The Intersection of Cognitive Load Theory and Practical Demonstrations in the Wood Technology Classroom: An Action Research Study.

Bachelor of Science (Honours) in Education (Design, Graphics and Construction)

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1. Introduction

Context:
Balancing the timing and frequency of practical demonstrations in the Wood Technology classroom was challenging while on previous School Placements.

Aim
To investigate the applicability of CLT, particularly instructional design in Wood Technology.

Objectives
- Conduct a literature analysis investigation of cognitive load theory, action research, and instructional design
- Clarify key terminology
- Conduct original primary research using an action research methodology.

2. Literature Analysis

Cognitive Load Theory

Cognitive Load theory (CLT) was established by John Sweller in the 1980s. CLT underscores the relationship between memory capacity (long term and short term) and learning.

Sweller et al. suggest that learning material with multiple elements imposes a heavier cognitive load on learners due to the increased use of short-term memory (Sweller & Chandler, 1994; Sweller & Sweller, 2006).

Wood Technology

Wood Technology is a subject at Junior Cycle in Ireland, focusing on wood and other materials, such as metal, plastics and glass, while also incorporating the design and manufacture of artefacts (Cross, 2020).

Instructional Design

Instructional Design (ID) refers to how information is presented to learners and plays a pivotal role in CLT (Sweller, 2020).

3. Methodology

Data Gathering

An action research methodology is employed for this study which allows for a collaborative and participatory approach to research. This approach promotes 'a culture of shared learning in which research and leading practice is encouraged and applied within the classroom setting' (Teaching Council 2023, para 1).

Three data gathering methods are used in this study:

1. Three action research critical reflections (journal)
2. Two observations by professional teachers
3. One expert interview.

Ethical Considerations

Research ethics can be described as the balance between the researchers' pursuit of truth, and the subjects' rights and values that could be in peril (Cohen et al 2007).

Six research ethics areas considered for this study:

1. Informed consent
2. Anonymity and confidentiality
3. Privacy and security
4. ATU GDPR requirements
5. Academic integrity
6. Responsibility.

Sample of Resource Created

Figure 1 and 2 show examples of resources created in an effort to reducing cognitive overload for student during practical demonstration in the Wood Technology classroom.

Figure 1 (right) was used alongside the demonstration in the first observation.

Fig. 1

Figure 2 (left) was used in the 2nd observation, during the observation lesson. As a result of the feedback from the previous handout:
- More images were included.
- Repetition of answers was reduced.
- The worksheet was provided to the students after the demonstration rather than before.

Fig. 2

4. Data Analysis Methodology

Braun & Clarke

Braun and Clarke (2013) devised a six-step thematic analysis methodology that is accessible and flexible. The methodology used in this research is an adapted version of Braun and Clarke's approach as shown in Figure 3.
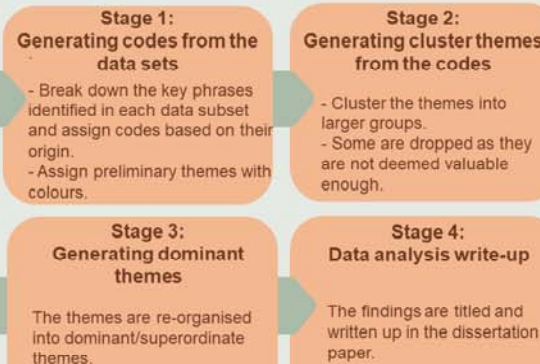
ATU Adapted Braun & Clarke

Stage 1: Generating codes from the data sets
- Break down the key phrases identified in each data subset and assign codes based on their origin.
- Assign preliminary themes with colours.

Stage 2: Generating cluster themes from the codes
- Cluster the themes into larger groups.
- Some are dropped as they are not deemed valuable enough.

Stage 3: Generating dominant themes
The themes are re-organised into dominant/superordinate themes.

Stage 4: Data analysis write-up
The findings are titled and written up in the dissertation paper.

Fig. 3.

Coding Sample

Fig. 4

5. Findings and Discussion

The impact of visual presentation, and "chunking it up"
It is argued that the visual sense is the most dominant, and can make it easier or harder to take in information, see (Atkinson et al., 2003).
Alex (INT#1, p36) explained that information also needs to be broken into segments or chunks, which will help the students to keep information in their memory.

How to train student attention and effective flagging
Students lacked motivation to use all available sources of information, and only paid attention to one or the other. Throughout the interview with Alex (INT#1), gaining student attention was a key theme.
I found that in (ARCR#3, p1) the use of having a worksheet with explicit goals to be useful for flagging attention and helping the student to manage their learning.

Information input and later retrieval of said information
The child's learning is through an active discovery of their world and is fully dependant on the depth of interaction and their investment in the interaction.
In (Obs #2) it was suggested that student participation in the demonstrations would allow them to reinforce the learning in the most direct sense – by doing it. The handout could not replace hands-on practice.

6. Conclusions

Evidence from this research suggests that visual presentation, the number of key learnings presented in an instance, media input and later retrieval from memory, all impact a student's learning. However, the effectiveness is limited by student attention and motivation factors. These must be considered by the teacher to provide an effective demonstration.
The handout (see figure 1 and 2) was an effective supplement to the student memory, as it structured and flagged their learning. However, it cannot replace the necessity to provide the students with hands on interaction during demonstration.

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