition CBL students were shown solutions to the first three exercises, and then asked to complete the remaining five sections. In the problem solving exercises students had to complete all eight sections, and this was the same for the students working with the printed materials.
- ▶ At the completion of the tutorial the students were instructed not to study this content further until they had undertaken a diagnostic test a week later.

## Experiment 1

- ▶ Two types of CBL materials
  - Worked Examples
  - Problem Solving (also in face-to-face mode)
- ▶ Key Student Difference
  - Prior or no-prior knowledge of subject material
- ▶ Feedback contained both verification and elaboration
  - Primarily “answer until correct” format but some instances of “knowledge of correct response” format but did not extend to “attribute isolation”

## Experiment 1 – Test results

Exercise Type	Accounting Knowledge								
	Prior Knowledge			No Prior Knowledge			Total		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Problem Solving CBL	10.45	2.37	22	7.59	1.79	22	9.02	2.5	44
Worked Examples CBL	10.17	1.96	26	8.32	1.5	23	9.31	2	49
Face to face / Printed	10.35	2.61	17	7	2.15	18	8.62	2.9	35
Total	10.31	2.24	65	7.69	1.84	63	9.02	2.4	128

## Experiment 1 – ANOVA results

- ▶ No significant differences between Exercise Types across the total student group.
- ▶ No significant differences between Exercise Types across the prior knowledge student group.
- ▶ Significant differences between Exercise Types across the no prior knowledge student group.

## Experiment 2 – Structure

- ▶ Experiment 1 with the following variations
  - Prior knowledge students were only supplied with problem solving exercises and no prior knowledge students were supplied with only worked example exercises
  - Two forms of feedback were used – basic and richer – where basic was only verification and richer included verification, elaboration and some praise.
  - An “answer until correct” approach was used with 3 attempts but in the richer format clues were provided after each incorrect attempt and explanations were given after correct attempts

## Experiment 2 – Results

### ▶ With Problem Solving CBL

Problem solving CBL Exercise type	N	Mean mark	Std Dev
With rich feedback	21	11.14	3.38
With basic feedback	20	10.85	2.99

### ▶ With Worked Example CBL

Worked Examples CBL Exercise type	N	Mean mark	Std Dev
With rich feedback	26	9	3.81
With basic feedback	20	7.8	2.85

## Experiment 2 – Results (cont.)

### ▶ Instructional Efficiency for Worked Examples CBL with no prior knowledge students

Worked examples CBL Exercise type	N	Z test		Z effort		Efficiency	
		Mean	SD	Mean	SD	Mean	SD
With rich feedback	26	0.14	1.11	-0.36	0.97	0.35	1
With basic feedback	19	-0.2	0.8	0.46	0.9	-0.46	0.76

### ▶ Shows a statistically significant difference in favour of rich feedback

## Conclusions

- ▶ There are differences between students with and without prior knowledge of the content area in terms of the learning outcomes from different exercise formats
- ▶ There are differences between students with and without prior knowledge of the content area in terms of the efficiency of learning associated with differing degrees of feedback

## QUESTIONS