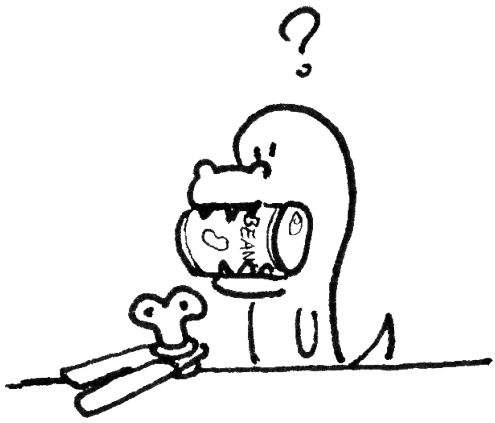

CHAPTER 13:

HOW CAN YOU MAKE CONSTRUCTIVISM AMOUNT TO MORE THAN A HILL OF BEANS?

Mark Childs and Mike Collins

Mike and Markzilla are virtually back from the town of the Cyber-Elves when they find themselves in the middle of a pitched battle.

Apparently, someone on social media has said something stupid, and both Dwarves and Elves are up in arms about it. 'Minimal guidance doesn't work,' shouts one side. 'Who are you calling Minimal Guidance?' bellows the other.

The Zillas are scared, and they've become separated from Beckzilla, who's presumably still off slaying vampires somewhere. Bravely, they try to find a way through the turmoil.

As we've seen throughout this section, two of the main schools of thought about how to approach learning and teaching sometimes find themselves in conflict. In the chapter on the ten principles of instruction and Yoda, the principles focus a lot on drill and practice, which are techniques that work, and that match closely what we know about cognitive science, how the brain processes and stores information, and what its limits are.

However, the teaching approaches that focus on how students construct learning through activity, problem-solving, putting things into practice, and reflecting on the consequences of that are core to a lot of what we see in education. Even though there is little or no empirical evidence from neuroscience to establish the validity of these approaches, experiences of direct observation of students' learning support them. And, of course, when there's no formal education available if people need to learn something, these have always been the approaches that have been called upon.

The battle (and it does sometimes get very heated) between these viewpoints is exacerbated because they are located in two very different epistemological positions – positivists like to study images of the brain and the outcomes of interventions, while interpretivists like their rich accounts of what goes on in students' minds.

Where there are two or more competing models, the truth is probably that both are correct in some situations, and we just need a model that encompasses them both. It's important to avoid false dichotomies; far fewer positions are as mutually exclusive as social media would have you believe. Just because one thing is true, doesn't mean an alternative explanation isn't. On the other hand, saying two statements are true doesn't automatically lead to the conclusion both are equally true. The path between false dichotomies and false equivalences is a broad one but, nevertheless, people often stumble away from it.

The *Pedagodzilla* ethos will flavour the discussion throughout this chapter, in which we try to resolve the debate between the cognitive science Positivism people, and the problem-based, active, and experiential Constructivism people. We do this by asking: **How can you make constructivism amount to more than a hill of beans**?

Another element of the *Pedagodzilla* ethos involves trying not to be crappy to people. Part of this stance is to have a content warning before we start whenever necessary. The example we've chosen in this chapter is a real one, involving what sounds like a pretty bad example of parenting.

A hill of beans

Our title makes reference to the 1942 film *Casablanca* and Humphrey Bogart's line in the final scene, 'It doesn't take much to see that the problems of three little people don't amount to a hill of beans in this crazy world.'

It's also a reference to a [then] Twitter storm around a series of tweets that became known as BeanDadGate (Campanoar, 2021; Petter, 2021). The person who became known as BeanDad tweeted a story in which he was doing a jigsaw puzzle, which apparently was really important to him, when his daughter came up and asked if she could have some lunch, which he saw as a very useful teaching moment.

Instead of getting his nine-year-old child some beans, he said, 'Well, let's get the tin opener and let's see if you can work it'. She fumbled around with the tin opener, it didn't really work, and he went back to his jigsaw puzzle.

The tin became substantially battered during the first few failed attempts to open it, so it was significantly more difficult to open than it should have been. Nevertheless, the child went forwards and backwards for about six hours until she finally got the tin open.

The story and the father's account of it have subsequently been deleted, because what he originally thought was a positive story got a significantly less than positive reaction.

To be as fair as possible to the parent, BeanDad's putting his child through that torment may have come from a well-meaning place. From Markzilla's personal experience, he'd vouch for the potential to act out of fear that your child won't develop to become a functional human being by the time they leave home or, worse, that they never become a functional enough human being to leave home. For BeanDad, having a daughter who gave up trying to do something could have sounded a warning bell that she would never try, and hence would never be successful.

Markzilla had the experience in his twenties of sharing a house with a friend a few years older than him who refused to use the tin opener because she didn't know how to. Markzilla had to open the tin for her while she looked on, resentful that there could be something so alien in the kitchen.

Where BeanDad overreacted, we would suggest, is that between the ages of nine and 30, there are plenty of opportunities to learn. There's no need to panic, and certainly no need to exert that much pressure on a nine-year-old child for six hours, even if you're keeping her fed with pistachio nuts while you're doing it (Skenazy, 2021).

Where this is interesting for our wider discussion of constructivism is that not only was this a teaching moment that failed, but also some of the responses to it included references to issues around minimal guidance, specifically a paper called, *Why Minimal Guidance During Instruction Does Not Work* (Kirschner, Sweller and Clark, 2006).

So, although a stressful story it was also an insightful one, and one to which many people can relate. Particularly as, when presented with situations in which we've been expected to perform with little or no guidance – in non-formal situations like DIY for example – we've performed so badly that we've learned nothing other than that we can't do it.

Constructivism vs cognitive architecture

To recap Chapter 6, constructivism is one of the overarching meta-concepts in teaching and learning. Under it sits a whole load of other approaches, including problem-based learning, experiential learning, and active learning.

These are all about learners who already have a schema of understanding, and a set of skills and knowledge. The teacher provides learning opportunities for students to build their own knowledge and connections on those foundations, thus creating another layer of abilities that will form the foundations of the next stage of learning.

By its very nature, constructivism is student-centred: you can't do it without starting from what the student is already capable of. It also includes a built-in assumption that the experience will be more effective if it's relevant to learners and their lives. The argument for constructivist approaches is that they're stronger and more effectively embedded than being taught something out of context in a classroom, because the

links to previous knowledge have been made by the students themselves.

Constructivist approaches aren't universally accepted, however. In *Constructivism Is Like a Zombie that Refuses To Die*, Isak Skogstad interviewed Paul Kirschner, one of the authors of the paper mentioned above, and Professor Kirschner raised a lot of valid points against constructivism as an approach, the chief one being that direct instruction is the most efficient use of the time available for teaching. He's also a big proponent of cognitive load theory and how 'cognitive architecture affects how we learn and how this interacts with instruction'. Which all seems valid.

Constructivism doesn't have the same neurological basis to it, and isn't an efficient way of learning. The Kirschner, Sweller and Park (2006) paper (and, yes, that is the same Sweller we came across in our cognitive load chapter) is an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Basically, everything we've been exploring in the last three chapters. The authors' argument is that minimal guidance overloads the working capacity of the cognitive architecture of the brain (KSP, 2006). In other words, you can't learn efficiently if your brain's got too many things to think about at once.

They conclude that, 'The onus should surely be on those who support inquiry-based instruction to explain how such a procedure circumvents the well-known limits of working memory when dealing with novel information' (KSP, 2006; 77).

However, all is not lost. Kirschner and pals also acknowledge that people do learn by building on what they know already. They state, 'The constructivist description of learning is accurate.' It's just that 'the instructional consequences suggested by constructivists do not necessarily follow' (KSP, 2006; 78) and even 'the addition of a more vigorous emphasis on the practical

application of inquiry and problem-solving skills seems very positive' (KSP, 2006; 77). Woo-hoo.

So what is their problem?

The teaching approach they're taking issue with is the idea of minimal guidance, which is 'the rejection of instruction based on the facts, laws, principles and theories that make up a discipline's content' (KSP, 2006; 78). Which does sound like a really bad idea. However, few people take constructivist approaches to that extreme. Showing why minimal guidance does not work is a long way from an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching.

There's a study presenting the opposing position that also got bounced around in the post-BeanDad storm. It's by Deslauriers et al (2019) and it advocates for active learning in classrooms rather than direct instruction. Papers in the *Proceedings of the National Academy of Sciences* (PNAS), which is where this paper appeared, don't just have abstracts, they have a significance statement, which is an excellent idea as you get the whole message encapsulated in one paragraph. To save you reading their paper, here's their significance statement:

> *'Despite active learning being recognized as a superior method of instruction in the classroom, a major recent survey found that most college STEM instructors still choose traditional teaching methods. This article addresses the long-standing question of why students and faculty remain resistant to active learning. Comparing passive lectures with active learning using a randomised experimental approach and identical course materials, we find that students in the active classroom learn more, but they feel like they learn less. We show that this negative correlation is caused in part by the increased cognitive effort required during active learning. Faculty who adopt*

active learning are encouraged to intervene and address this misperception, and we describe a successful example of such an intervention.'

Deslauriers et al (2019)

So, some things to unpack there – particularly active learning being recognised as a superior method of instruction (tell that to the positivists). You'll have to look up the paper to see them back up that claim (oh, looks like we haven't saved you that step after all).

However much the authors disagree with the Kirschner et al paper on that point, there's one area where they do agree: it's the extra cognitive load involved in active learning that gets in the way. In other words, students are so busy learning that they don't have the spare capacity to stand back and observe how well they're learning. Their cognitive load can't handle both cognition and metacognition at the same time.

And this is the point: behaviourism, constructivism and (to be covered in the next chapter) social constructivism aren't competing approaches, or even theories, about learning; they're complementary ones.

Direct instruction is efficient; the traditional approaches build on centuries of experience, and can be legitimised by reference to the cognitive architecture of the brain, which beats anything else. Remember our chapter on ontology and epistemology? Not all epistemologies are created equal.

The approaches where you can point to a scan and say, based on valid and reliable analysis, 'Look, that's where the learning is happening,' have more solid evidence than any number of interpretivist studies, no matter how randomised they are. From the learner perspective, students are familiar with traditional approaches, they know where they stand with them, and they recognise how learning works within them.

Constructivist approaches model real-world behaviour for most subjects. They're slower, more difficult, and involve more missteps, but they're more empowering, and they're often more fun. Learning has to be open-ended, random and playful sometimes, or who'd want to do it?

Kirschner's argument in the Skogstad interview that 'students need longer time to solve problems, to learn to solve them, they make more mistakes and also get frustrated on the way' is not a good reason for omitting problems from the curriculum. Efficiency is not the be-all and end-all of education. And we could also argue that, if you want efficiency, a 40- or 50-minute lecture isn't the best approach either.

The middle ground within both these papers (when they're not dissing the alternative approaches) is the acceptance by traditionalists that their approaches benefit from a bit of problem-based learning, and recognition by the active learning bods that active learning needs some scaffolding with direct instruction and modelling of approaches, in order for students to fully benefit from the activities. Once learners have acquired the basic schema for the subject, and have all the good facts-laws-principles-and-theories stuff bedded down in their long-term memory, then they've got the spare cognitive capacity to do all that constructivist-feelgood-empowering-and-fun farting-around-with-problems stuff without being overloaded and without the learning being too inefficient.

Then, when they've done that, teachers can show them what they've learned, because while they're deep down in the problem solving, they're too busy doing that to sort out what it is they're learning. And if they've somehow constructed the wrong schema in coming to an answer to the problem, teachers can point that out and help them to the correct solution.

So, basically, the summary of the problem is: learners don't want maximum guidance because it's boring and it doesn't teach

them to be independent learners. On the other hand, they don't want minimal guidance because that means they're lost. With minimal guidance, nothing makes it into your long-term memory due to cognitive overload, because everything's in your working memory. Not only that but you also feel as if you're not learning because you're not reflecting on your learning, and you're not being shown what you've learned.

Obviously, the best, most effective learning is something that combines those two things according to a ratio that you have to determine as an educator. And that choice is determined by a variety of contextual elements, including how well your students know the subject, what age they are, and what their previous experience is.

The answer

To answer our question, **How can you make constructivism amount to more than a hill of beans?**, let's take a look at BeanDadgate and how constructivism could have been used far more consciously to make this a good learning and teaching event.

The scenario starts with the daughter coming to her dad with a tin of beans, wanting some food. He gives her a tin opener and tells her to work out for herself how to open the tin. The worst form of minimal guidance. At the other end of the spectrum, equally bad from a learning point of view, would have been doing it for her and saying, 'There you go.' With the implicit metacognitive message being, 'Wasn't that simple? Aren't you an idiot for not being able to do it yourself?'

Though at least the daughter would have been fed and the father would have been able to go right back to his jigsaw puzzle.

Cynically, we're not convinced most universities would do it any better. Our best guess about what the university approach to tin opening would look like is: give a 60-minute lecture on the history of tins and how they have been opened, focusing on the white males who've opened tins in the past; describe how a tin opener works, including different mechanisms and the evolution of the design, possibly requiring students to buy an expensive textbook that illustrates the process in great technical detail; ask students to give presentations on tin opening and, finally, assess them by getting them to write an essay about tin opening. Enough to persuade any student they'd be better off going for a take-away. At no point though, would they actually pick up a tin opener and open a tin with it.

If BeanDad wanted to go for direct instruction, he could provide a demonstration to his daughter, explaining how to hold the tin opener, where the cutting blade is, and how the process works. She might learn how to do it in this way, but she might still not be able to open a tin, even if she could describe how the tin should be opened.

Ideally, BeanDad would scaffold the process by breaking it into three steps. The first would be to demonstrate how the tin opener works, accompanied by a description of what he was doing: 'You clip this on here and rotate this.' So far, so like direct instruction.

However, the teaching and learning wouldn't end at that point. Second step: once he'd demonstrated the process, he'd get his daughter to try it herself under his guidance, helping out if she ran into problems. Once she's opened the tin successfully with his support, he'd ask her to do it again – this time without guidance. They'd have ended up with three opened tins, but then some people like three tins of beans.

This is, incidentally, how meerkats teach their young to kill scorpions, by showing them how it's done, then giving them

increasingly difficult tasks; starting them off with dead scorpions before proceeding to live ones. (Hoppitt, et al, 2008; 487).

They're not consciously providing the scaffolding that educational theorist Vygotsky suggested was helpful for learning – they're just responding to different bleating from their pups. At least their approach is student-centred, though.

With scaffolding, each stage of the process only advances the required skills by a slight amount, so there's only a minimal use of working memory at any time. Each layer builds incrementally on the layer below, and nothing falls over because at no point is the learner having to do anything unsupported. Once the learner can do something, the scaffolding (guidance) can be removed.

Assuming his daughter has the patience, once she's finished the task (perhaps when they're eating the beans), they could talk through the steps involved in learning this skill, because although she can open a tin of beans now, there will be plenty of other things she needs to work out when BeanDad's not there, or when he's busy piecing together a more difficult jigsaw.

BeanDad might even present it to her as an example of problem-based learning (see chapter 11). She's worked through the first steps by herself:

1. She examined the case and identified that the day wasn't proceeding as it should.
2. She identified the problem – she was hungry.
3. She analysed the problem – usually, someone provides food around now.
4. She drafted an explanatory model – a good solution would be to get her dad to open a tin and heat up some beans.

Her dad could take her through the next steps of problem-based learning:

5. He established a learning goal for her – learn to use the tin opener. In future, she could establish her own learning goals.
6. Instead of asking him to open the tin, she could have collected information from him on how to do this.
7. The final stage would have been to apply and discuss what she had learned by trying to use the tin opener and asking him for support if necessary.

That's probably way too much formality for a discussion over a tin of beans, especially for someone who really wants to get back to his jigsaw, but the basics can be summed up briefly. 'You did really well in making some moves towards lunch. It's helpful to learn how to do things for yourself; you can always ask me for help with this sort of thing and check back with me if you run into problems.'

BeanDad and his daughter might have talked about places to go to learn how to do things, like YouTube, or how to search for operating manuals. They could have discussed how the feel of the machine and your own proprioception are important to get right when learning practical things and how you adapt grip etc to get the right feel of something clicking into place. They could have talked about experimentation and observation leading to the correct result.

Then maybe the next time the daughter was stuck on something she might have recalled how she learned to open the tin of beans and then applied those strategies to learn for herself rather than bothering BeanDad all the time. Jeez.

We keep emphasising metacognition in this book, because reflecting on how you've learned and learning the process of learning is translatable to other situations. Give a person a fish and they eat for a day, teach them to fish and they eat for a lifetime; teach them how to learn to fish and there's no end to

what they can do. If you're a vegan or vegetarian, substitute your own analogy here.

Another aspect to this process of teaching independent learning is that, as a parent, you don't know the answer to every question. As a teacher, the change in emphasis from sage on the stage to guide on the side lets you off the hook to some extent because it reduces the expectation that you'll always know the answer. The most exciting, and also daunting, moments are when your children or students surpass you in some areas.

The final lesson to take away from any sort of learning, particularly important with a constructivist approach, is that not knowing is fine. Maybe you don't know how to open tins of beans when you're nearly 30 because you've been buying those weird little plastic pots all these years. Mark's nineties flatmate had possibly just used tins with ring-pulls, or perhaps was too upper class to ever eat beans. Or perhaps had always hacked away at tins with a pen-knife or something. When faced with a tin opener for the first time, it's fine to ask how to use it. Being annoyed by and fearful of an unfamiliar tool in your shared kitchen isn't. The best thing to teach people is that not knowing is legitimate, not trying isn't. Which applies to teachers as well as learners.

While we're on the subjects of minimal guidance and cognitive load, there's another factor to be considered, building on the discussions in our cognitive load chapter, which is the role of germane cognitive load.

Germane load is basically nothing to do with the material being learned, or how it's presented. It refers to other elements in the scenario having an impact on the capacity to learn. A hugely limiting part of an excessive germane load is self-doubt. The higher their self-efficacy, the more a student is going to learn. A lot of that is because, while they're learning, their brain isn't full of messages like, 'I'm so shit at this.'

Some frustration is good, because if a learner is driven by needing to solve a problem, it can be motivating when they overcome the frustration and finally get it right. Too much frustration is demotivating. This is why the best console games adapt their difficulty levels to the player's ability. If a player fails too many times on a task they'll give up, not only on that game, but on being a potential customer for all the sequels.

Each successful task completed produces a small dopamine hit that reinforces behaviour, although how dopaminergic systems work with cognitive load is really complicated (Otto et al, 2013; 752).

Reinforcing an individual's motivation to learn is a good thing, whereas failure reinforces the message that they can't do it. This increases the germane load, making it even more difficult to do it in future.

This helps to explain why small step-changes are so successful as strategies for learning. Each small task is likely to be successful, because it makes small demands on skills or knowledge, and so learners are more motivated to try the next one. If you're bad at DIY, for example, solving a problem like an F01 error code on your washing machine can feel like a big deal and might encourage you to try something more complicated next time.

For anyone who's interested, it's an error with the basic input / output system (BIOS) so you need to reboot it. Just turn it off at the socket for two minutes, then turn it back on again (Whirlpool Appliances, 2020). For someone who knows what they're doing, they might then be up to replacing the drum. But replacing the drum when you have no idea about how washing machines work could go badly wrong.

As a learner, you have to make those calls for yourself. As a teacher or parent, your role is partly to assess whether a learner is at the turning-it-off-and-on again stage or whether they are now able to progress to the turning-it-off-and-waiting-two-minutes-before-turning-it-back-on-again stage. ~Markzilla

The other aspect of germane load that's relevant to our example is that learners who are hungry have much lower cognitive function, particularly children. When we were recording the original podcast in early 2021, footballer Marcus Rashford was campaigning for children in the UK to be fed during school holidays, because a lot of them rely on their school meals for a significant part of their nutrition. There have been a lot of studies linking children's hunger with poor cognition (e.g. Taras, 2005). If you're hungry, you're operating with one hand tied behind your back, cognitively speaking. Learning with minimal guidance is therefore going to be trickier, because you need to be fed in order to learn effectively.

In summary, to answer the question: **How can you make constructivism amount to more than a hill of beans**?

1. Minimal guidance isn't effective, but neither is an approach that fails to develop independent learners, so guide them step by step. Scaffold learners through the stages of opening a tin of beans, by demonstrating and explaining the process, getting them to repeat it with guidance and, once they have done it successfully, asking them to repeat the process independently.
2. Help learners to reflect on their own experience, so they understand how to learn for themselves.
3. Don't try to teach hungry kids, but do try to teach them that they can learn.

Tips for practice

Our top tip for applying the above in your own teaching practice is that there's no specific winning formula. Don't follow the cognitive-architecture-and-behaviourism people completely; don't put into practice a full-on version of the approaches suggested by the active-problem-based-constructivism people. You don't want minimal guidance, but you also don't want complete guidance.

With minimal guidance, you'll be overloading your students cognitively because they'll all be trying to think through everything from first principles. You need to model what they need to do. You need to provide some sort of scaffolding. Build in reflective stages so the problem-solving skills they've acquired can be applied the next time they need to solve a problem. This means you can gradually step back and start giving learners problems without providing a lot of guidance. The first time through, don't just throw them in at the deep end. Teach them how to swim first, get them to practise in the shallow end. Only when you're sure they won't drown can you throw them in at the deep end and expect them to have fun there.

At the other end of the spectrum, you don't want to provide complete guidance, because then learners won't acquire problem-solving skills. If all they're doing is learning the facts, then reiterating them might be efficient. It might be an effective way to learn the content of your course. But it's not going to provide the long-term skills that learners need to interact with the world, and it's not going to be fun either.

Getting the balance between those two elements right is a matter of judgement. It's a matter of knowing your learners, knowing what they're capable of at their age and their level. It's also being sensitive as a teacher and a learner to your students'

context, being sensitive to the fact that your students may not be in an ideal personal situation for their own learning, and perhaps thinking about ways of supporting them that don't just involve teaching.

And don't just enable your students to learn, but also teach them to reflect on that learning, on the processes they've tried out and how to apply them in the future. If you give people constant guidance, they don't learn to be independent learners. They may learn a lot of facts and they may learn them really quickly or effectively and efficiently, but if they're not given the opportunities to develop metacognitive skills, then once they're no longer under your direction they won't be ready to go off and do their own thing.

That's difficult, so here's our final point. While you're teaching students the reflective metacognitive skills that help them identify the process of their learning, there's another level. They need to be able to critically evaluate that process and identify the strengths and weaknesses of the approach for them as individuals. Doing this can not only help students to guide their own independent learning, you can use this approach to help you modify your approaches and take some of the guesswork out of creating the right balance. Not only does minimal guidance of learners by teachers have some major failings, so does the minimal guidance of teachers by learners.

But that's a whole other tin of beans.

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