Section 2:
Teaching and assessing computing in the curriculum

Is it a wave? Linking the abstract to the everyday and back again

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Raspberry Pi

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Is it a wave? Linking the abstract to the everyday and back again

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Abstract

Irrespective of the subject being taught and the pupils who are learning, contexts and vocabulary matter. In this article, I will describe a knowledge-building framework, which reveals the changes, over time, of contexts and vocabulary in learning experiences. I report on recent research conducted with Paul Curzon and Karl Maton, where we used this framework to review and improve computing lessons and illustrate where teachers and resource creators can use semantic wave profiling to do the same.

Introduction

Karl Maton has created a framework which helps educators review how knowledge is built during learning experiences (Maton, 2014; Maton et al., 2016). The framework is called Legitimation Code Theory (LCT) and introduces dimensions which reveal specific aspects of knowledge building. LCT is a sociological framework that primarily builds on the work of Basil Bernstein and specifically his code theory (Bernstein, 1971). Within LCT, several dimensions have been suggested and one of them is semantics. We can use semantics as a basis to review explanations as well as general learning activities. Lessons are reviewed by profiling them as a drawn diagram. Semantic profiling enables us to abstract the process of learning and gain a better understanding of how knowledge is developed over time. This process enables educators to reflect on, and improve, learning experiences for their students. A vibrant community of researchers and practitioners from across the world have started to use the framework to evaluate and improve teaching and learning in subjects as diverse as ballet and law.

Semantic profiling

The semantics dimension of LCT looks at the changes in two aspects of knowledge over time, the change in context and the change in the complexity of the knowledge. Simply put, for context, we look at whether learning is more abstract and context independent compared to learning set in a specific everyday context. For complexity, we look at whether the vocabulary used is highly abstract, technical, and complex or is familiar language. For example, a lesson might start by introducing the term algorithm, with no context given and no use of everyday language. Students then might take part in an activity where they follow everyday instructions to make a jam sandwich, they then review how precise these instructions are and a link is made back to the concept of an algorithm.

An example of a semantic profile

To evaluate a lesson using semantics, we draw a semantic profile. The profile shows the changes in context and vocabulary on a simple graph, with the time passing along the x-axis. Different shapes of profiles suggest different learning

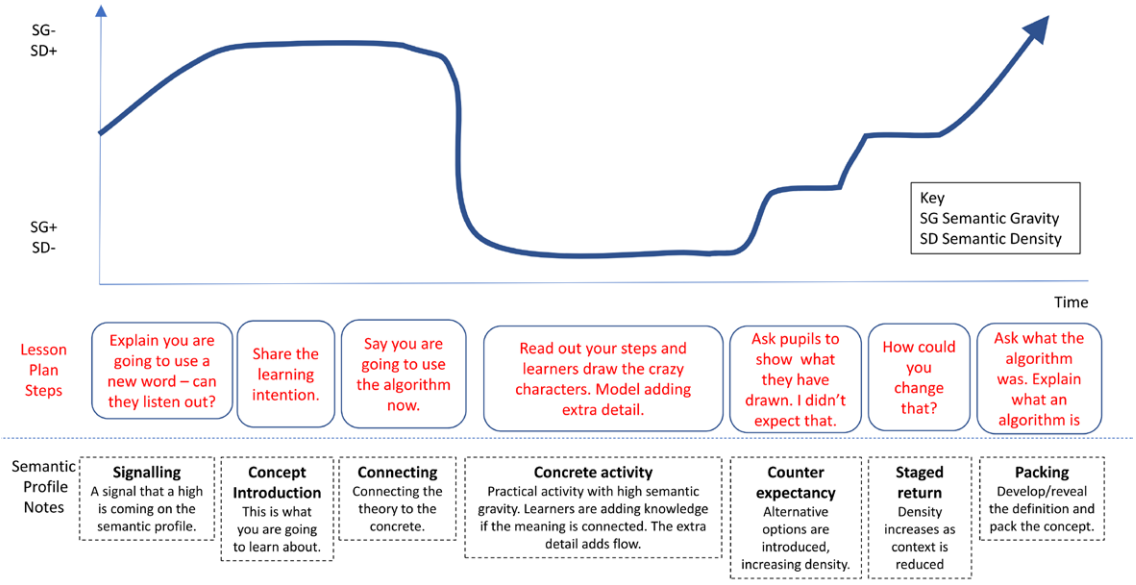

Figure 1. Crazy Characters semantic profile (Waite, Maton, Curzon, & Tuttiett, 2019)

experiences, and we can then compare these shapes when planning or reviewing learning.

An example semantic profile is shown in Figure 1. This is the profile of the introduction of a popular key stage 1 (pupils aged from 5 to 11 years old) lesson plan. The lesson, Crazy Characters, is one of the early Barefoot computing activities, written in 2017 to help demystify the term algorithm.

In the profile, we can see how knowledge is framed in an abstract context, using more technical language at the start of the teaching segment. During the practical part of the lesson, the knowledge is situated in a specific context: drawing a character using everyday familiar vocabulary.

After the practical activity, learners are required to repack their experience to a context-independent view of their newly developed knowledge using more technical vocabulary. This profile is a wave shape, similar to Figure 2, and is called a semantic wave.

Not all teaching experiences follow the same pattern, some can be a flat line, such as an activity which is only situated in a specific practical context, with no technical language, called a low flat line, see Figure 3. In creating the Crazy Character activity, the activity could have been designed where pupils followed instructions to draw a made-up persona with no reference to algorithms, no building of knowledge related to this core concept, in which the profile would have been a low flat line.

Another profile type is a high flat line, in which the learning is all theory and complex vocabulary, see Figure 4. In creating the Crazy Character activity, the activity could have been designed where the teacher explained what an algorithm is with no everyday examples nor any everyday words or phrases.

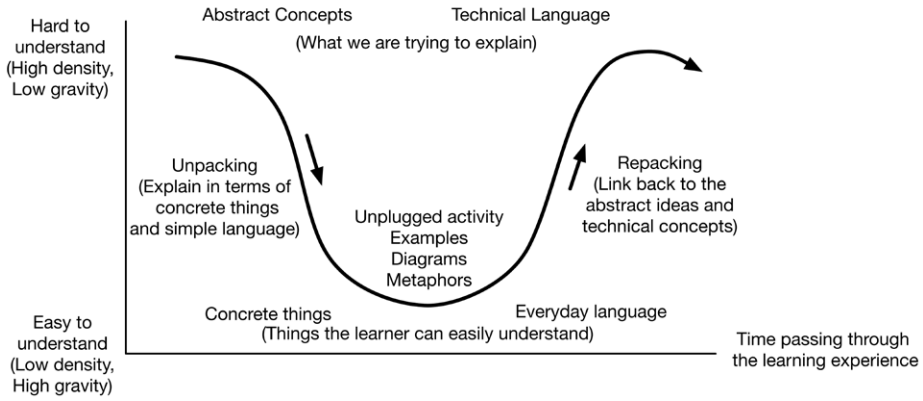

Figure 2. A semantic wave (Curzon, 2019)

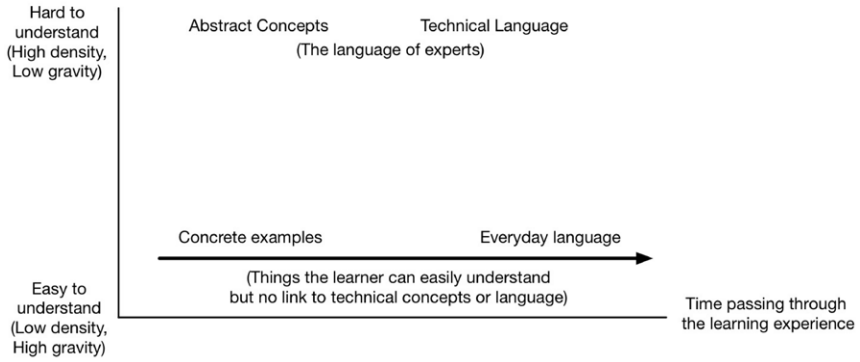

Figure 3. Low flat line (Curzon, 2019)

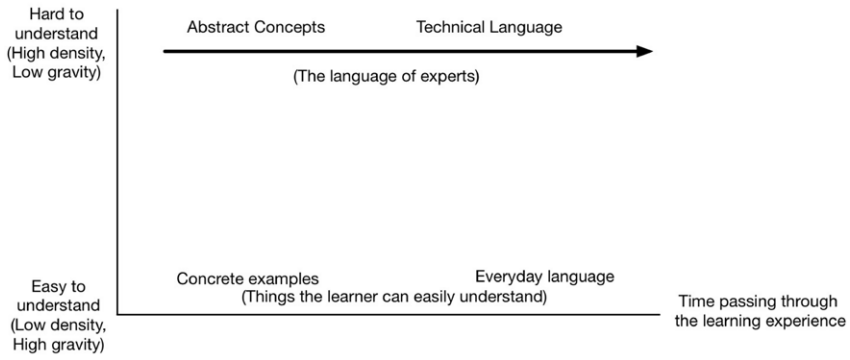

Figure 4. High flat line (Curzon, 2019)

How to use semantic profiling

Research on profiles indicates that experiences which incorporate waves help learners build mastery and a depth of understanding (Maton, 2020). These moves from context independence to context dependence and vice versa or from everyday, less dense vocabulary to technical, complex, rich vocabulary, are essential to knowledge building.

As well as using semantic profiling to see the shape of an existing lesson, we can use profiling to improve a lesson. To do this, we have trialled the use of three key questions that help teachers think about the vocabulary and context used and change their teaching to improve the wave.

The three key questions are:

- Is the profile a wave?
- Who unpacks and repacks?
- How high or low does the wave go? (Curzon et al., 2020)

The first question of "Is the profile a wave?" leads us to think about adding in steps that get the learner to use more or less technical language or introduce a more or less specific context. For example, in an activity that is a flat line, say because it is all theory, then add a practical everyday context using everyday language to explain it. If on the other hand, the activity has no theory, then add learning steps in which learners pay attention to the overarching concepts, before and after the practical work.
The second question, "Who unpacks and repacks?", asks us to think whether learners are engaged in linking their learning from the abstract to the concrete and vice versa or whether we, the teachers, do it for them. It is easy to recall lessons when at the end of the main teaching activity, we state what the activity has taught the students, linking the activity to the concepts for our learners. Whether our students, at that point, made the connection themselves is difficult to say. But if we add a distinct task that gets our learners to make their links, we can be sure that everyone follows the wave in the class. For example, for unpacking, we could ask learners to jot down everything they know about a concept, such as an algorithm, and to include an example that a novice would understand. For repacking, we could ask learners to share with a partner, in their own words, a general definition of a concept. As a point to note, in making student knowledge visible, there are opportunities for formative assessment during unpacking and repacking.

The third question of "How high or low does the wave go?" draws our attention to the depth of learning. To go lower, we could introduce role play or tangible objects. To go higher, we might request that an abstract view of a concept is provided that is context-free, such as a generalised definition. For example, when explaining variables, we could use an analogy such as a variable is like a box with a photocopier and shredder and explain this verbally. We could take the wave lower, drawing pictures of our analogy, or we could take it lower still by students acting out the analogy, physically with boxes, copying data, ripping up paper. There are similarities here with the ideas in maths of representing concepts in abstract, iconic (drawings) and physical forms.

Conclusion

In our research (Curzon et al., 2020) we have found that asking these three questions helps us redesign learning activities, and we have initial evidence that these new lessons are improved for learners. However, we need more evidence to be sure and are planning more research on the impact of making changes, based on these questions, to the profile of lessons.

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Appendix: Further Reading

1. Pedagogy Quick Read on semantic waves
2. Teaching London computing pages
3. Legitimate Code Theory website

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