Unplugged computing and semantic waves
Analysing Crazy Characters

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Aim: To explore the use of semantic waves as a way to better understand the effectiveness of unplugged computing activities.
Rational for our study

• Limited research on pedagogy to teach computing in school (Waite, 2017).
• Unplugged approach popular (Sentance & Csizmadia, 2016).
• Research on effectiveness of unplugged approach mixed (Feaster et al., 2011; Thies and Vahrenhold, 2016; Rodriguez et al., 2017).
Diverse range of unplugged activities

Range of approaches:
• analogies,
• similes,
• metaphors,
• role play,
• games,
• puzzles,
• magic tricks,
• and story telling

Differing delivery scenarios:
• whole class
• explanatory lectures
• individual

Background
From CSUnplugged. https://csunplugged.org/en
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Differing delivery scenarios:
• whole class
• explanatory lectures
• individual
Suggestions as to why unplugged works

• Physical enactment makes concepts concrete and memorable (Curzon et al., 2009; Baraslou et al., 2003).

• Curzon et al. (2018) suggested effectiveness is because of the recurrent movement between:
  • concrete and abstract activities
  • simpler to complex contexts

Linking this to a theory of knowledge building called semantic waves (Maton, 2013).
What are semantic waves?

• Semantic waves part of Legitimation Code Theory (LCT).


• LCT - framework for exploring what constitutes a good learning experience (Maton, 2013).

• Semantic waves used to analyse learning in many subjects (Blackie, 2019; Love, 2016).
What are semantic waves?

‘Semantics’ is one dimension of LCT and it can be used to analyse changes in a learning episode over time of:

- complexity of **meanings** - semantic density
- dependency on **context** - semantic gravity

(Macnaught et al. 2013; Maton 2013, 2014; Maton et al. 2016)
Semantic profiles and semantic waves

Adapted from Maton (2013)

Strong density
Weak gravity

Weak density
Strong gravity

Abstract Concepts
(What we are trying to explain)

Technical Language

Unpacking
(Explain in terms of concrete things and simple language)

Unplugged activity
Examples
Diagrams
Metaphors

Concrete things
(Things the learner can easily understand)

Everyday language

Repacking
(Link back to the abstract ideas and technical concepts)

Time passing through the learning experience

Background
Why wave?

• Semantic waves enable knowledge to be built, while flatlines (such as continuous description or incessant theorising) hinder knowledge building (Maton et al., 2016).
• Semantic waves enable knowledge building through accumulative connected waves.
• These insights are now feeding into teacher training, curriculum planning, and classroom practice.
Method:

- **Technique:** Simplified semantic profiling approach for exploratory case study (Maton, 2014).

- **Case study:** Appropriate for in-depth description/analysis of an instance in action (Merriam 2009; Stake 1995).


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https://www.barefootcomputing.org/resources/crazy-character-algorithms
Semantic Profile for Crazy Character’s whole class introduction

Key
SG Semantic Gravity
SD Semantic Density

<table>
<thead>
<tr>
<th>Lesson Plan Steps</th>
<th>Semantic Profile Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explain you are going to use a new word – can they listen out?</td>
<td>Signalling A signal that a high is coming on the semantic profile.</td>
</tr>
<tr>
<td>Share the learning intention.</td>
<td>Concept Introduction This is what you are going to learn about.</td>
</tr>
<tr>
<td>Say you are going to use the algorithm now.</td>
<td>Connecting Connecting the theory to the concrete.</td>
</tr>
<tr>
<td>Read out your steps and learners draw the crazy characters. Model adding extra detail.</td>
<td>Concrete activity Practical activity with high semantic gravity. Learners are adding knowledge if the meaning is connected. The extra detail adds flow.</td>
</tr>
<tr>
<td>Ask pupils to show what they have drawn. I didn’t expect that.</td>
<td>Counter expectancy Alternative options are introduced, increasing density.</td>
</tr>
<tr>
<td>How could you change that?</td>
<td>Staged return Density increases as context is reduced</td>
</tr>
<tr>
<td>Ask what the algorithm was. Explain what an algorithm is</td>
<td>Packing Develop/reveal the definition and pack the concept.</td>
</tr>
</tbody>
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Results
Discussion

Semantic profiling Crazy Characters provided:
- a language & method to analyse/improve planning,
- a practical and useful approach worthy of CS Education research.

However:
- each student’s experience will be different,
- implemented lesson will be different, teachers not aware of the key features (Bell & Lodi, 2019).
Conclusion

- The case study suggests Crazy Characters wave structure could be an explanation of effectiveness.
- CS is abstract - concept heavy/complex vocabulary.
- Very young learners now learn CS concepts.
- Semantic profiling has the potential power (vocabulary and technique) to review/understand teaching and progression of learners’ CS concept understanding.
Further work and opportunities

• Semantic profiling of more unplugged activities and chains of activities.
• Compare profiles of successful & less successful.
• Use semantic profiles to explore combination of unplugged & plugged to teach programming/CT.
• Trial the use of semantic waves by teachers, resource developers and in teacher professional development.
Any questions?

More can be found out about LCT at legitimationcodetheory.com
References


References


