



Queen Mary

University of London

Science and Engineering

Unplugged computing and semantic waves

Analysing Crazy Characters

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Aim

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



From Csunplugged. <https://csunplugged.org/en/>
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Barefoot

Recommended for
ages 5-7

Crazy Character Algorithms

An introduction to sequences of instructions
From Barefoot. With kind permission of BCS and BT
<https://www.barefootcomputing.org/resources/crazy-character-algorithms>.

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).
- Karl Maton creator of LCT, builds on the work of Bernstein and Bourdieu.
<http://legitimationcodetheory.com/home/theory/introducinglct/>
- 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:

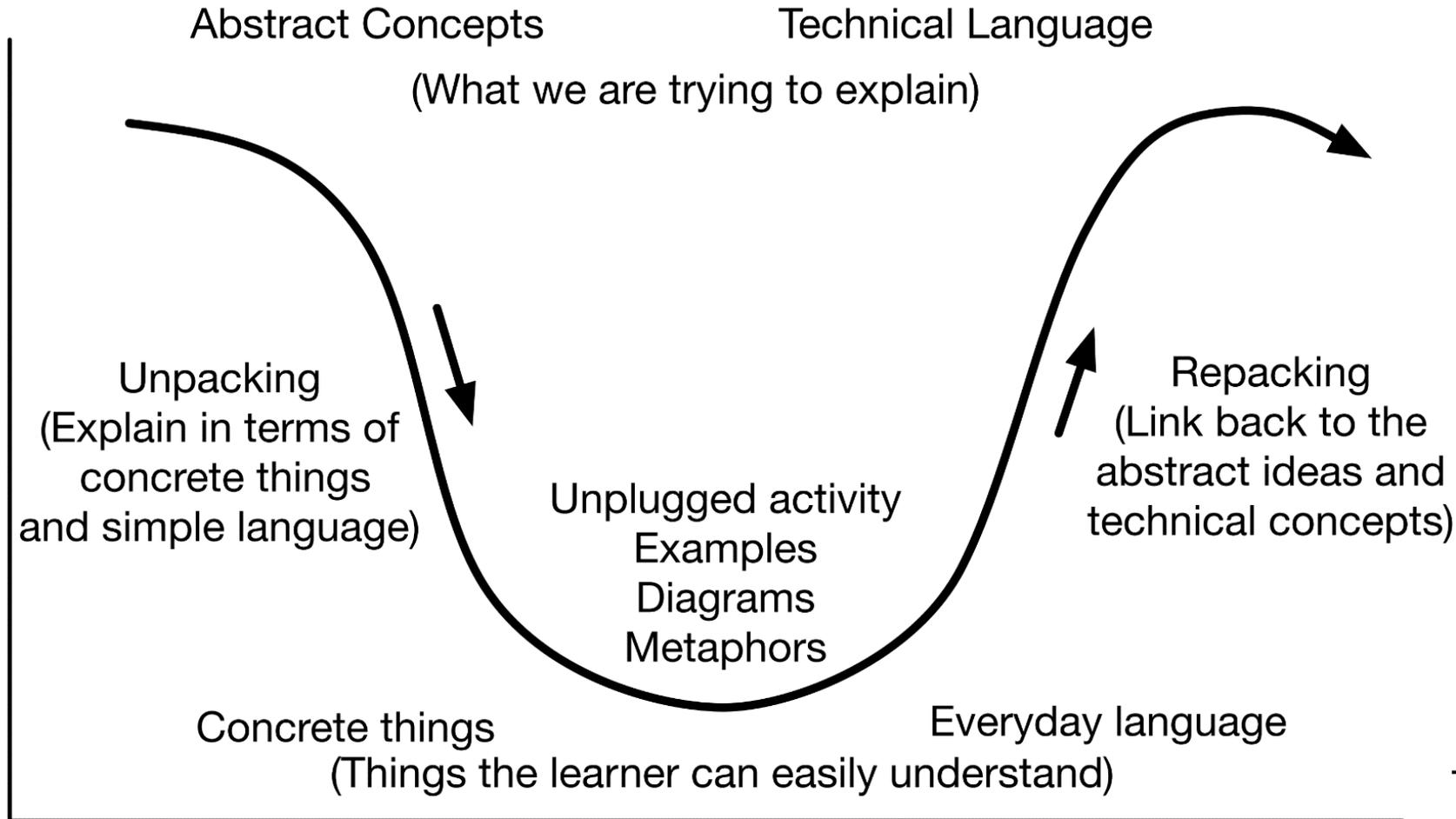
- complexity of **meanings** - semantic density
- dependency on **context** - semantic gravity

(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

Time passing through the learning experience

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).
- Resource: Most popular product Barefoot (The Royal Society, 2017) Crazy Characters lesson plan.

Overview

An **algorithm** is a precisely defined sequence of instructions or a set of rules for performing a specific task. By teaching this short unplugged activity, your pupils will create a set of instructions on how to draw a crazy character and so start to understand what algorithms are.

Pupil objectives

- ✓ I know what an algorithm is
- ✓ I can write an algorithm
- ✓ I can use an algorithm
- ✓ I can debug my algorithm

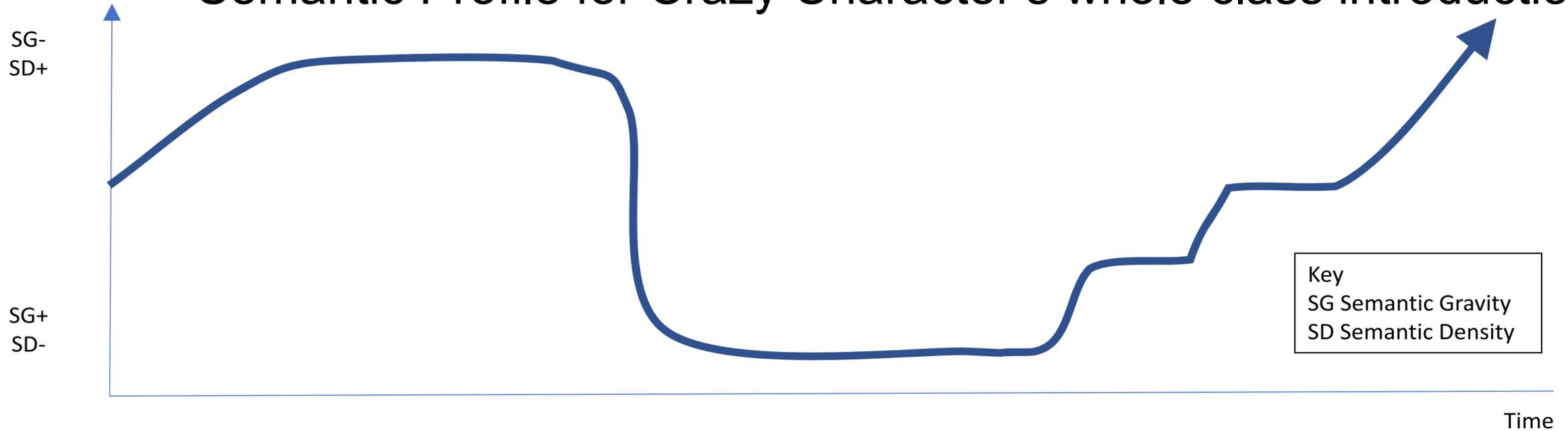
Introduction - whole class (10 mins)

- Explain you are going to teach pupils a new word - can they listen out for it?
- The lesson is going to be about instructions, and that they are going to follow some instructions to draw a crazy character
- Say you have created an **algorithm** to help them draw it. Slip the word in and see if anyone spots it. What might this word mean?
- Share the learning intentions on slide 2
- Say you are going to use the algorithm now. Read out your steps giving them time to draw each stage. Don't give them extra detail at this stage!



From Barefoot. With kind permission of BCS and BT.
<https://www.barefootcomputing.org/resources/crazy-character-algorithms>

Semantic Profile for Crazy Character's whole class introduction



Key
 SG Semantic Gravity
 SD Semantic Density

Lesson Plan Steps

- Explain you are going to use a new word – can they listen out?
- Share the learning intention.
- Say you are going to use the algorithm now.
- Read out your steps and learners draw the crazy characters. Model adding extra detail.
- Ask pupils to show what they have drawn. I didn't expect that.
- How could you change that?
- Ask what the algorithm was. Explain what an algorithm is

Semantic Profile Notes

- Signalling**
A signal that a high is coming on the semantic profile.
- Concept Introduction**
This is what you are going to learn about.
- Connecting**
Connecting the theory to the concrete.
- Concrete activity**
Practical activity with high semantic gravity. Learners are adding knowledge if the meaning is connected. The extra detail adds flow.
- Counter expectancy**
Alternative options are introduced, increasing density.
- Staged return**
Density increases as context is reduced
- Packing**
Develop/reveal the definition and pack the concept.

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

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