TEACHING FOR LEARNING IN A FAST-CHANGING WORLD

Edited by

Sarah Gravett

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First published November 2022

ISBN (print) 978-0-6399140-7-7

ISBN (ePDF) 978-1-928539-86-5

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Preface

> If I had to sum up, in one word, the singular talents of our species, I would answer with "learning". We are not simply Homo sapiens, but Homo docens—the species that teaches itself.
>
> *Dehaene, Stanislas*

The genesis of this open-source book is the need we identified for a text about teaching for pre-service and in-service teachers that foregrounds learning, by drawing on the literature of the science of learning. Though the number of books and articles on the science of learning have burgeoned during the past few years, these texts are either not accessible (too technical) or they focus on a specific perspective, e.g., drawing mainly on cognitive psychology, while other texts may have another point of departure e.g., cognitive neuroscience. This type of material can become quite confusing for pre-service and in-service teachers, particularly around the debates between different groupings of science of learning proponents.

Chapters 1 and 2 in the book draw on multiple perspectives on the science if learning. These two chapters also serve as a broad underpinning for the rest of the book. The first two chapters echo the words of the president of MIT, L Rafael Reif, who said: "If we don't know how we learn, how on earth do we know how to teach?" (March 23, 2017).

Another focus of this book is how to prepare teachers for the rapidly changing world in which they have to teach. We see a clear link between a focus on learning and the preparation of teachers for a future that is volatile, uncertain, complex, and ambiguous, often referred to by the acronym VUCA (OECD, 2017). We concur with Willingham and Riley (2020), writing about the implications of the pandemic for education and schooling, contending that "[i]f this pandemic has taught us anything, it's that the future is unpredictable". They argued that teacher education should therefore focus particularly on what will not change – how humans learn. We agree.

Learning is foregrounded in the book, but always in relation to teaching. Therefore, Chapters 1 and 2 talk about implications of the principles derived from the science of learning for teaching. Chapter 1 also provides a toolkit for teachers in an annexure. Chapter 3 focuses on lesson design and teaching using dialogue and inquiry, drawing on the principles and ideas articulated in Chapters 1 and 2.

Chapter 4 argues that playfulness contributes to creating an environment conducive to learning (already addressed in Chapter 2). It also shows that teaching that purposefully invokes play involves active (cognitive) engagement (minds-on) of learners, and emphasises meaning, social interaction, iteration, and joy. These aspects align with the science of learning literature on features that comprise optimal learning environments and are applicable to learners of all ages.

Though all the chapters implicitly address the demands of preparing teachers to teach in ways that will equip learners for the changing world, Chapter 5 addresses this explicitly. The purpose of the chapter is to support and guide teachers to understand the importance of developing an entrepreneurial mindset in learners. Developing such a mindset is explored in this chapter and is closely linked to competencies needed to adapt and thrive in a fast-changing world. The chapter argues that developing an entrepreneurial mindset is not limited to specific subjects but is applicable to learning across all disciplines.

Chapter 6 notes that multiple pedagogies could assist in developing competencies that learners need for the fast-changing world. This chapter unpacks one such a pedagogy that is deemed as particularly useful, namely project-based teaching and learning (PBTL). PBTL is an inquiry-based pedagogy that connects knowledge gained within the classroom (curriculum knowledge) and "real-world problems". The chapter presents a framework that teachers can use for planning PBTL.

The last chapter of the book brings together some threads from other chapters and presents an exemplar of project-based learning in South Africa. This chapter provides the reader with anecdotal insight into how the intentions of the South African Department of Basic Education to embed the entrepreneurial mindset have been applied in some schools and how this has impacted the learners in encouraging ways. The chapter provides snapshots of the experiences of "real teachers" in "real classrooms".

It is our hope that readers of the book will find stimulating and relevant ideas on teaching for learning in a fast-changing world. We hope they could implement these ideas reflectively in their own classrooms, or in the case of pre-service teachers, in planning lessons and when teaching during school practicum.

Each chapter ends with "Questions to think about". We urge readers to engage with these questions. We included these because we do not subscribe to a

"cookbook" or a "how-to" approach to teaching. Teachers need to be inquiring reflective practitioners.

My thanks and appreciation go to the authors of the book chapters. Many hours of hard work happened, resulting in many drafts, each time refining the content. However, there was also always joy and playfulness involved. Last but not least, a big thank you goes to the DBE-E^3 programme that supported the development of this book, funded by the LEGO Foundation, with no strings attached.

Sarah Gravett

Editor

October 2022

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Editor

Sarah Gravett is a Professor of Education and the former dean of the Faculty of Education at the University of Johannesburg (UJ), from January 2007 until December 2021. Her postdoctoral research included transformative learning, dialogic teaching and the design of learning environments in higher and adult education. Currently, she is mainly involved in projects on education imperatives for a fast-changing world, focusing particularly on teacher education and development. She is involved in and leads projects that investigate teacher education models, the incorporation of the science of learning in teacher education, creative coding and educational robotics for teachers and using mixed-reality simulations in teacher education. She is the author and co-author of numerous books and articles on teaching and learning, teacher education and related themes and has supervised numerous postgraduate students.

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Margaret Worthington-Smith began her career in 1985 teaching high school English. In 1988 she co-founded a job-creation NGO, the Triple Trust Organisation, directing this until the mid-1990s. During this time she also co-developed business training materials for unemployed adults. In 1996 Margie founded the South African Institute for Entrepreneurship primarily developing learning resources for entrepreneurial mindset development in schools. In 2009 Margie

joined the Allan Gray Orbis Foundation as Executive Programme Director combining her management experience with her passion for education and entrepreneurial mindset development for youth. In 2018, following some years as a strategy consultant for NGOs, Margie co-established E^3 (a programme within the Department of Basic Education) where she now works in its Research, Innovation and Development team. DBE-E^3's mission is to research and prototype a locally relevant teaching-for-learning approach that will best prepare learners to thrive.

Chapter 1

Teaching for learning: Insights from the science of learning

Sarah Gravett

Introduction

Teachers often lament that learners sometimes learn very superficially or end up with many misconceptions. This is quite disheartening for teachers giving their all.

In this chapter, I make the case that it is impossible to provide "recipes" for teaching, since it is complex and multi-faceted. Many factors play a role in teaching, including the nature of the subject matter, the age of the learners, the learners' background and existing knowledge, class size and the personality of the teacher. Thus, there are no "best" blanket teaching practices that (will) work every time in all contexts.

Nevertheless, the good news is that knowledge regarding human development and learning has been growing rapidly. In tandem, the opportunity to shape more effective educational practices has also increased (Darling-Hammond et al., 2020). This is what this chapter is about – exploring some aspects of the knowledge on human learning, referred to as the *science of learning*.

The term "science of learning" was coined in a report from the National Research Council (2000), *How People Learn*. It has since been used to refer to a combination of research in (primarily) cognitive psychology, developmental psychology, education, and cognitive neuroscience shedding light on the learning process.

The central idea of this chapter is that teaching is ultimately about guiding and supporting meaningful learning, thus creating significant learning experiences for learners. Therefore, if teachers have a basic understanding of some of the tenets of the science of learning that have teaching implications, it will give them a base to draw on for designing and implementing such significant learning experiences. Furthermore, it would enable teachers to develop a more nuanced, reflective approach to teaching.

The chapter commences with an explanation on how teaching is conceptualised. Thereafter, the discussion turns to how learning happens in our brains, followed

by a look at the three principles derived from the science of learning that could be used to inform teaching. The last section of the chapter puts forward a few broad, cross-cutting implications of the principles for designing significant learning experiences.

1.1 How is teaching conceptualised in this chapter?

When the term teaching is used, it refers to teacher conduct that has the conscious intention and potential to guide and support learning. In other words, learning is placed at the forefront. The guiding aspect captures the role of the teacher as accompanying the learners on their learning journey. This implies the following:

- purposefully mapping the learning territory to know in advance what the envisaged destination is, and how to best traverse the territory;
- planning for the obstacles that may be encountered, what to highlight and why, and how to deal with the stumbling blocks that may occur; and
- showing learners the way, pointing out highlights, and monitoring progress.

Supporting learners on their learning journey means offering encouragement when difficulties are encountered, providing feedback on progress, and scaffolding – providing support structures to help learners overcome obstacles or to get them to a next stage or level.

Guiding and supporting learners' learning implies, in agreement with Fink (2013), that teachers' main concern should be to create significant learning experiences for learners. Significant, in this context, means that teachers should create learning experiences that aim to optimise meaningful learning. Significance, as it relates to learning, is also about the potential longevity of learning. Surely, learning that is soon forgotten or that is of little value for learners' lives, currently and in the future, is not significant. Significant learning is durable, relevant learning, because it either forms an important basis for future learning or it is of value for learners' current lives or the lives that they are likely to live. Significant learning is also transferable learning in that it can be used or applied beyond the immediate situation. This type of learning is also referred to as deeper or meaningful learning (Pellegrino, 2017).

1.2 How do our brains learn?

What follows is a basic summary of learning from a brain science perspective that could help teachers understand what happens in our brains when we learn.

Your brain is a network consisting of a collection of parts that are connected to function as a single and flexible structure (Feldman Barrett, 2020). The fundamental building blocks of our brains are biological cells, called neurons. The human brain consists of billions of neurons communicating via neurotransmitters at synaptic junctions to form complex neuronal networks or circuits. When one learns, connections are made between neurons.

The description of neurons and their functioning that follows, leans heavily on Feldman Barrett (2020), Dehaene (2020) and Ludwig (2017).

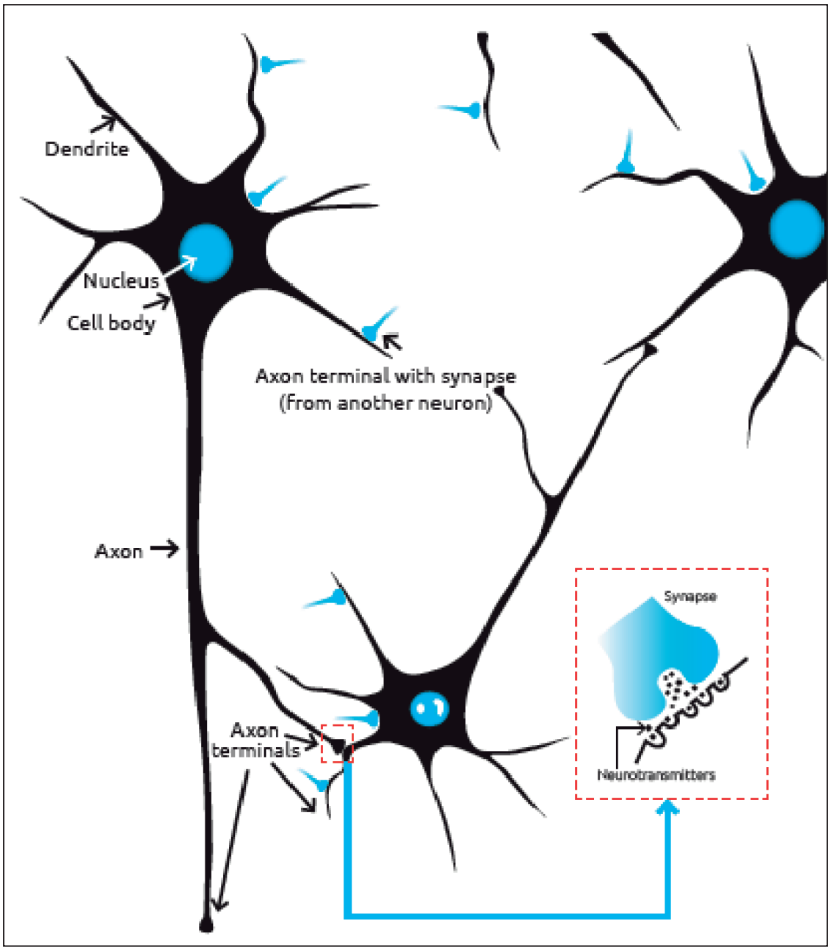

Figure 1.1: Neurons: The fundamental building blocks of the brain

Neurons communicate with each other using chemicals called neurotransmitters, sending messages from one neuron to another.

Thinking of a neuron as a tree is helpful. A neuron has three main parts, the cell body (tree trunk), an axon (the tree root), and the dendrites (branches of a tree). The cell body stores genetic information (DNA) in the nucleus. The cell body also contains the chemical "apparatus" to produce the neurotransmitters that the neuron uses for communication, while the dendrites are the parts of a neuron that receive signals. The axon is the structure used by a neuron to connect with and communicate with another neuron to send signals. Each axon has little balls on the end, axon terminals, that are filled with chemicals. The dendrites have receptors to receive the chemicals. Typically, the axon terminals of one neuron are close to the dendrites of thousands of other neurons, but they do not touch, and the spaces between them are called synapses.

An axon carries information similarly to a cable that carries electricity. When a neuron "fires" by sending an electrical impulse down its axon to its axon terminals, neurotransmitters are released into the synaptic space that separate the two neurons. The neurotransmitters then travel across the synapse and attach to receptors on the other neuron's dendrites. Neurotransmitters are to receptors like keys are to locks: they "unlock doors in the membrane of the neurons" (Dehaene, 2020, p. 85). The recipient neurons generate their own electrical impulses and release their own neurotransmitters, triggering the process in still more neurons, and so forth. This arrangement of synapses, axons, and dendrites connects our 128 billion individual neurons into a network, often referred to as the "wiring" of our brains. However, note that neurons are not literally "wired together" – they are separated by the synapses and chemicals serve as the connection (Feldman Barrett, 2020).

During learning neurons link and strengthen. Oakley et al., (2021, p. 3) denote this process as "learn it, link it". The "learn it, link it" notion has its origins in Hebbian learning, a process where neurons "that fire together wire together". The neuroscientist Donald Hebb first described this process; the phenomenon is more formally known as Hebb's principle or Hebbian plasticity. Strictly speaking, the firing is not simultaneous – one neuron fires just before another (Feldman Barrett, 2020).

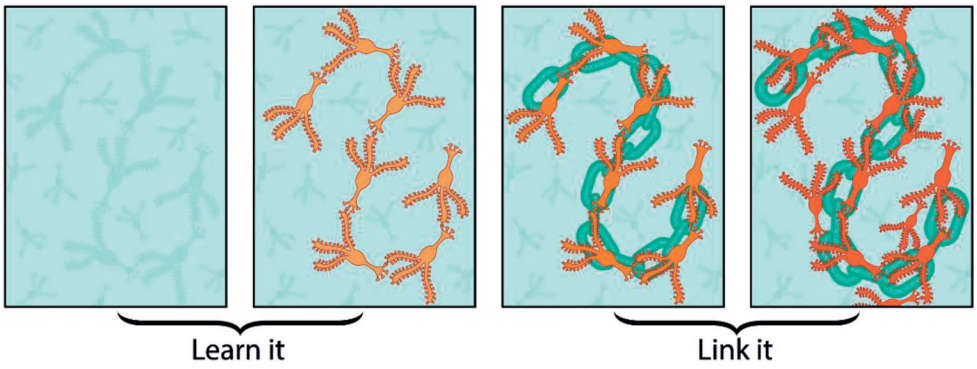

Figure 1.2: Learn it, link it

These four images from Oakley et al. (2021) explain the "learn it, link it" phenomenon: The first "learn it" image on the left depicts neurons beginning to find one another as a learner is introduced to a new concept, an example being when a teacher explains something, or while learners are reading a text or watching a video. The second "learn it" image shows connections that are made as a learner engages with the learning content, for example, by answering questions about the material or by practising. As a learner works in active ways (engages deeply) with the new idea, concept or skill, links solidify in the long-term memory and form the basis of proficiency. This is depicted in the third image. More practice in novel ways, e.g., through problem solving or via application to other contexts, can extend the learning to new areas (the fourth image), which allows the neurons to tie in with other neurons that underpin related concepts.

The more often the brain accesses a neural network, particularly through retrieval or varied forms of practice, the stronger the connections become. Once stabilised, these neuronal paths activate spontaneously when someone needs to cope with new situations. The above implies that the knowledge in our minds consists of neuronal networks in our brains. Therefore, if our knowledge is to grow and develop, the neuronal networks must grow and develop.

Leamnson (1999) alerted us that teachers should see learners as having brains of enormous potential, but teachers must understand that learners' brains are unstructured regarding the teachers' field of expertise/subject knowledge. Without this insight, teachers may assume that the learners' brains are pretty similar to their own and need only new or more information. If we consider that learners' brains may have limited synaptic connections about a subject area or

new learning content, we will realise the difficulty learners experience in decoding the meaning of lengthy or intricate explanations. No matter how well the teacher presents this, learners use the neuronal networks they have to make sense of new information. They have no other choice!

An understanding of the above also reminds us that it is the learners' neuronal networks that need strengthening. *They* are the ones that need to do the deep processing/engaging so that the desirable synaptic pathways are strengthened. This does not diminish the teacher's role. In fact, the teacher's role is crucial to create the learning experiences that will focus learners' attention and engage them to strengthen the desirable synaptic pathways.

All of the above points to brain plasticity, also called neural plasticity, neuronal plasticity, or neuroplasticity (Wilson & Conyers, 2020, p. 30). Plasticity refers to:

> How the brain responds to experience and changes its structure as a consequence of alterations in the environment. In other words, experiences embed themselves into the way in which the brain functions. This occurs at the level of connections between neurons. Plasticity changes in the brain occur when new connections are formed, existing connections are eliminated or existing connections are strengthened (Ansari, König & Leask, 2017, p. 200).

Neurons, synapses, and the microcircuits that they form are the "hardware" of brain plasticity. This implies that they adjust each time we learn (Dehaene, 2020).

Why should teachers and learners be aware and take account of neural plasticity?

Teachers should understand that the relationship between brain development and learning is reciprocal. The development of the brain affects behaviour and learning, and in turn, learning affects brain development. The brain's structure is changed through learning. The implication for teachers and learners is that the academic ability of almost all learners can be improved if educational conditions are favourable. The message for learners struggling with subjects they find difficult is that brain plasticity means they *are* able to learn and improve if they keep trying through practising, and through using appropriate strategies for the subject area and studying, guided by the teacher (Wilson & Conyers, 2020).

Ansari König and Leask (2017, p. 201) noted that even though teachers may not be aware of it, they are tasked to be the "the orchestrators of their students' neuronal

plasticity during classroom time". This will be explored in this chapter and in Chapter 2 with the help of some principles derived from the body of scholarship dubbed the science of learning.

1.3 Principles derived from the science of learning to inform teaching

Although this chapter argues that teachers should have a basic understanding of the core ideas from the science of learning to inform their practice, this does not provide a blueprint for practice. Why, would you ask?

Teaching practices that will work in all circumstances cannot be derived directly from the scientific study of learning. Willingham's (2021a) view put forward in a podcast is pertinent here: He said that the effectiveness of teaching methods is dependent on moment-by-moment decisions that a teacher makes about what a learner knows, what the teacher knows about the learner, and the teacher's connection with the learner. Thus, it is not possible to make a direct link between what "science" says about learning and what a teacher must do at a specific moment. Nevertheless, as noted above, when teachers understand the aspects of human learning that shed a light on how learning can be guided and supported, it could help them to make informed moment-by-moment decisions. In this book, four interrelated principles, derived from the science of learning literature will be discussed. These principles could help teachers design significant learning experiences for learners. Three principles are dealt with in this chapter and the fourth principle is discussed in Chapter 2. The principles are phrased as questions for teachers to think about.

1.3.1 What should teachers understand about the role of learners' existing knowledge in learning?

It turns out that learners' existing knowledge plays a crucial role in learning as learners understand and learn new ideas (what they don't know) by relating them to old ideas (what they do know) (Willingham, 2021b). Learners' existing knowledge serves as an interpretive framework for new learning. This means that learners construct new understandings based on their existing understandings and experiences.

Our existing knowledge is "located" in our long-term memory and it "lies quietly until it is needed and then enters working memory and so enters consciousness"

(Willingham, 2021b, p. 39). Our working memory is our "mental space" where we temporarily hold and process information. Understanding new ideas is mostly a matter of getting the applicable old ideas into the working memory and combining them in new ways (Willingham, 2021b, p. 145). More about this later. This implies that learners' prior knowledge that is stored in long-term memory can help learning. This, however, is only the case when the knowledge is adequate, accurate and appropriate to build on.

Learners' prior knowledge can also serve as an obstacle to learning, for example when the knowledge is inadequate or inaccurate to build on. When this is the case, the teacher may have to take a step back to first help learners attain the knowledge they need as a basis, or to address misconceptions, before introducing the new content. In addition, starting with learners' prior knowledge is a critical step in eliciting attention and cultivating engagement. Prior knowledge guides which aspects of learning content learners will deem worthy of attention.

Prior knowledge also serves to "knit details into larger units, making them easier to remember" (Willingham & Riener, 2019, p. 199). The more learners get the opportunity to see the connections between new learning content and their prior knowledge (knitting detail together), the stronger their grasp of the new learning content will be, and the more connections are created that will help them to remember the information later.

All this confirms that the insights expressed by David Ausubel many years ago are still very relevant. He declared: "If I had to reduce all of educational psychology to just one principle, I would say this: The most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly" (Ausubel, Novak & Hanesian, 1978, p. vi).

The above emphasises that creating significant learning experiences for learners implies that teachers must take learners' existing knowledge seriously. Teachers must build on learners' prior knowledge and must also take account of the gaps in understandings that learners have to try and resolve these issues. If learners' existing ideas and beliefs are ignored, learners may learn very little, or misconceptions may be perpetuated.

1.3.2 Why are learner attention and engagement crucial pillars of learning?

Dehaene (2020) refers to attention and engagement as crucial pillars of learning. Why, may you wonder?

1.3.2.1 Attention

If learners do not pay attention to the learning content that teachers want them to learn, it is unlikely that they will learn anything. Dehaene (2020) refers to attention as the gateway to learning. He contends that teachers should pay constant attention to attention. Teachers must purposefully select what they want learners to pay attention to, "because only the items that lie at the focus of attention are represented in the brain with sufficient strength to be efficiently learned". Thus, a core task of teachers as designers of significant learning experiences for learners is to persistently capture learners' attention and to direct their attention to the prioritised tasks they have designed to help learners achieve the learning goal.

Dehaene (2020) explained that in cognitive science, attention refers to all the mechanisms by which the brain selects information, amplifies it, channels it and deepens its processing. Similarly, Willingham and Riener (2019) noted that attention involves continued cognitive processing. If you do not pay attention to something, you cannot learn it.

We cannot expect a child (or an adult) to learn more than one thing simultaneously (Dehaene, 2020). Our brains are prone to be distractable (Lang, 2020). Our attention is limited – it "operates a lot like a small spotlight, focusing on a narrow subset of information at any given time" (Cavanagh, 2016, p. 33). Teachers often criticise learners for not paying attention. However, when learners do not pay attention to classroom teaching, it does not mean that their brains are inattentive. They are probably paying attention to some of the other competing kinesthetic, visual, and auditory input in the environment (Willis & Willis, 2020).

Given the above, Lang (2020) reminded us that teachers should realise that attention is an achievement – particularly the type of attention that we wish for in our classrooms, because of the hard cognitive work we are asking learners to do. Similar to Dehaene (2020), Lang argued that achieving attention in the classroom does not happen without effort. A core task of teachers should be to cultivate

attention deliberately. The achievement of capturing and focusing learner attention requires intentional and conscious effort from the teacher.

Attention also relates to the fact that our brains are predicting organs (Feldman Barret, 2020). The brain tries to predict the inputs it receives, based on past experience and knowledge, and it adjusts these predictions "… according to the degree of surprise, improbability, or error. To learn is to curtail the unpredictable" (Dehaene, 2020, p. 203). Successful prediction is one of the brain's best problem-solving strategies. Prediction induces interest and attention because the brain has the need to "check" the accuracy of its predictions (Willis & Willis, 2020).

Lang (2020, p. 14-15) concluded that "the cultivation and direction of attention are fundamental tasks of every teacher, from the kindergarten classrooms of an elementary school to the high-tech learning laboratories of the modern university".

This, of course, emphasises the crucial role of teachers as directors of attention. It implies that should there be signals that attention is wavering, teachers should purposefully plan how to grab learners' attention and must constantly monitor attention in the classroom to adapt teaching in a way that brings attention back to the learning goal.

1.3.2.2 Active engagement

Active engagement according to Dehaene (2020) is another crucial pillar of learning. He explains that when one is passive, it is unlikely that any learning will take place because learning requires engaging, exploring and active generating of mental models. "To learn, our brain must first form a hypothetical mental model of the outside world, which it then projects onto its environment and puts to a test by comparing its predictions to what it receives from the senses" (Dehaene, 2020, p. 178). We return to the notion of the brain as a "prediction organ" later in this chapter and in Chapter 2.

But what does active engagement mean in relation to teaching and learning?

Some would claim that learners are actively engaged when they are doing something, are moving, or are talking, in other words when they are involved in activities. However, this does not necessarily mean that any worthwhile learning is taking place. Active engagement in relation to learning is about what happens

in our brains when we try to make sense of something. It is about cognitive engagement/cognitive effort.

Engaging learners cognitively implies getting them to think about what we wish them to learn – providing them with cognitive work that poses a moderate challenge (Willingham, 2021b). This could involve hands-on activities or talking, but the tasks for learners must be designed to first and foremost engage them cognitively.

This quote from Caxton (2021, p. 109) is helpful to explain the "right level" of challenge:

> If the material is too remote from any pre-existing knowledge- or skill-base for students to get a handle on it, learning in the sense of understanding can't happen. All you can do is try to remember facts, definitions and procedures parrot-fashion. On the other hand, if it is too easy, understanding is not stretched, and all you can do is practise doing what you can already do so you can do it more speedily or efficiently. Learning that stretches competence and comprehension happens in the middle zone where your thinking and expertise are taxed, but where you are still able to engage and refine your understanding through trial and error – because you have some basis on which to create sensible 'trials'.

Willingham (2021b) advised that teachers should scan each lesson plan in relation to the cognitive work that learners will be expected to do. How often are learners expected to engage with the learning content – in other words, how often are they required to think deeply about the learning content?

Thinking can be defined as any mental work that requires effort and concentration (Willingham, 2021b). He explained that humans are not naturally good thinkers, but we are naturally curious, therefore seeking opportunities to engage in problem solving, i.e., cognitive/mental work that succeeds because of the satisfaction and fulfilment that comes with successful thinking. However, because thinking is so hard, the cognitive conditions have to be favourable for us to engage in thinking. One of these conditions relate to curiosity. (More about this later.) Another condition relates to meaning.

Thinking occurs when you combine information from the environment and existing knowledge in the long-term memory and transform this into something

new. Combining and transforming involves active processing and happens in our working memory (Willingham, 2021b). Moving information from the working memory to the long-term memory is affected by many factors. However, according to Willingham (2021b) the factor that trumps all the others is that learners remember what they think deeply about. In other words, the likelihood of retention of learning is increased if information has been processed deeply in the working memory by actively linking the new information to existing knowledge and by thinking deeply about the meaning of the information.

The obvious implication for teachers is that they must design learning experiences for learners that will focus their thinking on the meaning of learning content. The best barometer for every lesson plan according to Willingham is to use the question: What will the lesson make learners think of? How will the lesson help learners to think about the meaning of learning content?

Kosslyn (2021) brought attention and thinking together through a science of learning principle that he states as "Pay attention and think it through". The implication is that teachers should guide and focus learners' attention on the learning goal and create learning experiences that require deep thinking about the learning goal.

1.3.2.3 Curiosity – a driver of attention and engagement

Harnessing learner curiosity is important for attention and engagement. Dehaene (2020) referred to curiosity as a foundation of active engagement. He explained that curiosity is an intense and basic impulse that is critical to survival. Curiosity is intertwined with cognition because it is a force that encourages us to explore. If learners' curiosity is primed before or during a learning experience, the learning content becomes more desirable and memorable.

Getting and keeping learners curious is therefore one of the key factors for successful education — it lies at the heart of the educational process (Eyler, 2018). Research clearly shows that we learn more deeply when we bring curiosity to a task (Lang, 2020). Memory and curiosity are also linked — the more curious you are about something, the more likely you are to remember it (Dehaene, 2020).

Thus, piquing learners' curiosity at the beginning of a lesson will go a long way to activate and maintain attention and engagement. Once learners' attention is activated and their minds are searching for an explanation for the "puzzle" (i.e., the

unexpected or novelty that triggered their curiosity), what is left is for the teacher is to guide their curiosity.

But what is curiosity?

According to Dehaene (2020, p. 189), we have acquired the desire for knowledge in all fields including the most abstract over the course of our evolution. The desire for knowledge is referred to as epistemic curiosity. Humans, unlike other mammals, explore beyond the physical world – we explore the world through "thought experiments" and we explore "conceptual worlds". Epistemic curiosity is also sometimes referred to as intellectual, cognitive, or information-seeking curiosity (Grossnickle, 2016).

Dehaene (2020) explained that curiosity occurs whenever our brains detect a gap between what we already know and what we would like to know – a potential learning area. Similarly, Loewenstein, (1994, p. 87) proposed that curiosity arises when attention becomes focused on a gap in one's knowledge – an information gap. He explained this gap as the distance between "what one knows and what one wants to know." The information gap produces the feeling of deprivation, which is labelled as curiosity. This feeling of deprivation is often triggered by an element of surprise, novelty or something that we experience as puzzling, and it results in "information seeking behavior" (Kidd & Hayden, 2015, p. 449). When we are puzzled, we find a resolution rewarding. Seeking the resolution opens us up for learning (Loewenstein, 1994).

What stimulates or inhibits curiosity?

To be curious about something presupposes some background knowledge about the subject or topic. It stands to reason that if curiosity occurs when our brains detect a gap between what we know and what we would like to know, that we cannot be curious about something that is too far removed from our current knowledge or experience. When we know nothing about a topic, we find it hard to engage our brains, either because we cannot imagine that we would find it interesting, or because we may feel intimidated by the prospect of starting with something new that seems at face value incomprehensible or daunting.

This implies that although novelty or an element of surprise induces curiosity, curiosity will not be piqued by things that are too novel, unexpected or surprising

(Dehaene, 2020), or that we perceive as confusing or too complex due to our lack of related knowledge.

Conversely, one's assessment (often inadvertently) of how much you know about a topic, or a field, could be an inhibitor of curiosity. If you conclude that you know enough about a topic or have the sense that what you are required to learn (in a classroom situation) is "more of the same" it is unlikely that you would be interested to learn more about it. Disinterest would be elicited, resulting in wavering of attention and engagement. We have no curiosity for what we view as old hat or unsurprising (Dehaene, 2020). Curiosity guides us to what we think we can learn. Its opposite, boredom, turns us away from what we already know, or from areas that, according to our past experience, are unlikely to teach us anything new (Dehaene, 2020).

Whether curiosity is maintained often relates to our experience of making satisfactory progress or success. Even though an area or topic may have seemed attractive initially, we often lose curiosity and interest when our brains assess insufficient progress (Dehaene, 2020). It is successful learning that is pleasurable and "that will keep learners coming back for more" (Willingham, 2021b, p. 45).

1.3.3 What role does our memory system play in learning?

Memory is the mechanism by which we store what we have learned for future retrieval and use thereof (Wilson & Conyers, 2020). From a brain science perspective, learning involves connecting, strengthening, and extending sets of neural links in long-term memory in the neocortex, as discussed above.

Kosslyn (2017; 2021) connected learning and memory as follows: Learning involves encoding (acquiring or taking information in and storing it) and integrating the new information into what you already know. Memory consists of retention – previously learned information that has been stored, and retrieval – digging the information out of storage when you need it. Thus, learning and memory are different sides of the same coin. Without learning there is no memory: if there is nothing to retrieve from memory, learning has not taken place.

The human memory system involves many types of memory with different purposes. For classroom learning, two types are particularly pertinent, namely working memory and long-term memory. The neurons from working memory cannot hold information for very long (Oakley et al., 2021). As a result, information

in the working memory quickly gets lost if it is not rehearsed or updated. Also, working memory has a limited capacity and can easily become overloaded. Conversely, the neurons of long-term memory can hold information for a long time (Oakley et al., 2021). Long-term memory also serves as the mind's vast storehouse for factual knowledge (declarative knowledge) and procedural knowledge (how to do things) (Willingham, 2021b).

Working memory is where we keep things "in mind" – the site of our awareness and thinking, where we temporarily hold and process information (Willingham, 2021b). Attention is a primary contributor to what is held and mentally manipulated in the working memory. Thinking occurs when one combines information in new ways in the working memory. That information might come from the environment or from long-term memory or from both (Willingham, 2021b).

Teachers need to be aware of the limited capacity of working memory (Oakley, et al., 2021). It becomes increasingly difficult to think if one's working memory gets overloaded (Willingham, 2021b). This happens, for example, if lists of facts or ideas seem to be the unconnected, or if a large amount of information is presented without providing thinking breaks to learners to make sense of the information. In other words, if learners are required to deal with too much information or too many ideas at once, this will restrict learners' ability to comprehend/process the new ideas. This is particularly the case when learners have limited background knowledge of the learning content that is being taught.

However, the limited capacity of working memory is aided by background knowledge stored in long-term memory (Willingham, 2021b). The more knowledgeable one is about a topic, the more it frees one's working memory to process new ideas. The more knowledge is held in long-term memory, the easier it is to add more.

What does the interaction between working memory and long-term memory involve?

New information enters long-term memory through working memory. However, not all information moves from working memory to long-term memory. The transfer of information to long-term memory is influenced by a number of factors.

First, for material to be learned (that is, to end up in long-term memory), it must reside in working memory for some time. This means that a learner must pay attention to the information. Here curiosity comes into play. Memory and curiosity

are linked – the more curious you are about something, the more likely you are to remember it (Dehaene, 2020).

Second, the depth of processing (Willingham & Riener, 2019; Kosslyn, 2021) plays a role. The more mental processing one performs on information, the more likely one is to retain it (in your long-term memory) (Kosslyn, 2021). Here we highlight one aspect related to the depth of processing, namely thinking about meaning.

According to Willingham (2021b, p. 96-97), "Memory is the residue of thought". Whatever learners pay attention to and think deeply about (i.e., thinking about its meaning), is what they will remember. Information is more likely to move from working memory to long-term memory if the learner experiences it as meaningful, because understanding enables "placing" the material into a framework developed by prior knowledge. When we understand a concept, we are more likely to remember it. Thus, when we teach for meaning, we are simultaneously teaching for memory (Wilson & Conyers, 2021).

The obvious implication for teachers is that they must design learning experiences that will focus the thinking of the learners on the meaning of the learning content.

Apart from attention and meaning, we also know that retention of knowledge requires that information in the long-term memory must be stabilised/ strengthened. Embedding new learning in long-term memory requires a process of consolidation, which involves connecting new learning to prior knowledge and strengthening the neural pathways.

A way to strengthen the neural pathways is through regular practice as practising enables consolidation of learning. However, mere repetition of information (rote practice) is often of little value because the information is not connected in a meaningful way to the pattern of one's existing knowledge. Thus, the "linking" part of "learn it, link it" (Oakley et al., 2021 p.14) is lacking. Varied practice is required through embedding practice in different types of activities, while practice is more valuable if spaced out.

Dehaene (2020, p. 218) explained why spacing is effective and important:

> Repetition seems to create an illusion of knowledge, an overconfidence due to the presence of information in working memory: it seems available, we have it in mind, so we do not see the point of working any harder. On the other hand, spacing out the learning increases brain activity: it seems

to create an effect of 'desirable difficulty' by prohibiting simple storage in working memory, and thus forcing the relevant circuits to work more.

Another powerful way to strengthen knowledge in the long-term memory is through retrieval (Dehaene, 2020). Kosslyn (2017, p. 155) referred to this as "eliciting the generation effect". The mere act of digging information out of memory "reconstructs and strengthens the mental representation of the information". In other words, the more times that you practise remembering something, the more adept you become at remembering that thing in the future (Lang, 2021). Retrieval (often referred to as retrieval practice in the literature) strengthens the connections between neurons in long-term memory. It induces thinking and it forces learners to check whether they have begun to make links in the long-term memory (Oakley et al., 2021).

So, one may well ask what retrieval practice involves. It involves actively recalling (retrieving) and working with already learnt material. It could comprise recalling core ideas/concepts/facts; drawing on one's existing knowledge to try and solve a problem before being taught the solution; distilling the underlying principles or rules that differentiate types of problems, etc. While any kind of retrieval reinforces learning, it seems as if when more cognitive effort (effortful retrieval involving thinking) is required, retention is strengthened.

Using retrieval practice to revisit important learning covered before, helps learners to construct more complex mental models and develop deeper understanding of the relationships between ideas (Brown, Roediger III & McDaniel, 2014). This is important for learning to transfer. Retrieval practices that foster transfer typically involve retrieving information in a deeper and more elaborate way than standard practice questions and exercises require. Examples of such practices are to task learners to retrieve broadly, for example, to retrieve as much as they can remember from a previous lesson, and to construct explanations of what they have learnt, focusing less on "what" and more on "why" and "how" (Pan & Argawal, 2018).

To effectively foster transfer, retrieval practice should be combined with feedback. This helps learners to check whether what they recalled was accurate, and to identify and fill in the knowledge gaps identified during retrieval. They will also be better able to integrate what they have retrieved with the rest of the materials to be learned, because their existing knowledge has been activated. All of this could contribute to overall improved understanding – and thus, better transfer of learning (Pan & Argawal, 2018).

Lang (2021, pp. 49-50) summarised the power of retrieval for learning as follows:

> Every time we extract a piece of information or an experience from our memory, we are strengthening neural pathways that lead from our long-term memory into our working memory, where we can use our memories to think and take actions. The more times we draw it from memory, the more deeply we carve out that pathway, and the more we make that piece of information or experience available to us in the future.

1.4 What are important implications of an understanding of how the brain learns and the principles discussed above?

An understanding of how the brain learns and the principles derived from the science of learning literature signal broad implications for how to create significant learning experiences for learners. Here are a few implications that are cross-cutting, in other words, they relate to more than one principle. **(See Appendix 1 for teaching techniques associated with the above principles.)**

- Significant learning experiences will be designed to take account of learners' existing knowledge, and this knowledge will be used as a springboard for teaching new content. Eliciting learners' existing knowledge is indispensable for teaching. Apart from the insight that teachers get to help them to teach at an appropriate level, or to first attend to misconceptions before moving to teaching the new content, starting with learners' existing knowledge has an additional benefit. If learners are made aware of the gaps in their knowledge, it could simultaneously serve to elicit curiosity which is important for learner attention and engagement. Retrieving existing knowledge could serve to identify the gaps and is simultaneously an important way to strengthen neural connections. Activating prior knowledge has the added advantage of strengthening learning through helping learners to find associations with information already stored in memory (Kosslyn, 2017).
- Significant learning experiences harness learner curiosity. Curiosity is piqued when learners become aware of gaps in their knowledge, and they therefore want to learn more. However, wanting to learn more is not necessarily the direct result of becoming aware of a knowledge gap. There is a prerequisite – learners will want to learn more if they experience the gap as inherently puzzling, interesting or relevant to their lives. Thus, curiosity, and as a result attention and engagement, will be maintained if learners experience inquisitiveness. Such

inquisitiveness could be stimulated through using open-ended questions that highlight knowledge gaps or questions that require prediction. Questions or provocations that elicit prediction in relation to the focus of the lesson will prompt learners' brains to pay attention to the lesson to find out whether their predictions are accurate/correct. Also, including prediction opportunities not only at the onset of the lesson, but also during the lesson to allow learners to revise or add to the initial predictions, can help them remain focused and interested (Willis & Willis, 2020; McTighe & Willis, 2019).

- Significant learning experiences are created to elicit and maintain learner attention and engagement. Interest is a way of supporting attention. When learners are interested in what they are learning and doing, they will be less likely to shift their attention to other things. The distinction that Hidi and Harackiewicz (2000) as reported in Weinstein, Sumeracki and Caviglioli (2019) make between personal interest and situational interest is useful. Teachers are not in control of learners' personal interests, but teachers can influence situational interest in the classroom. Situational interest relates to how engaging/appealing a teacher makes the class (thus eliciting curiosity and attention).
- Significant learning experiences make the learning goal clear to learners. An important way of supporting attention and engagement is to be transparent about the learning goal. A goal that is known and articulated helps both the learners and the teacher to focus. Willingham (2021b) suggested that teachers should link the learning goal to a question. When designing a lesson, start with what learners should know and/or be able to do by its end (the learning goal). Make the learning goal explicit to learners, phrased as a key question. Willingham (2021b) explained that the material we want learners to learn is actually the "answer" to an intellectual question. On its own, the answer is often not attention-grabbing. However, if the teacher and the learners know the question and its significance (the why of the question – its relevance), guiding learners towards the answer (in the lesson) may provoke interest and deep thinking.
- Significant learning experiences are characterised by learning tasks that induce deep processing, i.e., help learners to think of the meaning of the learning content. This can be done by using open-ended questions that require explanation and/or prediction. Teachers will also then take account of cognitive load in relation to deep processing. In other words, teachers will

plan not to overload the working memory of learners. This can be done by giving regular brain breaks that allow for consolidation (Oakley et al., 2021). Brain breaks can be as short as twenty to forty seconds. It could, for instance, be when learners pause and turn to others for a collaborative activity, and with another twenty to forty seconds added after the activity is completed. Also, collaborative activities themselves give brain breaks because of the social connection with others and can also contribute to deep processing if the collaborative activities invoke open-ended questions or provide practice opportunities. Another way of fostering thinking is to present new learning content in segments interspersed with open-ended questions that require learners to "act on" the content. Kosslyn (2021) refers to this as "learning by using". Deep processing could also be fostered by using retrieval practice.

Summary

The principles articulated in this chapter do not prescribe specific pedagogical approaches or strategies. It is aimed at providing insights from the science of learning that could help teachers create significant learning experiences for learners. Dehaene's (2020, p. 179) view of how to guide and support learning that endures serves as an apt summary of the core ideas of the chapter:

> Learning that lasts requires learner attention and engagement in deep thinking and an effort to strengthen memory pathways in the brain. Without these lessons fade away, without leaving much of a trace in the brain.

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Questions to think about

1. Three principles derived from the science of learning literature are explored in this chapter. What key insights have you gained that you wish to use to enrich your teaching? How will you use these insights in your teaching?
2. It is important to read Chapter 2 in conjunction with this chapter. How do the four principles discussed in the two chapters interrelate? Why is it important to understand the interrelatedness as a teacher?
3. The title of this book refers to a fast-changing world. How do these two chapters relate to teaching in and for a fast-changing world?
4. Based on your reading of the preface and this chapter, what would you predict as "the golden thread" that runs through all chapters in the book?

Chapter 2

Cognition and emotion are intertwined: Creating emotionally positive learning environments

Sarah Gravett

Introduction

In Chapter 1, the case was made that teaching is ultimately about guiding and supporting meaningful learning or creating significant learning experiences. Therefore, teachers should have a solid understanding of what learning involves and of the conditions conducive to learning.

Chapter 1 indicated that advances in the science of learning provide significant insights into how learning can best be guided and supported. Three principles derived from the body of scholarship dubbed the science of learning were explored in Chapter 1. The first principle highlighted the importance of eliciting and activating learners' prior knowledge of the topic or subject at hand because our existing knowledge forms the basis and framework for all new learning. The second principle explained that learning is dependent on learner attention and engagement and that curiosity is a driver for both attention and engagement. The third principle clarified the role of our memory system in learning. It included the limitations of our working memory and the conditions required for information that is encoded in the working memory to move to the long-term memory where if it is stabilised and it becomes part of our knowledge, we can draw on it when needed. The principles touched on the role of emotion in learning – for attention, engagement and memory.

This chapter takes a closer look at emotion and discusses a fourth principle, namely that cognition and emotion are *intertwined*. In other words, learning is not purely cognitive but also involves emotion. This has significant implications for teaching and learning. The first section of the chapter speaks to the significance of emotions for learning. This is followed by explicating the importance of creating an emotionally positive learning environment and what this would involve in terms of the learning climate and some teaching variables that play a role.

2.1 The significance of emotions for learning

Immordino-Yang (2015-11-15T22:58:59.000) explained that

> Scientific understanding of the influence of emotions on thinking and learning has undergone a major transformation in recent years. In particular, a revolution in neuroscience over the past two decades has overturned early notions that emotions interfere with learning, revealing instead that emotion and cognition are supported by interdependent neural processes. It is literally neurobiologically impossible to build memories, engage complex thoughts, or make meaningful decisions without emotion.

Dehaene (2020, p. xxiii) also highlighted the significance of emotion for education. He contended that "there will be no progress in education without simultaneously considering the emotional and cognitive facets of our brain — in today's cognitive neuroscience, both are considered key ingredients of the learning cocktail."

Thus, scientific understanding of the influence of emotions on thinking and learning has now confirmed the intuitions of those who have long appreciated the significance of emotions in teaching and learning. Despite this, some persist in viewing teaching and learning as purely intellectual work (Eyler, 2018).

What is meant when the term emotion is used?

The definition of emotion used in this chapter is informed by the growing evidence that there are no separate parts in the brain for emotion and rationality/reason (Posey, 2018; Feldman Barrett, 2020a). Instead, emotions are "built" by the brain. "Emotions are not reactions to the world. You are not a passive receiver of sensory input but an active constructor of your emotions. From sensory input and past experience, your brain constructs meaning and prescribes action" (Feldman, 2017b, p. 6). This means that our brains combine information from outside (sensory input) and inside our heads (prior experience and knowledge stored as memory) to produce everything we see, hear, smell, taste, and feel (Feldman Barrett, 2020b).

It turns out that your brain is a predicting organ (Feldman Barrett, 2020b). It does not passively wait for incoming sensory information. Instead, it actively appraises each moment to anticipate what you may need (Posey, 2018). Feldman Barret (2020b, p. 74) explained the predictions that the brain makes as the brain having a "conversation" with itself:

> A bunch of neurons make their best guess about what will happen in the immediate future based on whatever combination of past and present that your brain is currently conjuring. Those neurons then announce that guess to neurons in other brain areas, changing their firing. Meanwhile, sense data from the world and your body injects itself into the conversation, confirming (or not) the prediction that you'll experience as your reality.

Because the brain is constantly predicting to make sense of the sensory input that it encounters by drawing on past experiences (memories) that are somewhat similar to the current sensory input, it implies that learners' brains appraise every learning event in classrooms consciously or unconsciously in a "is this good or bad for me" way (Posey, 2018).

Given the interconnectedness of cognition and emotion, it follows that teachers should understand how to create significant learning experiences for learners that take account of the interconnectedness.

You will note that some of the aspects discussed in Chapter 1 reappear in this chapter, sometimes in another guise. This attests to the interrelatedness of the different principles.

2.2 Creating an emotionally positive learning environment

Here two dimensions of an emotionally positive learning environment are foregrounded. First, learning climate is discussed. This is followed by briefly exploring how selected teaching variables could contribute to an emotionally positive learning environment. You will note that even though different aspects of an emotionally positive learning environment are distinguished for the purpose of analysis, the different aspects are intertwined.

2.2.1 An emotionally positive classroom climate

Cavanagh (2016) claimed that the most powerful action that teachers can take to maximise learners' attention and motivation is to manage the emotional climate of the classroom. Similarly, Willis and Willis (2020) referred to teachers as guardians of classroom climate.

What can a teacher do to be a creator and guardian of a classroom climate conducive to learning? Here three aspects are discussed, namely safety, emotional contagion and caring and connectedness.

2.2.1.1 Physical and psychological safety

Dehaene (2020, p. xxiii) highlighted the importance of positive emotions for creating a safe learning climate as follows: "Negative emotions crush our brain's learning potential, whereas providing the brain with a fear-free environment may reopen the gates of neuronal plasticity". Numerous studies confirm that stress and anxiety can dramatically hinder the ability to learn (Eyler, 2018; Dehaene, 2020).

Before learners can direct their attention to what teachers want them to learn, they must feel physically and emotionally safe. The notion of emotional contagion plays a role here, together with caring and connectedness. These are discussed later. For now, the focus is on the importance of consistency in routines and practices to support predictability.

As noted above and in Chapter 1, the brain is a "prediction organ". In addition, the brain loves order; it is calm when things are orderly and gets unsettled when it cannot predict what is going to happen next (Learning Policy Institute & Turnaround for Children, 2021). Though some unsettledness could contribute to eliciting curiosity and attention in relation to specific learning goals and content (see Chapter 1), constant unpredictability induces anxiety and stress which hamper learning. Conversely, a well-managed classroom environment provides safety and predictability which, in turn, creates a positive space for deep cognitive engagement.

When the parameters of expected behaviour and ways of doing are unclear and inconsistent, routines are lacking, materials are disorganised, or rules are inconsistently applied, learners may become distracted, confused, and recalcitrant (Willis & Willis, 2020). On the other hand, consistency in routines, procedures and practices provides an "anticipation" framework for learners. This reduces cognitive load and therefore increases mental capacity for risk taking, exploration, problem solving and collaborating with others (Learning Policy Institute & Turnaround for Children, 2021, p.35).

It is impossible to eliminate all stress from learners' lives – their home situation may, for example, be unpredictable and stressful. If that is the case, it is even more important to create an environment in the classroom in which learners feel safe, cared for and supported (Learning Policy Institute & Turnaround for Children, 2021). This will provide comfort that enables them to pursue curiosity and do the cognitive work required of them (Willis & Willis, 2020).

Note that the above does not suggest eliminating challenge. Memorable learning moments are often created by learning tasks that invoke productive discomfort/dissonance – e.g., by introducing some confusion or doing something unfamiliar and unexpected (James & Brookfield, 2014). If the learning climate is generally calm and well organised, such dissonance will be conducive to learning and will not induce stress.

Smith (2018) and Cavanagh (2016) emphasise the importance of clarity and transparency in relation to psychological safety, and for building a positive relationship with learners. Transparency will heighten learners' perception of the teacher's supportiveness and honesty and decrease anxiety. Transparency relates to shared mutual expectations – thus making it clear what the learning in a course is for and how to know when it has been successfully achieved.

2.2.1.2 Emotional contagion

Human beings are social in nature: we tend to first perceive and then acquire the emotions of those around us (Cavanagh, 2016). This is a process of figuratively infecting one another with emotions, referred to as emotional contagion.

According to Herrando and Constantinides (2021) emotional contagion can be triggered by facial expressions, indirect human interactions, and/or by observing other people's behaviour in direct and indirect interactions. Furthermore, emotional contagion can be activated physiologically or neurologically by synchronising with the emotional state of others during human interactions.

Cavanagh (2016) pointed out that emotional contagion is most certainly at play in classrooms. A prominent way in which it manifests is through teacher demeanour in relation to how learners and the subject matter are perceived. The first relates to whether the teacher demeanour projects respect and consideration for learners in word and deed. The second relates mainly to enthusiasm. Eyler (2018, p.128) said: "To some degree, simply displaying our own delight and enthusiasm for our subjects creates an atmosphere of happiness that cultivates learning. Enthusiasm is one of the most underestimated teaching tools at our disposal". Tokuhama-Espinosa (2018, p. 64) expressed a similar view: "Passion (or boredom) for the subject is contagious".

Emotional contagion is not only positive. Threatening teacher demeanour could induce negative emotional contagion resulting in threat and stress. Anxiety has a

detrimental effect on the willingness of learners to explore new ideas and to ask questions. If teachers are perceived as unfriendly and unapproachable or when they display a lack of empathy, they could inhibit the learning process. Even the most curious learners will be stifled if they feel intimidated by their teacher. Eyler (2018, p. 64) gives sound advice to teachers: "Don't be scary!"

Another way in which positive emotional contagion could be provoked is through playfulness. Playfulness is associated with a positive mood state which allows for playful thinking and acting, generating novel patterns of thought and action (Bateson & Marten, 2013). This is exactly what we want in classrooms – learners susceptible to new ways of thinking and doing. Playfulness could be invoked through light-hearted teacher conduct, appropriate use of stories, and humour. Brain breaks (see Chapter 1) could also be used playfully, involving brief playful activities that invoke creativity, surprise and imagination (e.g., singing, dancing, solving a puzzle, playing a game that relates to the learning topic). Such brain breaks help to fight fatigue, boredom, distraction, and inattention (McTighe & Willis, 2019) while simultaneously contributing to a positive mood state.

Emotional contagion also relates to the social nature of the classroom. This implies that emotional responses are often the result of what is happening within the group rather than within the individual. An environment of trust, support and collaboration creates a classroom in which students feel respected and valued (Smith, 2018).

2.2.1.2 Caring and connectedness

Learning is a cognitive, emotional and social process. It involves acting in the world, interacting with others, and experiencing both interpersonal and intrapersonal feedback (Smith, 2018). As human beings, we have the need to feel connected to others (Lang, 2020). Consequently, an emotionally supportive classroom exhibits a sense of community and connectedness, and such connectedness is established through shared values, articulated shared commitments, and through creating a well-ordered and predictable learning environment (Learning Policy Institute & Turnaround for Children, 2021). By collaboratively creating rules and expectations with learners, and reflecting on them regularly, learners are able to build their understanding of behaviour that promotes learning, and how they can contribute to a positive sense of community (Willis & Willis, 2020). All this communicates to learners that they are respected and cared for.

The research on positive emotions and learning reveals that "pedagogical caring" in the classroom leads to more emotional attachment and consequently often higher academic achievement. Pedagogical caring does not imply lowering of standards. How we teach, combined with our behaviours and attitudes, will facilitate the caring relationship. It requires "being present for our students as fellow human beings" and investing ourselves in helping them to succeed (Eyler, 2018, p. 147).

McTighe and Willis (2021) made the point that effective teaching practices and inspired teaching will be hampered if learners feel rejected, fearful or overly stressed. Teachers who care about learning recognise that they must attend to the social and emotional factors that affect learners. They understand that positive teacher-learner relationships can help learners engage, give them the courage to take on academic challenges, regulate their emotions and build social competence (Osher et al., 2020).

Willingham (2021, p. 112) aptly brought the emotional bond with learners together with effective teaching practices:

> The emotional bond between students and teacher – for better or worse – plays a definite role in whether students learn. The brilliantly well-organized teacher whom fourth graders see as mean will not be very effective. But the funny teacher, or the gentle storytelling teacher, whose lessons are poorly organized won't be much good either. Effective teachers have both qualities. They are able to connect personally with students, and they organize the material in a way that makes it interesting and easy to understand.

Thus, good teachers build positive relationships with learners, also through how they teach.

2.3 Teaching variables

Teaching variables that contribute to an emotionally positive learning environment include transparency and significance, learners' perceived capacity to succeed, as well as assessment for learning, accompanied by feedback.

2.3.1 Transparency and significance

Understanding that the brain is an active predictor and that emotions are fundamental to the brain's appraisals (McTighe & Willis, 2019) underscores the importance of transparency and significance for an emotionally positive learning environment. A crucial way to achieve transparency and significance is through the articulation of learning goals, including the purpose of pursuing these goals. Purpose is about addressing the "so what?" question. Why does this matter? Thus, purpose is about significance. Teachers should ask themselves: What meaningful connections can I make so that learners will care about pursuing the learning goal? How can I help learners to see connections, e.g., how the learning goal and its associated content relates to and will enrich what they already know, or how it will form a basis for future learning, or how the learning goal and content relate to real-life events, issues or problems? How can I use authentic learning tasks (see Chapter 6) in service of purpose?

If learners are acquainted with the goals and their significance, their brains know what to focus on and how to predict and direct energy for attention and engagement. Posey (2018, p. 83) linked goal clarity to attention, explaining that attention can be thought of as a sort of spotlight. If the goal and its accompanying purpose is clear and perceived as significant or worthy of pursuit, "the brain is strategic in how it directs its attention spotlight. It will invite curiosity, so that learners might take notice or want to explore more".

Conversely, if the goal is absent or not clear, "attention may be inappropriately focused – more like a wandering searchlight" (Posey, 2018, p. 83). The brain is most likely to apply its resources when it recognises that effort will help to attain a desired goal (Willis & Willis, 2020). In other words, goal clarity and buy-in is critical for learning in order to activate the brain to focus its attention, apply its energy resources, and persist when challenges are encountered (McTighe & Willis, 2019, p. 17).

Transparency about what it will take to achieve the learning goals, including what would serve as evidence of achievement is equally important. This implies that learners should know on what basis and how they will be assessed in relation to the learning goal – thus what the success criteria are. Learners need clarity about exactly what they have to do in order to progress – in other words – clarity on the assessment process and criteria that will be used and why these are appropriate for the learning goal.

Rubrics that make the criteria clear are useful to guide learners about what they need to do to attain the learning goal. This is even more so when the rubric is accompanied by models/exemplars of expected products or performances to make the success criteria found in the rubric tangible (McTighe & Willis, 2019). This is important because it gives learners a sense that success or mastery is within reach if they do the work required. Because the brain seeks to preserve its limited energy resources, it directs its effort based on the probability that the effort expended will result in success/positive outcomes (McTighe & Willis, 2019).

In summary – engagement will be enhanced when the goal and purpose of learning is known to all involved and when learners can see that everything at their disposal converges toward that purpose (Dehaene, 2020, p. 242).

2.3.2 Perceived capacity to succeed

The neuroscience of learning underscores the need for learners to believe that they have the capacity to succeed at learning new things and perform well on associated tasks (McTighe & Willis, 2019).

Willingham (2021, p. 277-278) explain that researchers generally accepted for many years that

> about half of intelligence came from your genes and half from the environment. However, more recent research indicates that the environment is much more important than people had estimated. We also have good evidence that intelligence can be increased and that schooling makes you smarter. That does take hard work, however, and children will be more willing to do this hard work if they know it will pay off, that is, if they believe that they can get smarter.

Here the notion of a fixed vs. a growth mindset comes into play, and it is suggested that learners would benefit from understanding what it would mean to have a "growth mindset".

Research conducted by Dweck (2015; 2017) and her team showed that how learners perceive their abilities, referred to as mindsets, was pivotal in their motivation and achievement. They also found that if learners' mindsets changed – moving from a fixed mindset to a growth mindset – their achievement could improve. Learners who believed that intelligence or abilities could be developed (a growth mindset) outperformed those who believed their talent or intelligence

was fixed (a fixed mindset). Another finding was that having learners focus on the process that leads to learning (such as hard work or trying new strategies) could advance a growth mindset.

Polk (2018) noted that the notions of a fixed and growth mindset are closely related to perceived control (the extent to which you believe that you have control of how much you learn). If you believe that poor performance is a result of fixed abilities (fixed mindset), then you have very little perceived control. Therefore, putting a lot of energy into working hard does not make sense. In fact, learners with a fixed mindset may view the need to put in more effort as a sign of inferior abilities. A growth mindset is more consistent with a high level of perceived control. If you think your abilities can change with effort, then that means you have more control over your performance, so poor performance could spur you on to put in more effort rather than less.

Dweck (2015) warned against misconceptions about the mindset concept. She explained that a growth mindset should not simply be equated with effort. Effort is crucial for achievement, but there is more involved in this pursuit, such as learners seeking input and feedback from others when they are stuck, acting on the input or feedback which may involve trying new appropriate strategies/approaches to make progress. She reminded us that effort is a means to an end to the goal of learning and improving, while praise given for effort instead of learning is not useful. When learners struggle, teachers can appreciate and acknowledge their effort, but add: "Let's discuss what you've tried, and what you can try next."

Dweck (2015) also expressed concern that the growth mindset concept is used by some to perpetuate the failed self-esteem movement which is about making learners feeling good by praising them even when they are not learning. Achievement should be assessed truthfully. This implies that progress as well as learning gaps should be acknowledged, and then, based on constructive feedback and scaffolding, the teacher and learner work together to help him or her achieve better.

Dehaene (2020) emphasised that holding the view that anyone has the potential to progress is, in itself, a source of progress. Conversely, those who are of the view that intelligence is fixed (one is either gifted or not) tend to perform worse. Such a fixed mindset is demotivating because "it encourages neither attention nor active engagement, and it interprets errors as markers of intrinsic inferiority" (p. 213).

Teachers and learners need to understand that making mistakes is the most natural way to learn (Dehaene 2020). Every error offers an opportunity to learn. He explained that to update their mental models, our brain areas must exchange error messages. "Error is therefore the very condition of learning" (p. 200). Errors that learners make must be corrected quickly through detailed, stress-free feedback. The latter point is crucial: while error feedback is essential, many learners lose confidence and curiosity because their errors are punished rather than corrected.

Teachers can play a pivotal role in influencing learners' perceptions of their ability to learn. There are three primary ways:

Explain to learners the notion of growth mindset and that intelligence is not fixed, but incremental and malleable. Also, helping learners to understand how learning works, will increase their agency. Some fundamental ideas about learning could be communicated to even very young learners. Some of these ideas are (Brown et al., 2014):

- Learning is not easy and experiencing difficulties and failures is part of the learning process. In fact, some difficulties during learning help to make the learning stronger. Thus, it is important to persist when one is experiencing such difficulties. Striving to improve often results in setbacks. Setbacks should not lead to discouragement, because setbacks often provide the essential information on what the learning gaps are that should be addressed to make progress and how to adjust strategies to address these gaps and to achieve mastery.
- Failure is a natural part of learning. Making mistakes is neither scary nor bad because you can learn from the mistakes. (This of course implies that teachers need to make the classroom a safe space so that learners will feel protected to take the risks that may result in failing.)
- Not all of our intellectual abilities are "fixed". In fact, when learning is effortful, it changes the brain. The brain makes new connections, and this increases one's intellectual ability (the notion of brain plasticity).
- You often learn better when you wrestle with new problems before being shown the solution, rather than the other way around. The "wrestling" opens you up for the new learning.

Use assessment for learning tasks accompanied by specific, supportive and explanatory feedback to help learners get a sense of their progress and to identify learning gaps. It is important for learners and the teacher alike to diagnose progress relative to learning goals. This could be done by using ongoing assessment for learning. The purpose of engaging learners in assessment for learning tasks is to assess understanding, provide immediate feedback to improve learning, have learners help each other to learn, and develop learners' ability to monitor and assess their own learning. Thus, it enables the teacher and learners to become aware of learning gaps and to take appropriate action to close the gaps. Using open-ended questions is useful in this regard (see Chapter 3).

Assessment for learning should always involve feedback about the quality of the learners' work or the rate of learning progress with specific advice on what needs to be done in order to improve – what the next steps are and how to take them. The quality and accuracy of the feedback we receive determines how quickly we learn (Dehaene, 2020).

Track, highlight and celebrate learning progress and achievement. Learners should be helped to track their incremental progress toward learning goals. This can be done by breaking complex tasks into smaller, achievable chunks that could serve as milestones of progress and by highlighting the progress results achieved because of the learners' efforts. Tracking achievement links to assessment for learning as discussed above. It implies that learners receive continuous feedback on learning gains and learning gaps accompanied by scaffolds (cues, strategies, and tips) (McTighe & Willis, 2019).

Highlighting and celebrating progress and achievement could serve to reinforce a growth mindset:

> When learners have repeated experiences in recognizing that their focused efforts can result in progress and learning achievements, they would be willing to tackle – and persevere through – more challenging learning tasks, seek and accept corrective feedback, and be willing to make needed revisions or practise more diligently (McTighe & Willis, p. 154).

Summary

Evidence from recent advances in neuroscience show unequivocally that emotion is integral to learning, attention, memory and decision making. The title of an article by Immordino-Yang and Damasio (2011, p. 188), captured this well: 'We feel, therefore we learn'. The authors explained in the article that emotion-related processes act as a rudder to guide judgement and action.

This chapter explored the implications of an understanding that emotions are fundamental to learning for creating significant learning experiences for learners. The core idea of the chapter is that teachers are tasked with the imperative to create an emotionally positive learning environment in their classrooms.

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Questions to think about

1. A colleague saw you reading this chapter and wants to know what it means to create an emotionally positive learning environment and why a chapter in a book about teaching is devoted to this. What would you say to the colleague?
2. What would the relevance of creating an emotionally positive learning environment be for teaching dialogically (Chapter 3)?
3. Based on what you learnt from this chapter, what should you do as a teacher to elicit learners' positive emotions and communicate to them that you care for them as learners and human beings?

Chapter 3

Lesson design for teaching through dialogue, drawing on the science of learning

Dean van der Merwe

Introduction

Sir Winston Churchill said, "He who fails to plan is planning to fail". This is especially true for teachers. Teaching is complex and teachers must make informed decisions about the lessons they design and teach. According to Kilpatrick, Swafford and Findell (2001, p. 337), "teaching requires a considerable effort at design". Teachers are required to design and teach lessons daily – and there are many ways to design lessons. Regardless of the approach to lesson design, planning out the details of lessons in advance is essential.

Teachers' decisions during the design of a lesson can influence how well learners learn (Superfine, 2008). Traditionally, teachers use written or typed lesson plans to document the designing of lessons. A written lesson plan can be a useful way of enabling judgement whether a lesson has been designed in a way that will facilitate learning. It unpacks the formulation of learning objectives, as well as the design of learning activities to achieve the objectives (Cameron & Campbell, 2013).

Many teachers refer to lesson design as *lesson planning*. While there is nothing wrong with the term lesson planning, we prefer the term *design* because we believe it captures what is expected of a good teacher more accurately than *plan*. The term *design* invokes meanings such as deliberate and purposive planning, involving reasoned choices, and being able to provide a rationale for the choices (Gravett, Lang & Van der Merwe, 2022).

To plan coherent and cohesive lessons teachers must know all the important considerations to keep in mind. Novice teachers, in particular, must learn to make the thinking that underlies their teaching actions explicit. With more experience, it may no longer be necessary to attend to all the detail that lesson design requires because the requirements of good lessons will have become part of a teacher's thinking.

There are no recipes on how best to design lessons. According to Claxton (2021, p. 183), "[b]ecause classrooms and schools are full of human beings, it is usually hard, and often impossible in principle, to distil out simple recipes for 'what works' or 'best practice'".

This chapter explores one approach to lesson design: lesson design for teaching through dialogue. I will explore how to design lessons using inquiry as a central organising principle, as well as why this is important, particularly in approaching teaching as a learning-centred dialogue. This chapter draws on several principles derived from the science of learning literature to support the rationale for using this approach to design lessons.

3.1 Why inquiry?

In this book, teaching is conceptualised as creating an environment that is conducive to learning. In Chapters 1 and 2, you learnt that this could be done by creating an environment that harnesses positive emotions and uses engaging and varied learning tasks that prompt learners to act on the learning content. An important way of engaging learners is through inquiry.

According to Goodman and Berntson (2000), there is no single definition of inquiry-based learning. However, they argue that inquiry-based learning consists of questions being used "as a vehicle for students to explore and learn about a given topic" (Goodman & Berntson, 2000, p. 474). Similarly, Kawalkar and Vijapurkar (2013, p. 2004) argued that inquiry could be conceptualised as "question-driven learning". Inquiry thus implies using carefully selected higher-order or open-ended questions as the basis of learning tasks.

Why is inquiry, and by implication using questions, powerful as a core teaching practice? The short answer is that inquiry is important for guiding and supporting deeper learning and relates to all the principles and implications for classroom practice that are explored in Chapter 1.

Inquiry can foster and sustain cognitive engagement. We saw the role that cognitive engagement (thinking) plays in learning in Chapter 1. Open-ended questions (that form the basis of inquiry) challenge learners to think deeply about the learning material (Behrenbruch, 2012). In other words, inquiry-based learning continually "challenges as well as supports students' thinking" (Kawalkar

& Vijapurkar, 2013, p. 2007). Encouraging learners to answer questions allows them to articulate what they are *thinking*.

3.2 Teaching through dialogue

According to Kawalkar and Vijapurkar (2013, p. 2007), teachers who use inquiry-based learning tasks use "questions to continually challenge as well as support students' thinking and progressively build on students' responses". Kidman and Casinder (2017, p. 80) argued that "questions are a key component of a natural conversation and challenge the views of those conversing" thus, open-ended or higher-order questions can also be used to foster and sustain learning-focused conversations (dialogue) in the classroom. This was also the view of Kawalkar and Vijapurkar (2013), who argued that teachers use questioning to facilitate dialogues aimed at conceptual understanding of the subject matter in inquiry-oriented classrooms.

3.3 What is dialogic teaching?

According to Alexander (2020, p. 1), using learning-focused dialogues in the classroom harnesses "the power of talk" to engage learners' interest, stimulate their thinking and advance their understanding of the subject matter. In addition, learning-focused dialogues help learners expand on ideas and build and evaluate arguments. Similarly, Šeďová et al. (2020, p. 12) argued that dialogic teaching "is a style of teaching utilizing a connection between thinking and speech and aiming, through talk, to influence student thinking and understanding". According to Šeďová et al. (2020, p. 1), there is a strong connection between speech and thought, and engaging learners in classroom talk "positively affects their learning outcomes".

Gravett (2005, p. 41) noted that the core of dialogic teaching is learning-focused dialogues, which are marked by "an attitude of reciprocity among participants, underpinned by the interest, trust, respect and concern they share for one another". The tone of learning-focused dialogues is exploratory with the purpose to "break through to, examine and validate new insights" relating to the learning material. She added that learning-focused dialogues implies "cooperative and reciprocal inquiry through questions, responses, comments, reflective observations, redirections and building statements."

3.4 Teaching through dialogue, drawing on the science of learning

In Chapter 1, principles derived from the science of learning literature is explored. The implications of the principles point to approaching teaching as a learning-focused dialogue with learners. In the following sections, some principles are used as examples to support the rationale for teaching through dialogue.

3.4.1 Using dialogue to elicit learners' prior knowledge

We saw in Chapter 1 that for learners to remember what they learn, they must relate the content they are learning to their prior knowledge in a meaningful way. Therefore, for meaningful learning to occur, learners need relevant prior knowledge. Ambrose et al. (2010, p. 5) argued that when learners "can connect what they are learning to accurate and relevant prior knowledge, they learn and retain more. In essence, new knowledge 'sticks' better when it has prior knowledge to stick to". This implies that teachers have to find ways of establishing what learners already know about the new content they will teach (Kirschner & Hendrick, 2020). If learners' prior knowledge is flawed (contains gaps, is inaccurate, contains misconceptions, etc.), teachers must first address these (Darling-Hammond, Flook et al., 2019).

Teachers need to determine what learners know and think, and then teach accordingly. How does one elicit learners' prior knowledge? One way is to ask an open-ended or higher-order question or to use a learning task with an open-ended or higher-order question at its core. Open-ended questions form the backbone of teaching through dialogue. Although using open-ended or higher-order questions is emphasised here, closed questions also have a role to play. For example, closed questions are often used when you use a quiz to gauge learners' prior knowledge.

3.4.2 Using dialogue to focus learners' attention and activate hard thinking

Attention refers to our ability to filter and select the information we perceive through our senses (seeing, hearing, smelling, etc.). When we choose to focus on specific incoming information, we can process it. Think about the environment you are currently in – you are likely paying attention to reading this – but did you notice any sounds around you? Perhaps you can hear the sound of cars driving

in the distance or birds chirping outside. If you were paying close attention and thinking deeply about what you were reading, you likely did not notice any sounds. However, when you were asked to think about your environment and the sounds that may be around you, you likely noticed a few sounds – so, the focus of your attention shifted (even momentarily) from what you were reading to the sounds in your environment.

For learning to happen in classrooms, learners need to pay attention to the most important or relevant aspect that teachers want them to learn. A learner can only process the information they are paying attention to, in other words, only when a learner pays attention to something, can they start processing it in their working memory. Thus, when designing lessons, you need to consider how to elicit learners' attention and what each lesson will make learners think about, and explicitly draw their attention to this.

One way to explicitly draw learners' attention to what you want them to think about during a lesson is by using carefully selected open-ended questions. Asking open-ended or higher-order questions during a learning-focused dialogue can effectively draw learners' attention to the main aspects you want them to learn, as well as engage them in hard thinking. According to McTighe and Wiggins (2013, p. 3), open-ended or higher-order questions, can be used to "stimulate thought, to provoke inquiry, and to spark more questions". When learners are required to respond to open-ended or higher-order questions, they get the opportunity to articulate their thinking. Another way to draw learners' attention to the main aspects you want them to think about during a lesson is to use learning tasks or activities that have an open-ended or higher-order question at their core.

Learning tasks or activities should require learners to focus on the meaning of the content. It is useful to design tasks and activities that require learners to attempt to solve a problem (either individually or in groups – see Section 3.7.6), followed by talking about their thinking processes (Gravett, 2022). In addition, provocative questions (see Section 3.5) can be used throughout the lesson to stimulate curiosity and engage learners in effortful (hard) thinking (Gravett, 2022).

3.4.3 Using dialogue to elicit and sustain learners' curiosity

Dialogue can be used in the classroom to elicit and sustain learners' curiosity. We saw in Chapter 1 that *getting and keeping learners curious is one of the key factors*

for successful education. According to Kidman and Casinader (2017), the teacher should stimulate learners' curiosity about the content for teaching to be effective. Goodman and Berntson (2000) argued that learners' curiosity about a topic could be elicited through teaching that foregrounds inquiry and dialogue. This was also Cassinelli's (2018, p. 17) view, who argued that "curiosity fuels students' passion to make connections with topics that are meaningful and real". She argues that being curious means being aware that there is an "information gap between what we know and what we don't know" (Cassinelli, 2018, p. 17).

Engaging learners in deep thinking and inquiry by asking thought-provoking questions during a learning-focused dialogue could spark their curiosity and make them aware of the gap between what they know and do not know. Questions that are "open, provocative, arguable, reflective in nature, and have no simple, singular answer" can elicit and sustain learners' curiosity during lessons (Cassinelli, 2018, p. 59).

3.4.4 Using dialogue to assist learners with their limited working memory capacity

Working memory is the "space" in which learners keep information in their mind so as to process it (Deans for Impact, 2015; Kirschner & Hendrick, 2020). Once the information has been meaningfully processed, it is more likely to be stored in long-term memory, where it can be retrieved for later use. As we saw in Chapter 1, there is a catch, however. Our working memory is limited and being presented with too much information at once swamps or overwhelms our working memory (Rosenshine, 2012; Deans for Impact, 2015). If learners are presented with more information than they can process, some information will inevitably get lost.

To optimise learning, teachers need to reduce unnecessary distractions during lessons, help learners pay attention to the main aspects they want them to learn, and ensure that they do not overload learners' working memories (Darling-Hammond, Oakes et al., 2019). One way in which teachers can assist learners with their limited working memory capacities is by presenting learning material (content) in steps (chunks) that are interspersed with assessment for learning tasks (Willingham, 2009; Rosenshine, 2012; Deans for Impact, 2015). Approaching teaching as a learning-focused dialogue would entail a teacher introducing new learning content in small chunks and designing and using learning tasks that engage learners in answering open-ended or higher-order questions based

on the content. This approach would also enable a teacher to slow down when dealing with complicated learning content and "regularly use assessment for learning tasks to gauge understanding" (Gravett, 2022, p. 15).

Another way teachers can assist learners with the limitations of their working memory is by helping learners to practise essential aspects of the learning content. For learners to become proficient or fluent at a task or skill, they need many opportunities for practise (Willingham, 2009; Weinstein et al., 2018; Coe et al., 2020). Ambrose et al. (2010, p. 125) defined practise as an activity "in which students engage their knowledge or skills". Ambrose et al. (2010, p. 6) argued that learning is fostered when practise opportunities focus "on a specific goal or criterion [target], an appropriate level of challenge, and [are] of sufficient quantity and frequency to meet the performance criteria".

If learners have sufficient and varied opportunities to practise new material, they will likely "store this material in their long-term memory", making it easier to "retrieve this material" at a later stage (if and when they need to use it) (Rosenshine, 2012, p. 16). One way to get learners to practise is through a learning-focused dialogue. Responding to open-ended or higher-order questions the teacher requires learners to verbalise or articulate thinking (either verbally or in writing). Verbalising thinking is a form of practise. This is important for learning because as learners talk about their thinking (reasoning), it sharpens their thinking, and helps them (and the teacher) realise what they understand (and don't understand).

3.4.5 Using dialogue to engage learners in metacognition

Metacognition is essential for learning; however, few learners engage in metacognitive processes naturally (Ambrose et al., 2010; Deans for Impact, 2015). Metacognition, in simple terms, means "thinking about your thinking". Schneider and Stern (2010) argued that learners who do not use metacognition practices/skills would not be able to notice inconsistencies in their knowledge base. Metacognitive skills therefore need to be foregrounded in the teaching of subjects (Scott, 2015; Bialik & Fadel, 2015). According to Ambrose et al. (2010, pp. 6-7), teachers should create opportunities for learners to engage in metacognitive processes, which allow learners to "monitor and control their learning" through "assessing the task at hand, evaluating their own strengths and weaknesses, planning their approach, applying and monitoring various strategies, and reflecting on the degree to which their current approach is working".

As discussed in the previous section, responding to open-ended or higher-order questions during a learning-focused dialogue can enable learners to realise what they don't understand. Asking well-thought-out open or higher-order questions can also enable learners to predict their performance on various tasks and monitor their level of understanding.

3.5 The importance of questioning and types of questions

By now, we hope you would have realised that questioning plays an essential role in lessons, especially in inquiry-oriented lessons that approach teaching as a learning-centred dialogue. The importance of questioning cannot be overstated; however, the ability to use questions effectively does not come naturally to every teacher. Questioning is extremely complex (Roth, 1996).

Using questions has a long tradition in teaching and learning (Stokhof, 2018). According to Tofade, Elsner and Haines (2013, p. 1), "[u]sing questions to teach is an age-old practice and has been the cornerstone of education for centuries"; however, "the art of asking the right questions at the appropriate time is not innate".

Research suggests that poor questions can stifle learning and confuse learners (Tofade, Elsner & Haines, 2013). Yet, when used effectively, questions can support more open forms of classroom dialogue. Therefore, it is important to ask the right questions at the right time. This implies that teachers have to be intentional in formulating questions that are fit for purpose.

To be intentional about the types of questions you ask, you need to understand the different types of questions and their purpose. There are many types of questions, and this chapter cannot deal with all of them. However, a brief summary of some of the most frequently used question types follow:

- Hook questions are provocative and thought-provoking and "seek to bring minds to life" (McTighe & Wiggins, 2013, p. 19).
- Reflective questions require learners to reflect on the meaning of learning content. In other words – to think deeply about how they understand the content, whether previously learnt or new content (also see Appendix 2).
- Diagnostic questions elicit prior knowledge and determine learners' level of understanding before teaching them the new content.

- Probing questions are useful for probing further into learners' thinking or understanding.
- Clarification and elaboration questions following learner responses on a task would flow from the learner responses.

It is important to note that no matter what type of question is asked, the question should be of a higher order to elicit deeper thinking about the subject matter (Tofade, Elsner & Haines, 2013).

3.6 How to use questions

Planning to use questions effectively is a complex process. According to Fusco (2012, p. 39), lesson planning (design) and the effective use of questions go hand in hand:

> Good lesson planning is the key to good questions and instructional practice. The teacher builds the lesson starting with an awareness of how the lesson fits into the overall unit. From the goals and objectives, the teacher frames the essential questions that structure the class's exploration of the topic. Next, the teacher thinks about the students' prior knowledge, background, cognitive abilities, and the support that may be needed to help students reach the desired objectives. Finally, the teacher plans guiding questions to direct the discussion and extend students' thinking.

Here are some things to consider when you are planning to use questions:

- Avoid asking too many questions. According to Fusco (2012, p. 25), teachers should focus on asking fewer questions that are designed to elicit thinking about the learning material purposefully.
- Plan core (guiding) questions in advance.
- Plan to give learners time to think before calling on them to answer a question. Fusco (2012, p. 61) argued that learners' responses improve when teachers "allow for as little as 3 to 5 seconds of wait time" after asking a question.
- Plan how you will involve all the learners in answering questions. One way is by asking the whole class, "Who agrees or disagrees with this answer – raise your hands?", and then asking individuals or groups to explain why they agree or disagree.

- Plan how to deal with wrong answers. If a learner gives a wrong answer, elicit answers from several learners and use their responses as a way to offer alternative explanations or summarise why a specific answer is correct.

3.6.1 Getting learners to ask questions

Traditionally, teachers ask questions in the classroom and learners are mainly expected to provide answers (Kitagawa, 1982; Stokhof, 2018). However, research has shown many benefits to getting learners to ask questions. According to Fusco (2012), learners become more inquiry-oriented when they hear and ask good questions. Questions generated by learners can also reveal what they know and understand and highlight any misconceptions they may have. Stokhof (2018) noted that learner-generated questions can foster intrinsic motivation and curiosity and require the learners' conscious effort to identify gaps in their knowledge. Despite the educational advantages of getting learners to ask questions, most teachers do not utilise the potential of learner-generated questions (Stokhof, 2018).

Teachers can prompt learners to produce questions through various instructional strategies such as through exploring and discussing texts that require learners to formulate questions about the text, and engaging learners in experiments or problem-solving tasks which form the basis for generating questions (Stokhof, 2018). At the start of a lesson, the teacher can ask learners to generate questions about the topic and these questions could be used as an entry point into the lesson and the teacher could address them during the lesson (Gravett, 2022). The teacher can also ask learners to generate questions they can ask their peers during peer or group learning activities. After involving learners in the teaching of the new content, the teacher can ask learners to state questions they may still have about the content, in other words, what they are still curious about.

3.7 The lesson design approach

The way we conceptualise putting inquiry into practice when it comes to designing lessons is via carefully planned and sequencing of questions as part of learning tasks for learners. In other words, every lesson should be approached as a learning-focused dialogue. Refer to Figure 3.1 for the possible flow of a lesson.

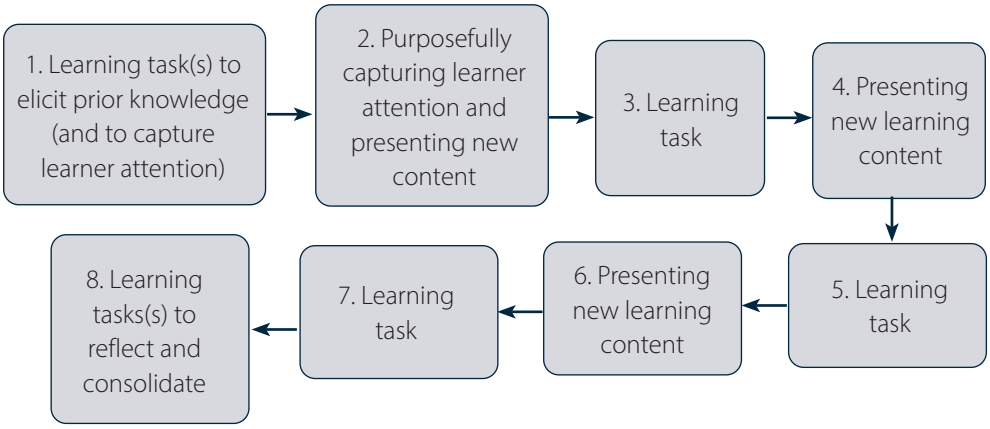

Figure 3.1 The possible flow of a lesson

3.7.1 Consider the key question

When designing a lesson, you need to consider the key question (guiding question) that the lesson will address and plan your lesson around this question. It is important to start with what learners should be able to do or know by the end of the lesson and make this explicit to learners, phrased as the key question (Gravett, 2022). Phrasing this as a question could contribute to eliciting curiosity and an inquiring attitude. The lesson then provides an answer to the key question. In other words, learners should be able to "answer" the key question after engaging in the lesson. It is important to phrase the key question so that it has the right level of difficulty to engage the learners and to stretch them while respecting their cognitive limitations. An example of a key question for a lesson on recycling could be "Why is it important to recycle waste material and how can waste material be recycled?"

3.7.2 Write down the lesson's aims and objectives

The aim of the lesson should relate directly to the key question. Ask yourself "What do I aim to achieve by teaching this lesson?". For example, "The aim of the lesson is to teach learners why it is important to recycle waste material and how waste material can be recycled." Objectives describe learners' possible performance so that their learning is observable and measurable throughout the lesson. According to De Beer and Gravett (2014, p. 119), objectives should be SMART: "specific, measurable, attainable, realistic and time-appropriate".

Objectives are useful to help you determine if your aim has been achieved. For example, "Learners should be able to describe why it is important to recycle waste material".

3.7.3 Eliciting learners' prior knowledge and introducing the lesson

It is vital to elicit learners' prior knowledge at the start of every lesson. The teacher must create the opportunity for learners to voice their existing knowledge so that misconceptions (if any) can be addressed, and you can build on the learners' existing views and understandings. Think about lessons you have taught in the past, or may have observed: Was learners' prior knowledge elicited?

One way in which learners' prior knowledge could be elicited in the introduction phase of a lesson is by starting the lesson with questions that require retrieval of prior knowledge. It is important to make sure that the questions are relevant to the content that will be covered in the lesson. It is equally important to make sure that all learners are involved in answering the questions. The questions or activities used to elicit learners' prior knowledge should allow learners to retrieve the knowledge from their memory. This allows the knowledge to become active in their minds, making it possible to "build" on their prior knowledge.

The following are examples of questions that could be used to elicit and build on prior knowledge:

- Today's lesson addresses or is about the question XXX. What have you learned before, that will be useful for the lesson today? Why is it useful?
- In today's lesson, we'll try to answer the question XXX. What examples can you give of XXX?
- Today we are going to solve a problem related to XXX. What problem have we solved before that is similar to this one? How are they the same? How are they different?
- I am going to show you a short video that relates to the focus of today's lesson. While watching the video, focus on finding answers to the following two questions: XXX.
- I am going to show you a few pictures that relate to today's lesson. Study the pictures carefully and think about or write down what you think the question is that we are going to explore today. Why do you say so?

3.7.4 Presenting the new content

Learning material (new content) needs to be introduced in steps (chunks) that are interspersed with learning tasks. Remember that carefully selected higher-order or open-ended questions should form the basis of learning tasks – see Section 3.4.4. It is important to slow down when dealing with complicated information and to use multiple modalities (e.g., pictures or graphic representations that illustrate your oral explanations) and concrete examples when teaching the new content.

Throughout the lesson, it is vital to persistently capture and channel learners' attention and to focus their attention on the core content that you want them to learn. If you do not explicitly draw learners' attention to what it is to be learned, there is a risk they will be distracted by other things. Using questions that focus learners' thinking (cognitive engagement) is an excellent way to do that.

The following are some examples of questions that can be used to focus attention and foster cognitive engagement:

- Why are you thinking or assuming that …?
- Why does that answer make sense to you? / Why does that answer not make sense to you?
- Why do you believe that …?
- Why do you agree or disagree?
- How can we find out more about …?
- How would it look differently if …?
- How do you know …?
- How did you come up with the idea of …?
- What would change if …?
- What would happen if …?
- What would it be like if …?
- What was most surprising to you about …?

3.7.5 Consolidating the lesson

Tying the lesson's introduction, body, and conclusion together is important. Learners should see the link between what was done throughout the lesson and

get the overall 'big picture' of what was taught. One way to do this is by asking learners how what they have learned relates to their own lives. Another way is by asking open-ended questions requiring learners to summarise the key ideas in the lesson (Gravett, 2022). During the consolidation phase of a lesson, many teachers like to give learners time to practise what they have learned. This usually takes place in the form of an activity or task that has an open-ended or higher-order question at its core. It is important to provide instructive or actionable feedback on the tasks that learners complete for them to learn from the feedback.

3.7.6 Group learning

Throughout each lesson phase, you may consider using group learning tasks. During group learning tasks, learners typically work together in groups of three to six, though larger groups run the risk that not all learners will participate. Several studies have found that purposeful group learning tasks can have a positive impact on learning (Chiriac & Frykedal, 2011; Baines et al., 2009). Frykedal and Chiriac (2012, p. 3), for example, found that when learners engage in group learning tasks, they "inquire, share ideas, clarify differences and construct new understandings". When engaging in group learning tasks, learners verbalise their thinking and listen to each other's responses, which can help them gain knowledge about the content.

According to Gravett (2005, p. 51), group learning has many advantages, if planned well, such as: affording learners the opportunity to express their problems or misunderstandings in a non-threatening environment; enabling learners to verbalise their thoughts and learn from their peers; developing social and interpersonal skills; and also, problems may become more manageable when tackled as a group. Despite evidence that group learning can positively impact learning, many teachers are reluctant to use group learning tasks because they do not know how to use group work effectively.

According to Chiriac and Frykedal (2011), group learning tasks should have a clearly defined goal or purpose and learners should work cooperatively or collaboratively to solve a problem or reach the goal. This can be achieved by ensuring that group learning tasks have open-ended or higher-order questions that learners need to work collaboratively toward answering. Gravett (2005) suggested the following guidelines for using group learning tasks: Group learning tasks should always serve a well-defined purpose; learners should be given explicit instructions and

an indication of how much time they have for the group activity; the teacher must monitor the groups; and groups should have the opportunity to share their results with the rest of the class.

During the introduction phase, you may use a group learning task to elicit learners' prior knowledge about the topic. This can be done by grouping learners and asking them to discuss an open-ended question in relation to the topic. When engaging learners with the new content, you may use group learning tasks that require learners to work together to solve a problem or practise important skills (based on an open-ended or higher-order question). Learners could also be asked to summarise their learning in groups, based on an open question, at the end of a lesson (See Appendix 2).

Summary

This chapter explored an approach to lesson design that foregrounds teaching through dialogue. To support the rationale for using this approach to design lessons, we drew on some principles derived from the science of learning. We also explored inquiry as a central organising principle and why this is important, particularly in approaching teaching as a learning-centred dialogue.

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Questions to think about

1. Other chapters in the book focus on the importance of developing learners' "Competencies for a fast-changing world". How can you use inquiry to develop learners' competencies for a fast-changing world?
2. Based on your answer above, how can the lesson design approach you learned about in this chapter be adapted to include the development of competencies for a fast-changing world?
3. In Chapter 6, we see that project-based teaching and learning (PBTL) is a pedagogy that can assist in preparing learners for the fast-changing world. How can you apply what you have learned in this chapter to PBTL?

Chapter 4

Play and playfulness for teaching and learning

Lerato Ndabezitha

Introduction

Why a focus on play and playfulness for teaching and learning? Surely, play is something for children, you may think, far removed from teaching and learning.

This chapter shows that playfulness contributes to creating an environment conducive to learning (see Chapter 2). It also shows teaching that purposefully invokes play involves active (cognitive) engagement (minds-on) of learners, and emphasises meaning, social interaction, iteration, and joy. These aspects align with the science of learning literature on features that comprise optimal learning environments (Zosh et al., 2017) and are applicable to learners of all ages (Parker, Thomsen & Berry, 2022). Play can successfully be used for learning and teaching, regardless of the age of learners.

The chapter starts by defining play, playfulness and playful learning. Thereafter, it discusses the notion of playfulness in teaching, followed by a look at the conceptualisation of play as a spectrum and the characteristics inherent to play. The benefits and types of play that are described in the literature are discussed, and finally, the focus shifts to guided play and its practices.

4.1 Play, playfulness, and playful learning in the field of education

The concept of play has been a topic of interest for education researchers for decades (Whitehead et al., 2017; Yogman et al., 2018). Various definitions and characteristics of play have been presented and contested. In this section, the concepts of play, playfulness, and playful learning are clarified as they relate to the field of education.

Everyone recognises play when they see it in the streets, villages, on playgrounds, and in classrooms. This is because people from every culture and economic background engage in play. However, how play is conceived is complex, with no unified definition thereof (Whitebread et al., 2017; Whitebread et al., 2012;

Wood, 2014). In the play literature, there are many definitions, characteristics, and categories of play, making it difficult to arrive at one clear-cut definition. The following are aspects that are common to many definitions found in the literature. These are that play is a pleasurable, spontaneous, non-goal-directed activity that can include anticipation, flow, and surprise (Barnett & Owens, 2015; Eberle, 2014; Gray, 2015; Hirsh-Pasek et al., 2009).

Playfulness is recognised by many as the essence or spirit of play, though it is not always the case (Whitton & Moseley, 2019) as is noted below.

Playful learning is an overarching term that includes free play and guided play (Hirsh-Pasek et al., 2020). Mardell et al. (2016) regard delight, wonder, and choice as indicators of playful learning.

4.1.1 Invoking playfulness in teaching

The differentiation between playfulness and play as stated by Whitton & Moseley (2019, p. 14) is quite useful:

> Play is an activity, hard to define definitively … but generally described as an activity that is voluntary, open-ended and engaged in for its own sake, for which the key reason for playing is the enjoyment of the play activity itself. On the other hand, playfulness is a *state of mind or an attitude*; a willingness to accept and embrace the constraints of a play activity, or indeed any activity; to try something new; to attempt something difficult where success is not guaranteed. Playfulness is an approach that embraces whimsy, the spirit of the carnival, creativity, humour, surprise and imagination. While play activities are commonly approached playfully, this is not always the case; take, for example, the solemnity and ritual in high-level chess. Likewise, playfulness is not limited to play our games but is a state of mind that a person can apply to any activity."

Simply put, the difference between play and playfulness is that playfulness is an attitude — a state of mind that encompasses joy and other positive emotions towards an activity. Play is a voluntary activity with the aim of enjoying the activity itself.

Playfulness applies to young learners, older learners, and teachers (Bruno et al., 2013). James and Brookfield (2014) related playfulness in teaching to "humor,

light-heartedness, and openness of the curious inquirer". So, how is playfulness relevant to teaching and learning?

The answer lies in the connectedness of cognition and emotion. Learning is not a purely cognitive activity, but also involves emotion (Tyng et al., 2017). For example, you are less likely to engage in learning if you experience negative emotions, such as fearing the teacher and not feeling safe. However, if you experience positive emotions, you are more likely to engage and learn, because positive emotions are usually associated with interest and motivation (see Chapter 2). Learners who experience positive emotions are inspired to ask questions and explore possibilities. This is important for them to reach their full potential (Zosh et al., 2017).

Think back to when you were a primary or secondary school learner. How did it make you feel to be in a class where you were afraid of the teacher? Were you able to learn well? On the other hand, how was your learning influenced when you felt relaxed because the teacher created an environment in which you experienced interest and joy? A playful learning environment could contribute significantly to support learning (Vincent-Snow & Tong, 2019) because it is invitational. It invites joyful and flexible classroom interactions, exploration, and creativity (Pinchover, 2017).

Using playfulness in teaching is not only valuable for the learners. It is a two-way street. As noted above, the learners benefit, but the teacher also benefits from using playfulness in teaching. You may be thinking: what value is there for a teacher? Adopting playfulness supports teachers' well-being because it promotes happiness, work satisfaction, and creativity (Proyer, 2017). In essence, playfulness in teaching offers the teacher and learners the opportunity to experience a positive learning environment (Walsh et al., 2017). This type of positivity in the classroom encourages and nurtures healthy and strong relationships between the teacher and the learner.

4.2 Defining play as a spectrum

According to Zosh et al. (2018), defining play on a spectrum recognises different forms of play. Figure 4.1 below is an adaptation of the playful spectrum put forward by Zosh et al. (2018). It explains the different forms of play through the differentiated involvement of the main role-players in play activities. During free

play, the child is fully self-directed, while in guided play, self-direction of the child/learner is balanced with the guidance of an adult/more knowledgeable person. In games and direct instruction, the adult/more knowledgeable person designs and sets rules and constraints for the activity. Zosh et al. (2018) placed direct instruction outside the spectrum of playful learning. However, I argue that direct instruction could invoke and include playfulness.

The main focus of this chapter is guided play as a form of *playful* learning.

Figure 4.1: Play spectrum (adapted from Zosh et al., 2018)

4.2.1 Characteristics of play in relation to learning

This chapter addresses the characteristics of play as put forward by Zosh et al. (2017) as these characteristics correspond with research on the science of learning discussed in Chapter 1. Play advocates, such as Zosh et al. (2018), argue that guided play particularly harnesses active, minds-on thinking (not passive), engagement, meaning-making, joy, and iteration more than other forms of play, which helps to maximise learning.

Some play characteristics in relation to how humans learn will be highlighted. When applicable, the implications for guided play will be referred to, although guided play is explored in more detail in Section 4.4.

4.2.1.1 Active engagement

Active engagement here refers to active mental activity or thinking. It is about being "minds-on". This implies that learning tasks used in guided play should inspire learners to explore, think, and actively look for solutions to problems or questions inherent to the learning task. Active engagement could also involve physical engagement, but if learners are not also engaged mentally, they may learn very little. The challenge is to keep learners in minds-on mode as that is crucial for learning. In order to be successful in this, eliciting and harnessing learner curiosity is vital. Studies (Gruber & Fandakova, 2021; Wade & Kidd, 2019) have shown that when learners are curious about a concept, they are more likely to recall what they have learned (Chapter 2 offers more detail about curiosity and learning).

Ultimately, active engagement will result in a more profound, conceptual understanding of knowledge and experience. This is best supported by combining exploration by learners (thereby respecting learner self-directedness) with teacher guidance and scaffolding (Hirsh-Pasek et al., 2020; Zosh et al., 2017; Zosh et al., 2018).

4.2.1.2 Meaningful learning

For learning to be meaningful, it should go beyond facts and lead to deeper thinking that can be transferred to new situations (Hirsh-Pasek, et al., 2020; Zosh et al., 2017; Zosh et al., 2018). For example, there is a difference between memorising that a circle has no sides versus understanding that a wheel of a bicycle and a coin in the real world resemble circles. A core aspect of meaningful learning is about finding meaning in an experience. That implies that learning experiences must be relevant to learners' lives. Also, finding meaning in an experience is about connecting it to something you already know. Play activities usually relate to themes and objectives pertinent to learners' lives. In this way, playful learning experiences allow learners to experience meaningful learning. Through appropriate playful learning experiences, learners tap into their existing knowledge, and they are inspired to make connections, see relationships, and understand their complex world.

4.2.1.3 Social interaction

Social interaction is a powerful context for both learning and play. By sharing their thinking and understanding with others, and communicating ideas, learners can enjoy being with others and build deeper understandings and robust relationships. Playing with others also adds social meaning to the activity, making it enjoyable, and it could support appreciation of diversity (Zosh et al., 2017; Zosh et al., 2018).

4.2.1.4 Iteration

A growing body of literature shows that learners generate, test, and revise hypotheses while interacting with their environment, thereby extending their knowledge and deepening their understanding of concepts (Hirsh-Pasek et al., 2020). Play is expressed as an opportunity for exploration and iteration. Play provides learners with a safe space for investigation and experimentation, which is essential for developing learner agency. Iteration encourages reflection which contributes to revision of learning. Through trial and error when playing, learners learn to understand that failure is part of learning and that they should not be afraid to take risks (Zosh et al., 2017; Zosh et al., 2018).

4.2.1.5 Joy

Play researchers indicate that joy and positive emotions are inherent play elements (Zosh et al., 2018). Joy is required for an activity to be considered as play. Joy is defined as "motivation, thrill, and positive emotion" (Zosh et al., 2017, p. 18). This does not mean that engaging in play will not sometimes involve negative emotions. Play can sometimes be frustrating, for example when building a puzzle with small pieces. It can be very frustrating when you cannot see or find a particular puzzle piece. When the puzzle has finally been solved, a feeling of joy and thrill is experienced. The important point to emphasise here is that engaging in play usually results in joy, whether during the play activity itself or after completion of the play activity.

The five characteristics addressed above interchange when learners learn through play (Zosh et al., 2017). This means that not all five characteristics will necessarily be present simultaneously or in every lesson. However, learning through play involves that learners should experience moments of joy and surprise over time, make a meaningful connection, be active, iterate, and engage with others. Hirsh-

Pasek et al. (2020) also highlighted that these characteristics are consistent with learning across the play spectrum. However, different types of play embody the characteristics in different degrees.

Figure 4.2: Five types of play (adapted from Whitebread et al., 2017)

4.3 The different types of play

As noted earlier, play is generally recognised as being challenging to define because of its complexity. Therefore, it is not surprising that there have been numerous attempts to categorise play (Whitebread et al., 2017). Here I draw on the categorisation of Whitebread et al. (2017), who indicated that psychological literature divides play into five different types based on the developmental purpose and how it supports learning. Figure 4.2 illustrates this.

These types of play are referred to as physical play, play with objects, symbolic play, pretense/socio-dramatic play, and games with rules. Although different types of play have specific developmental and learning value, they can all support aspects of physical, intellectual, and social-emotional growth in children. In addition, these types of play are more prevalent in young learners but can be useful for older learners also. The important point is balancing these play types to support learning and development. The following section will describe these play types and some of the benefits for learning and development.

4.3.1 Physical play

Physical play, also known as locomotor play, involves active exercise (e.g., jumping, climbing, dancing, skipping, bike riding, and ball play), rough-and-tumble (with friends, siblings, or parents/guardians), and fine-motor practice (e.g. sewing, colouring, cutting, junk modelling and manipulating action and construction toys) (Whitebread et al., 2017; Whitebread, 2012).

Physical play can contribute to the development and expression of self-regulation which are important for learning because children learn to follow instructions and adjust when rules change. For example, when children play hide and seek, they are at a high level of arousal, but when the game is over, they need to control their behaviour to disengage and settle down. The control of their behaviour is closely linked to developing executive functions and self-regulation. Play creates opportunities for young children to pursue goals and ignore distractions, which are also important for developing executive function and self-regulation (Huizinga et al., 2018).

Physical play can also be conducted with older learners, such as high school and university students. For example, to create a safe learning environment, the teacher could play a greeting or goodbye song see link https://www.youtube.com/watch?v=gghDRJVxFxU / https://www.youtube.com/watch?v=2O975ewRT7Q that includes actions. In doing this, teachers could be helping learners get to know each other, and it contributes to creating an invitational and joyful learning environment.

4.3.2 Play with objects

Object play, also known as sensory-motor play, can be described as active, playful manipulation of objects (Whitebread, 2017). Object play examples include throwing a ball around or building a race track out of blocks. Play with objects starts as soon as infants can grasp and hold on to objects. This enables children to engage in investigative behaviours such as biting, rotating while looking, rubbing/stroking, hitting, and dropping. By the age of four years, building, making, and constructing behaviours emerge (Whitebread, 2012).

Playing with objects can benefit children's cognitive development (Whitebread et al., 2017). Playing with different objects presents information about the world. Such play allows children to create and express themselves by making new objects, it encourages creative problem solving, and builds a solid foundation for mathematics and science learning (Wynberg et al., 2022). In addition, when children build or make something with objects, they are developing a story. Using objects and creating a story develops reasoning and problem-solving skills (Holmes et al., 2019).

4.3.3 Symbolic play

Symbolic play happens when children use objects to represent other objects. For example, a shoe can represent a cell phone.

The first benefit of symbolic play is that it serves as a foundation for literacy and numeracy (Whitebread, 2017). When we write letters and numbers, they are symbols for what we convey. The second benefit is creativity and imagination. When children are using a saucepan as a saucepan, that is not very creative, but when they use a slab of wood and a tin for drinking tea, that shows their imagination and demonstrates their creativity. This is important because children are motivated to learn through creativity, as it is linked to intrinsic motivation (Krueger, 2021).

4.3.4 Pretence/socio-dramatic play

Pretend play involves creating alternative realities to the real world (Whitebread et al., 2017). Children learn about their likes, dislikes, interests, and abilities in pretend play. They learn about this through role-playing and making sense of what they have observed of other people (Lillard et al., 2013). For example, when

children play with dolls, the doll often becomes a version of themselves, and when the doll is, for instance, "talking" or "acting," it is a safe way for them to express new ideas and feelings.

Children also use pretend play to work out confusing and new life situations. For example, a child might pretend to be visiting a doctor. Children become more comfortable and prepared for life events through these role plays. Pretend play helps young children cope, express themselves, and learn about their environment. It allows them to practise social skills and emotional intelligence. They learn to regulate emotions, wait for their turn, and negotiate. These benefits are long term as they are needed in life (Whitebread et al., 2017).

Role play is useful in teaching because it has been proven to improve enthusiasm, self-confidence, empathy, and critical thinking (Altun, 2015). When a teacher uses role-playing in the classroom, it allows learners to experience various kinds of real situations through simulation.

An example could be when teaching mathematics. The teacher can ask learners to pretend that they are working in a big bakery and are required to bake a cake for the president. The manager of the bakery wants them to be very precise. Thus, he wants them to show him how they would measure the ingredients. In pretending to be bakers, learners practise what they have learned about measurement in a playful way.

4.3.5 Games with rules

Games with rules is a type of play that enables children to practise self-regulation because of the rules of the game that must be followed (DeVries, 2021). Games with rules include logic and order, and as children grow, they develop a strategy to plan their games (Whitebread et al., 2017; DeVries, 2021).

When children engage in a game with rules with others, they get the opportunity to develop social skills such as cooperation and how to deal with competition. In addition, they learn about turn-taking, and how to follow rules and procedures to complete the game. If the rules are not followed during play, some penalties apply.

This section has discussed five different types of play and their potential value for learning and development. These types of play are more prevalent with young

children but are also applicable for older children. It depends on the teacher what type of play they want to use, and for what purpose. Bear in mind that this is but one way to categorise play. Other categorisations that indicate types in other ways are also used. For example, Hughes (2013) categorised types of play for adults who study and facilitate play.

4.4 Guided play

When the word play is used, we usually think of children playing on their own. They design and direct their own play activities. This type of play is free play. Free play has significant value for children. Research has shown that free play can help with various aspects of development (Fisher et al., 2011; Hatzigianni et al., 2018). Children who engage in free play gain better social skills (Jarvis et al., 2014), develop self-regulation skills (Whitehead et al., 2017), and creative thinking is developed (Michalopoulou, 2014).

However, free play is often not useful for achieving a curriculum goal in a school setting (Fisher et al., 2011). Why is this the case? According to Weisberg et al. (2015, p.15) "Although children engaged in unfettered exploration could potentially stumble on the information that a teacher is trying to impart, it would lead to haphazard success at best". When children have to figure out on their own, without guidance, ("stumble" on) what the teacher wishes to convey through the play activity, it may result in superficial learning or no learning in relation to the curriculum goal. Guided play is the best approach to achieving a curriculum goal while respecting child agency.

What is the difference between free play and guided play? To help crystalise this distinction, Table 4.1 which is an adaptation of a table created by Weisberg et al. (2015) illustrates this. In free play, the learner initiates and directs the play. The learner decides what to play and how to play. When the facilitator/more knowledgeable person directs and initiates play, usually a teacher in the classroom situation, it could take the form of direct instruction. In this case, the facilitator/more knowledgeable person directs the play in relation to what to play and how to play. When the learner initiates play, and the facilitator/more knowledgeable person directs, it is referred to as co-opted play. Guided play is a blend of initiation by the facilitator/more knowledgeable person and learner self-direction (Weisberg, Hirsh-Pasek & Golinkoff, 2013).

Table 4.1: Forms of play (adapted from Weisberg et al., 2015)

Forms of play	Facilitator initiated	Learner initiated
Facilitator-directed	Instruction	Co-opted play
Learner-directed	Guided play	Free play

What follows is about guided play as it relates to schooling. Therefore, the terms "learner" and "teacher" will be used to further explain the notion of guided play. In guided play, the joyful aspects of free play and self-direction are maintained with the added dimension of focusing on learning objectives through guiding and scaffolding (Darling-Hammond et al., 2020; Weisberg et al., 2016).

Guided play consists of two elements (Weisberg et al., 2013). The first element is agency, implying that learner self-direction is prominent (Zosh et al., 2018). This means that the teacher acknowledges and draws on the learners' existing knowledge and capabilities instead of viewing them as blank slates (Daniels & Shumow, 2003). When agency is prominent, inquiry becomes important to allow the learner the freedom to explore, investigate and discover.

The second element is teacher guidance. The teacher ensures that the environment is available and suitable for learners to play. The teacher uses open-ended questions and suggestions to guide learners towards a learning goal while at the same time allowing learners to explore (Weisberg et al., 2013; Yu et al., 2018). There is a strong sense of collaboration between the teacher and learners in guided play. The learners' interests are invoked, and the teacher guides the learners.

Weisberg et al. (2016, p. 10) claimed that "guided play represents an *enhanced discovery* approach to learning that increases children's knowledge through opportunities to receive immediate, meaningful adult feedback". Thus, guided play is not unlike, what Mayer (2004, p. 15) referred to as "guided discovery" which involves learners engaging somewhat independently with learning tasks, while the teacher provides hints, direction, feedback, and modelling to keep the learners on track towards the learning goal. The difference between guided discovery and guided play would be that the latter would include play activities or playfulness.

Therefore, well-designed and implemented guided play should form part of a teacher's teaching repertoire. Guided play that draws on and incorporates the

characteristics of play in learning contexts (Hirsh-Pasek et al., 2015) provides learning opportunities that are designed to engage learners actively. Learners experience joy, and they learn more deeply through iteration and interaction with other learners. An additional benefit is that learners who are exposed to guided play develop love and motivation for school (Walsh, 2017).

4.5 Guided play practices

Section 4.4 discussed what guided play involves and why it is useful for achieving a curriculum goal. This section will discuss how to plan a guided play activity. In addition, some of the guided play practices that teachers can use when engaging learners in guided play will be explored.

When designing a guided play activity, the first point to consider is formulating an aim and/or objective(s) of the play activity in relation to the curriculum theme that you wish to address. This is important for you to stipulate because it will guide your thinking on the type of play you want the learners to engage in and why. In addition, it will help you to determine if you have achieved your aim and objectives at the end of the play activity.

The second point to consider is who the learners are – their age, background, and relevant prior knowledge. This is important to consider as it will help you design an age-appropriate guided play activity and one that is related to their context for them to comprehend the play activity. Considering the context of the learners will influence how they will learn and whether they will be able to transfer knowledge gained to different situations.

It is also important to draw on play characteristics, as discussed in Section 5. This does not imply the guided play activity should have all the characteristics of play. It depends on the play activity that you have designed. However, it is important that the guided play allows learners to experience joy, find the activity meaningful, and learn from their peers.

We have seen that guided play in the classroom usually involves the teacher (or sometimes a more knowledgeable peer) to guide learners towards achieving a curriculum goal. However, teachers cannot guide the learners if they (the teachers) are unaware of what happens while learners are engaging in the guided play activity. Therefore, the first guided play practice teachers need to adopt when engaging learners in guided play is observing the learners.

Why is this essential?

The purpose of observation during play is to help the teacher find clues on how to support and enhance the learning. As teachers observe learners during play, they get an opportunity to understand what the learners are interested in, and how they are progressing towards achieving the learning goal (Louis, 2018). In other words, the teacher becomes a "participant observer" to make informed decisions on how best to extend or adapt the learning opportunity for the learners at a specific moment. This is important because learners will be eager to participate in experiences that cater to their needs and interests (McDonald, Macdonald, & Ounis, 2018).

The second guided play practice is to ask open-ended questions. Using questioning during guided play is vital because it serves to gauge learners' understanding and to guide them towards the learning goal without giving direct instructions. Open-ended questions do not have one correct answer, thus asking learners open questions allow them to explore. In addition, open questions help activate learners' thinking (Gravett, 2022).

Asking open-ended questions during guided play may aid learners in thinking about new ideas and ways to do things, which will lead them to explore more about what they are learning. According to Gravett (2022, p. 42), if open-ended questions are used appropriately, they could "also foster inquisitiveness (curiosity) and an inquiry attitude." In addition, using opened-ended questions during play allows learners to reflect during play. This is important because it enables learners to experience what they might find confusing, and it can help them to overcome the confusion by engaging with the open-ended questions used by the teacher (Schulz, 2021).

The third guided play practice is giving informative feedback to learners. Feedback is information that the teacher gives to learners regarding their performance or understanding. According to Wiliam (2011, p.14),

> [f]eedback should focus on the specific features of the task and provide suggestions on how to improve, rather than focus on the learner; it should focus on the 'what, how and why' of a problem rather than simply indicating to students whether they were correct or not.

The purpose of providing learners with specific feedback during play is to help them think further about their ideas and to help them to assess their progress.

The last guided play practice is scaffolding. Scaffolding is used to guide learners on how to solve problems by supporting them when the need arises (Kampman, 2022). This means that the teacher simplifies what the learner has to do to enable them to complete the activity. Scaffolding involves the teacher allowing the learners to attempt the activity on their own and assisting learners once they struggle. In allowing learners to attempt the task on their own the teacher gets an opportunity to observe their progress and intervene when the need arises (Bosanquet et al., 2021).

The term "scaffolding" has emerged from the idea of the zone of proximal development, which Lev Vygotsky conceptualised in 1930 (Kampman, 2022; Pierucci, 2016). The zone of proximal development is the bridge between what learners can do on their own and what they can do with help from an adult. In this case, the adult is the teacher. Learners may deviate from a guided play activity as designed by the teacher. This may happen because they become engrossed in the play as such and lose track of what is required of them (the learning goal).

For example, a teacher teaches a mathematical concept of two-dimensional shapes, specifically a triangle. The teacher gives learners a picture of a house they need to paint. The learners need to identify all the features that represent a triangle by painting these features. A learner could get excited about the painting as such and therefore does not focus on the task at hand. The learner might paint the whole picture or paint the wrong shape. To refocus the learner, the teacher can do the following. First, remind the learner of the focus of the task and then ask an open-ended question to help the learner refocus. Depending on the response the learner gives the teacher, it may be possible to gauge the learner's understanding of the task and its requirements. The teacher may then decide to provide more scaffolding, if required, e.g., modelling one aspect of the task to the learner.

Summary

In this chapter, different definitions of play were discussed, and in doing so, I showed the difference between play, playfulness, and playful learning in relation to education. The value of invoking playfulness in teaching was another focus. This focus illustrated that playfulness invokes positive emotions, which are essential to learning, and that playfulness is beneficial for the learner and the teacher. In addition, different types of play and the characteristics of play were highlighted

because they can help teachers plan for a guided play approach. The final section explored what guided play involves and why it is useful to achieve a curriculum goal. Lastly, guided play practices that can be employed when engaging in guided play were explored. The recommended guided play practices discussed in this chapter are the following: observing the learners, asking open-ended questions, giving specific feedback, and scaffolding. These practices are essential because they can help the teacher achieve a curriculum goal and help the learner learn.

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Questions to think about

1. Having read the chapter, has your view on play as it relates to teaching and learning changed? If so, how?
2. What in your opinion, makes the difference between a teacher who interacts appropriately in guided play to extend learning as opposed to one who does not?
3. How, in your opinion, can the teacher nurture learners' confidence to participate in a relaxed learning environment?
4. What key ideas outlined in this chapter caught your attention and why?

Chapter 5

Teaching to develop an entrepreneurial mindset

Margie Worthington-Smith & Sarita Ramsaroop

Introduction

Children are born naturally curious. In the early years they learn through active observation, experimentation and discovery (Gray, 2013; Löbler, 2016). Curiosity stimulates questioning and develops resilience to fail and try again – plus a host of other "skills" that ensure that they survive these uncertain early years of life. Children also remain steadfast and motivated, solving problems through playful learning and they are not afraid to experiment (refer to Chapter 4 on playful learning). As with adults, they also use their existing knowledge and prior experiences (see Chapter 1) which serve as the building blocks to expand and experiment without the fear of failure or judgement. As they master a particular skill through repeated trial and error or iteration and perseverance (see Krueger, 2017; Lynch & Corbett, 2021), they see patterns that are used as basic building blocks to continue experimenting, stimulating creativity and innovation. Through such exploration, children learn and construct their own knowledge. We acknowledge that all individuals learn in this way throughout life. But the seeds of life-long learning are planted in the early years and should be cultivated, perpetuated and nurtured throughout their schooling.

These skills are the same skills that people with an entrepreneurial mindset utilise as they create innovative solutions that add value to the world. It stands to reason that the years in school are therefore a great opportunity to prepare learners to be able to sustain, perpetuate and practise these skills. So, understanding an entrepreneurial mindset (EM) and how it develops has value: not only for entrepreneurship and entrepreneurial education, but also for how and what we teach across all subjects in the school curriculum so that we can sustain and practise these skills across all disciplines. Many of these dispositions and skills which are recognised as contributing towards an entrepreneurial mindset are also skills recognised as developing skills for a changing world.

The purpose of this chapter is to support and guide teachers to understand the importance of developing an entrepreneurial mindset in all learners, in both

primary and secondary schools. We first examine what the term "entrepreneurial mindset" entails and how developing such a mindset is closely linked to competencies required by children to adapt and thrive in a fast-changing world. As such, we argue that developing an entrepreneurial mindset is not limited to specific subjects but is applicable to learning across all disciplines.

The chapter ends with practical examples for teachers on how they can teach so that learners can develop the entrepreneurial mindset skills which will help them to survive and thrive in this changing and challenging world.

5.1 Understanding the term "entrepreneurial mindset"

The term "entrepreneur" seems to have its roots in individuals running their own successful business ventures or in establishing a business enterprise (Gibb, 1996). Such a view, linked to entrepreneurship education, is described in the literature as the driver for social and economic development for the 21st century (Wilson, 2009). It also resulted in increasing calls being made to embed entrepreneurship education in the curriculum, aimed at producing more entrepreneurs (Langston, 2020). We, however, maintain that being entrepreneurial is not merely limited to association with business ownership. Rather, we perceive entrepreneurship as a way of approaching problems, implementing innovations, finding solutions, sharing ideas, adding value and making change happen that utilises the entrepreneurial mindset and way-of-being.

Lessons learnt from skills that people with an entrepreneurial mindset utilise such as "creativity, originality, initiative, idea generation, design thinking, adaptability and reflexivity with problem identification, problem solving, innovation, expression, communication and practical action" (Quality Assurance Agency for Higher Education [QAA], 2018, p. 7) are the very skills needed to prepare learners to navigate the complexities associated with a fast-changing world. While entrepreneurial thinking could be applied to starting a new business, diversification within an existing business and for considering and developing new product lines, we claim that entrepreneurship should be conceived more broadly as a frame of mind and a way of being that individuals can apply in their approaches to everyday life.

At its core, entrepreneurial activity is about value creation. For this reason, we redefine entrepreneurship as the creation of value for others through the self-

directed pursuit of problems and their solutions. The value created through entrepreneurial activity can be financial, as well as cultural or social and is not necessarily only about the establishment of a business. Therefore, entrepreneurial activity is not limited to new venture creation but also includes those who identify opportunities to create value within established institutions and organisations (The Entrepreneurial Learning Initiative Inc, 2021). People who embrace entrepreneurial thinking are change agents or disruptors who think beyond the status quo and who are motivated to make things happen.

Understanding an entrepreneurial mindset (EM) and how it develops has value not only for entrepreneurship and entrepreneurial education, but for how and what we teach across all subjects in the school curriculum. Many of these dispositions and skills recognised as contributing towards an entrepreneurial mindset are also skills that are recognised as universally applicable skills that can prepare learners for the changing world, as outlined in the following definition:

> Entrepreneurial mindset is defined as a cognitive perspective that enables an individual to create value by recognising and acting on opportunities, making decisions with limited information, and remaining adaptable and resilient in conditions that are often uncertain and complex (Daspit et al., 2021, p. 7).

Finally, we like to refer to people with this mindset as "entrepreneurials" (a play on the noun "millennials"). These are people of the search and discovery generation who are problem-finders and solution-seeking. They are self-directed in their search for and pursuit of opportunities to create value for others.

5.2 An entrepreneurial mindset in a changing and challenging world

We are now living in a fast-changing world that is volatile (speed, magnitude and unpredictability of change), uncertain (lack of knowledge of the impact of change), complex (interconnected systems impacted by change) and ambiguous (different interpretations of change) (VUCA) (Horney, Pasmore & O'Shea, 2010). The VUCA world is also reflective of a society that is undergoing constant innovation. Technologies such as virtual and augmented reality, artificial intelligence, robotics and advanced communication systems have resulted in some content and technologies quickly becoming outdated, giving rise to renewed demands and competencies for the workplace.

The vision for education is to develop skills and attitudes that will enable future learners to succeed in a VUCA world (Laukkonen, Biddel, & Gallagher, 2019). It requires new ways of thinking and new models for teaching and learning if we are to equip future learners with competencies needed to adapt to constantly changing conditions and to creatively solve problems. This essentially means that the future lies with innovators, creative thinkers, entrepreneurial thinkers and that entrepreneurial thinking should be used as a lens in teaching and learning through which children could see the world (Blenker et al., 2011).

As part of the discourse concerning what is required to prepare learners to cope, survive and particularly to thrive under complex conditions in this fast-changing world, we refer to the four-dimensional framework designed by the Centre for Curriculum Redesign (CCR) (Bialik et al., 2018). The first is that of knowledge; what we know and understand. The second encompasses skills, that is, how we use what we know. Next is the character dimension, how we behave and engage in the world. Finally, the meta-learning dimension is about how we reflect and adapt and learn how to learn (Bialik et al., 2018).

The identified skills such as critical thinking, collaboration, creativity and communication have always been at the centre of learning (Iurina & Gorlova, 2018; Silva, 2009) and are, therefore, not new. The point, however, is what learners can do with the knowledge rather than what knowledge they have (Silva, 2009). In other words, knowledge that can be applied or transferred to new situations (National Research Council, 2012), reiterating what Perkins (2014) describes as *life-worthy knowledge*. However, the skills, character and meta-learning competencies are foundational to the development of an entrepreneurial mindset. Entrepreneurs are creative critical thinkers who can identify and solve problems when the rules are not clear or well defined. They possess the qualities a rapidly changing world now demands.

5.3 Competencies and their relationship to the entrepreneurial mindset

The "how we use what we know" skills (or competencies) are of particular interest given their close relationship to the entrepreneurial way of being. Important here is how these competencies, when viewed through an entrepreneurial mindset lens, have the potential to create an enabling context. In this context, learners can see the value at a personal and/or a community level as they exercise their

entrepreneurial abilities to search, discover and solve problems for others. Let's further unpack these competencies.

- **Collaboration**

  Learning how to collaborate well with others (including working with diverse teams) and how to plan and manage projects with associated attitudes of respect, open-mindedness and perseverance (Griffin et al., 2012) are important skills in developing an entrepreneurial mindset. Part of the entrepreneurial mindset is influencing others, be it in the form of having paying customers, having people attend an event, or working with colleagues to bring good ideas to life. The entrepreneurial is collaborating (be it formally or unknowingly) in order to enable the solution, vision, or value to manifest. This is done by leveraging the strengths of all team members towards meeting a common goal. In South Africa, the entrepreneurial experiences success (however defined) when the collective is involved and thriving.

- **Communication**

  Communication involves active engagement by listening, asking questions and considering alternate perspectives. It also requires clear and concise articulation of "ideas or messages; using and understanding nonverbal and paralingual communication; communicating via multiple modes and developing and navigating interpersonal relationships" (Bialik et al., 2018, p. 13). An entrepreneurial with a limited ability to communicate is an entrepreneurial with limited potential. Communication is critical to the entrepreneurial at all stages of the entrepreneurial process. As they search, communication helps the entrepreneurial better understand the problem/opportunity. For *creation*, communication helps the entrepreneurial make something that better aligns with the problem it intends to address. For *influence*, communication helps the entrepreneurial attract others to engage in the solution.

- **Critical thinking**

  This involves being able to identify gaps and asking significant questions aimed at solving problems and making decisions. Thinking critically means understanding strategies that can be useful to address unfamiliar problems, as well as the importance of evidence when confronted with conflicting information, (Binkley et al., 2012). Critical thinking for entrepreneurials allows them to see the same things that others are seeing but come to different conclusions and so open opportunities to add value. The entrepreneurial is

able to create a solution that matches the needs of others because of their critical thinking. They are able to ask meaningful questions and are able to break down information as well as see how it all fits together (Bialik et al., 2018). Ultimately, critical thinking sets up the South African entrepreneurial to make clever and insightful choices, as they work to invite, enrol and encourage others to embrace what they brought to life.

- **Creativity (or creative innovation)**

  Without the creation of something new that adds the kind of value for people that they want, there is no entrepreneurship of any kind. Nothing creative, nothing innovative: inertia carries the day and "business as usual" ensues, maintaining the status quo. Creativity unlocks the potential to imagine possibilities, new ideas and being able to transfer learnings from one context to another (Bialik et al., 2018). Creativity also lends itself to taking risks through experimentation to come up with innovative ideas (Bialik et al., 2018). The South African entrepreneurial must be creative and innovative, must be willing and able to build, make and rearrange things in new and newly valuable ways and must respect the extent to which their creativity is impacting their customers, community and country.

- **Meta-learning**

  Meta-learning refers to the ability to reflect and adapt and includes the meta-cognition and growth-mindset competencies (NECT, 2021). Metacognition is the bedrock that supports the development of an entrepreneurial mindset as it involves thinking about one's own thought processes, or simply put, "thinking about thinking" (Flavell, 1987). Entrepreneurials understand what motivates them, their strengths, weaknesses and are engaged thinkers with multiple cognitive strategies they use for their goals, needs and motives (Fiske & Taylor, 1991, p. 13). Thinking metacognitively means being self-aware, having a plan and acting on it followed by self-monitoring (Guterman, 2002). This is also applicable to the school context in that learning is enhanced across all subjects and grades if learners understand how they learn and can manage their own learning.

Successful entrepreneurials have a growth mindset and attribute their success to having a desire to continuously learn new skills and knowledge, persistence and using all available resources to try other approaches (Dweck, 2010). The

South African entrepreneur must be able to believe that their intelligence can grow through learning as well as view failures or obstacles as opportunities to learn from. The entrepreneurial accepts and manages risks, essential elements of an entrepreneurial mindset, that to a large extent contribute to the growth and success of an enterprise. Individuals with a fixed mindset on the other hand, believe that their intelligence and abilities are permanent and cannot be improved (Johnson, 2009).

Zhao and Gearin (2017, p. 40) suggest that "instead of trying to make children proficient in a narrow set of academic skills like reading and math, the world would be better served if schools tried to foster an entrepreneurial mindset in their students". We, however, argue that both are equally important – children need to learn academic skills like reading and mathematics in addition to developing an entrepreneurial mindset. This means teaching learners across all grades how to unlearn and relearn, how to motivate themselves how to take risks and become creative and innovative (Ngek, 2012).

The character category includes curiosity, resilience and mindfulness and refers to "how individuals behave and engage in the world" (Bialik et al., 2018).

- **Curiosity**

  The curiosity competency entails thinking about why and how things work, actively looking for novel experiences and perspectives while nurturing passion and excitement for learning (NECT, 2021). Individuals who lack curiosity are not motivated to act in innovative ways (Nadelson et al., 2018). Refer to Chapter 1 on the importance of harnessing learner curiosity. The South African entrepreneurial needs to be constantly curious about their changing environment. It is this curiosity that gets them motivated to seek creative and innovative solutions that will be of value to the community they serve.

- **Resilience**

  Resilience refers to developing the skill of being flexible while simultaneously managing stress and emotions in a healthy manner (NECT, 2021). Part of an entrepreneurial mindset is being able to persevere when faced with difficult times or failure (Nadelson et al., 2018) and to be able to recover by adjusting and transforming in the face of change (Korber et al., 2017). The entrepreneurial's success lies in their belief in their ability to cope in stressful environments.

- **Mindfulness**

  Mindfulness is a mental process that requires being aware of one's senses, thoughts and emotions, what our triggers are, how we act on these emotions and possible consequences (Bialik et al., 2018, p. 23–25). Mindfulness as a disposition means being alert to events in the present moment and how they cognitively affect you. In an environment characterised by uncertainty and change, being mindful and attentive to the here and now means being able to think on one's feet, adapt or improvise. Mindfulness, in relation to an entrepreneurial mindset, implies being open to novel ideas and change, alertness to the present and sensitivity and awareness of different contexts and perspectives while being self-aware of one's own competencies.

5.4 The great opportunity

In the previous section, we looked at what it means to be "prepared". We looked at what competencies, skills and behaviours constitute preparing learners for the changing world – and particularly how these relate to having and growing an entrepreneurial mindset.

In this section, we look at the bleak South African situation of extreme unemployment (and especially youth unemployment), low levels of entrepreneurship and disengaged, unprepared youth from a more positive perspective.

Our mandatory schooling system provides a wonderful opportunity to unlock the vast potential that lies in all our youth. The 13 or so years that children spend at school gives us the opportunity to grow the enterprising qualities innate in all young people – by creating solution-seeking, motivated children with an entrepreneurial way of being. This is not a mere belief, but a reality that is based on evidence. Let's discuss this in more detail here.

Firstly, infants are born with an intrinsic motivation to learn. As Harari (2014) noted in his book *Sapiens*, humans are born prematurely, when many of their vital systems are still underdeveloped. This requires them to learn fast in order to survive. Gray (2013, p. 71) further noted that children come into the world eager and excited to learn and are "naturally curious, naturally playful and they explore and play in ways that teach them about the social and physical world to which they must adapt".

This natural curiosity, exploration and playfulness is the basis of the skills and competencies of all entrepreneurs. Löbler (2006, p. 16) noted that many of these skills and competencies can be observed in children as follows:

> If we look at the 'skills and competencies of entrepreneurs from a constructivists' perspective, we find most of them by observing children under the age of five or six: they are motivated to learn, they are interested in a variety of different topics, they ask excellent questions, they try many things to get insights, they are creative, they are impatient. In short, they create and govern their own learning process, which is open for any content, style, goal, experience, etc., and allows them to take every opportunity to answer the question in concern.

Although children are born enterprising, it is not encouraged as they grow up (Johannisson, 2010). Children develop their resilience and grit through a process of engaging in self-exploration and reflection which in turn supports the development of their entrepreneurial mindset (Daspit, Fox & Findley, 2021). In particular, children learn through playing and having fun. However, learning through play is not given sufficient attention and as described by Löbler (2006, p. 31):

> It seems that we totally underestimate the value of playing and having fun for the purpose of learning, especially in learning entrepreneurial skills and competencies or characteristics. In general, if you are really interested in something you do not perceive your endeavours as work or learning but as fun! Achievement and fun are no contradiction, as typically can be seen in the field of successful entrepreneurs.

So, let's go back to the wonderful opportunity we have to access and support all young South Africans from early childhood to late teenagers. If we could emulate the conditions at school that created their innate entrepreneurial way of being and intrinsic motivation to learn, we would be well on our way to growing young "entrepreneurials".

How do we create a schooling system that perpetuates and catalyses this entrepreneurial potential in children? The answer lies in three critical factors:

Firstly, if we are to ensure that the vital elements for an entrepreneurial mindset (namely curiosity and creativity) are nurtured, we need to create psychologically

safe and supportive environments for learning to happen. Refer to Chapter 1 on what curiosity entails and Chapter 2 on why it is so important to create emotionally positive classrooms. On implications for practice in schools, we refer to Darling-Hammond et al. (2020), who identify three key principles:

- build strong positive relationships between teachers and learners,
- schools and classrooms must be physically and emotionally safe, and
- school practices should be designed to strengthen relational trust.

Secondly, we could consider schooling as an opportunity to emulate, sustain and perpetuate the playful way in which children learn before they start school. These include the following learning factors:

- **Social interaction:** Social interactions feed and strengthen the entrepreneurial mindset, enabling learners to empathise with others and gather critical data they will need to pursue opportunities to solve problems (see Naumann, 2017). Social interactions provide new opportunities to learn and create, which can help to sharpen learners' entrepreneurial mindset.
- **Purpose-driven goal-oriented activities:** Learners need opportunities to connect what they are learning in the classroom to their real lives. As soon as learners discover real purpose or meaning in what they do and can connect what they learn and do at school to their lives outside of school, motivation improves and deeper learning takes place. Learning that has purpose increases learners' motivation to continue to learn (Clarke & Dede, 2005; Wilson et al., 1989). A sense of purpose serves as the fuel to get them where they want to go, providing further opportunities to refine their entrepreneurial mindset (see Kauanui et al., 2010). Without purpose, the learner is less likely to have the motivation and focus needed to persevere when the work gets especially challenging.
- **Enjoyment through fun:** Enjoyment comes when learning experiences are pleasant. These experiences are more likely to keep learners deeply engaged. When the experiences are enjoyable, learners create the space to practise the entrepreneurial way of being (see Jackson, Mawson, & Bodnar, 2021).
- **Safe opportunities to be curious:** When learners have opportunities to engage their curiosity, they simultaneously have opportunities to engage

their entrepreneurial mindset (see Estell, Reaping, & Sapp, 2016; Nadelson et al., 2018). Curiosity increases the chances that the learner has to discover a new problem, produce a new question, forge a new way to make things better for someone — in line with an entrepreneurial mindset.

- **The chance to iterate (try and fail and try again):** It is rarely the case that the first version of anything is of high quality and worth keeping. Iteration enhances the entrepreneurial mindset by challenging the learner to learn from and improve upon the previous attempts, providing ongoing opportunities to practise all aspects of the entrepreneurial mindset (see Krueger, 2017; Lynch & Corbett, 2021). When learning experiences and activities are designed in such a way that requires creating, learning and refining, learners have opportunities to sharpen their entrepreneurial mindset through iteration.
- **Active engagement:** This means being minds-on as well as doing hands-on tasks, persisting through distractions, and actively solving problems rather than being instructed on how to solve the problem (Zosh et al., 2017). These are all elements of the entrepreneurial way of being which drives learners' ability to create value for others.
- **Learner autonomy:** Learners have the opportunity to make their own decisions about how to solve problems. It means driving their own learning choices in a bid for autonomy and agency. Part of what gives entrepreneurs the oxygen they need to thrive is the freedom and flexibility to see opportunities, create solutions and invite others to engage. With too many constraints, the entrepreneur would suffocate. Similarly, for learners, the entrepreneurial mindset benefits from learner autonomy because it provides the time, space and contexts to strengthen the muscles of the entrepreneurial mindset, as driven by the learner (see Blake Hylton, et al., 2020; Rae, 2010).

Thirdly, we should consider using teaching-for-learning approaches such as project-based learning that activate the entrepreneurial qualities. There is not much literature that links teaching approaches to the development of the entrepreneurial mindset in the education sector. However, Löbler (2006, p. 32-36) suggests several principles which we might find useful to consider when embarking on teaching specifically for developing an entrepreneurial mindset. Many of these resonate with the principles of teaching-for-learning that are mentioned in this book, but his emphasis on the fact that they also support

the development of entrepreneurial qualities is what makes them particularly relevant to this chapter.

Löbler (2006) suggests that teachers need to be able to support the learning process by, for example: creating experiences where learners learn by doing; guiding learners to ask good questions and create their own answers; and reframing problems or information to create new solutions or ideas. An entrepreneurial teaching process would develop knowledge into skills/competencies (i.e., using what we know). It is these competencies that underpin the entrepreneurial mindset – like collaboration, critical thinking and creative innovation. This teaching process would involve learners pursuing their own learning goals in a more self-directed way, identifying problems and searching for content that helps them find solutions as entrepreneurs do.

Teachers in an entrepreneurial learning environment could create learning spaces where they and the learners collaborate towards a co-owned goal or outcome while providing support information that encourages the flow of communication between everyone in the classroom. Like entrepreneurs, learners could be given the opportunity to combine information in different ways and consider a range of options while making mistakes, solving problems and learning from them. As with playful learning, in such an environment, learners find joy in learning because they are able to persist through challenges to find the joy on the other side as they taste little bites of success in their learning journey. Many of these teaching elements are reflected in the literature on learning through play (Zosh et al., 2017).

The use of project-based teaching for learning is an ideal approach which activates many of these principles. It uses multi-faceted projects as vehicles for delivering an authentic education that connects what learners learn in school to real-world issues, problems and applications. This approach mirrors real-life contexts and equips learners with practical and useful skills. In this way, they are more likely to be interested in and motivated by what they are learning. This includes 21st century knowledge, work habits and character traits that are critically important to thrive in today's changing world. You can read more about project-based teaching and learning and its application in a South African context in Chapter 6 and Chapter 7.

5.5 Integrating the entrepreneurial mindset across all grades and subjects

Teaching for developing an entrepreneurial mindset is not a stand-alone that is confined to the teaching of only certain subjects or grades. Instead it is something that should be embedded generally in all teaching practice and lesson design regardless of the subject or grade. Schooling is about learning how to learn (and the need to sustain the intrinsic motivation to learn that children develop as infants) – which is also generic and critical to all grades and subjects. Critically, it is about the way teaching happens regardless of the topic/subject being taught – not specifically a "module" or unit within a subject.

It is a bit like the vehicle that carries the load. The load (subject) may change but the vehicle must always have the critical elements to get it to move forward i.e., the elements that ensure that an entrepreneurial mindset is cultivated and that competencies and mindsets will ensue. All of this can be present in all lesson design in all subjects and in all grades. As we have said before, the elements (vehicle) that should be present in all classrooms and lesson design are:

- a safe environment so that curiosity is encouraged (critical for the "radar on" element of the EM);
- an environment that encourages the elements for playful learning such as social interaction, iteration, etc., – all elements of the EM ; and
- a teaching-for-learning approach that mirrors aspects of reality so that it is engaging and meaningful to the learners and creates opportunities to practise the EM and the entrepreneurial way-of-being.

All these elements unlock the domains of the science of learning (Darling-Hammond et al., 2020) required to develop the whole child (academic, cognitive, ethical, physical, psychological, socio-emotional). These domains are:

- **A supportive environment:** Located here is a safe environment and the S.P.E.C.I A.L. elements of playful learning which support the EM (see Chapter 4).
- **Productive instructional strategies:** Located here is project-based learning as an approach that gives ample opportunity to practice the EM through problem-solving projects.
- **Social and emotional development:** Located here is EM and the competencies which are the outcomes of this approach and environment.

- **System of support:** Here we find the out-of-classroom support, e.g., parents, community, extra-mural support, etc. (not covered in the scope of this book).

Summary

In summary, the challenge to existing and new teachers is to be aware that their learners will arrive with an innate motivation to learn; they will have developed their entrepreneurial mindset and toolkit by learning through natural curiosity and the playful learning environment they experienced as infants and young children. The schooling environment therefore does not need to create, but rather to sustain and perpetuate this potential, in every lesson in every grade. We suggest that they do this by providing physical and psychologically safe spaces to take learning risks; by emulating the playful learning environments that include the key elements for learning; and by teaching using approaches such as project-based learning that are engaging, mirror real life and that create repeated opportunities to practise the entrepreneurial way of being.

If we all do this, we will unlock the vast potential in the 12 million young people currently in the school system and the millions that follow them every year. We will be creating a South Africa full of engaged, solution-seeking young people who will be prepared and motivated to solve the problems of the country and the world.

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Questions to think about

1. Why is it important that teachers create significant learning experiences that develop an entrepreneurial mindset in learners as opposed to only preparing them to become entrepreneurs? (Refer also to Chapter 1 to remind yourself about what a "significant" learning experience is.)
2. What is the relationship between skills and other competencies needed to be prepared for a changing world and an entrepreneurial mindset? (Refer also to Chapter 5 on Project-based teaching and learning.)
3. What three elements does this chapter suggest are needed for a conducive learning environment that would grow the entrepreneurial way of being and potential that young people already experience as infants? How do these contribute to the growth of an entrepreneurial mindset? (Refer to Chapter 5 on Project-based teaching and learning; Chapter 2 on Creating emotionally positive learning environments and Chapter 4 on Play and playfulness for teaching and learning.)
4. Share ideas/examples that you can integrate into your teaching aimed at developing an entrepreneurial mindset in the subject/s you teach. You can use the steps in Chapter 3 on the lesson design approach to guide your thinking. You can also refer to Chapter 4 on playful learning and Chapters 6 and 7 on project-based learning for examples or bring in your own examples that can work in your context.

Chapter 6

Project-based teaching and learning

Semoni Cancelliere & Elizabeth Mokwena

Introduction

Multiple pedagogies could assist in developing competencies that learners need for our fast-changing world. This chapter unpacks one such a pedagogy that we deem as particularly useful, namely project-based teaching and learning.

Modern society is often described using the abbreviation VUCA which stands for volatile, uncertain, complex, and ambiguous (Grossman, Dean, Kavanagh & Herrmann, 2019). This VUCA world includes challenges such as climate change and recently the Covid-19 pandemic; however, it also includes the rapid development of innovations such as robotics and artificial intelligence. Thus, it is imperative to prepare school-leaving individuals for this VUCA world. Learners must have the competencies to survive and be successful in this fast-changing world. Thus, we need to include competencies like critical thinking, communication, collaboration and creativity in our classrooms (Ananiadou & Claro, 2009; Barron & Darling-Hammond, 2010; Dede, 2010; Eadie, Villiers, Gunawan & Haq, 2021; Gravett, 2022; Gravett & Eadie, 2021).

Project-based teaching and learning (PBTL) is a pedagogy that can assist in preparing learners for this fast-changing world (Barron & Darling-Hammond, 2010). It is an inquiry-based pedagogy that involves the connection between knowledge gained within the classroom and "real-world problems", and develops "communication, collaboration, creativity and deep thinking" (Barron & Darling-Hammond, 2010, p. 199).

This chapter investigates the definitions, core characteristics and frameworks of PBTL. Thereafter a framework is used to show how a teacher can plan for implementing PBTL. Also, the benefits and challenges associated with implementing PBTL are explored.

6.1 What is PBTL?

Various terms are used in the literature when referring to PBTL. It is referred to as a pedagogy (E3, 2020a), a teaching strategy (Grossman et al., 2019) or an approach (E3, 2020b). In this chapter, the term pedagogy is used. The terms PBTL and project-based learning are both used in literature. We prefer the term PBTL as it includes the role of the teacher. This is important because it is the teacher who designs, plans and creates opportunities for authentic learning experiences within a PBTL project.

There are also numerous definitions of PBTL. UQx LEARNx (2018) explained PBTL as a learner-centred pedagogy that involves learners identifying a real-world problem and engaging in hands-on learning to identify a solution. PBLWorks (2022) described PBTL as a teaching pedagogy that engages learners actively in solving a real-world problem that is meaningful over an extended period of time. Eventually, learners showcase their knowledge and skills by designing a public product or presentation for an audience that solves the real-world problem. E3 (2022) explained PBTL as a process with authentic opportunities that assist learners in drawing connections between curriculum knowledge and the real world. This process requires learners to work collaboratively, actively ask questions, think critically, and produce creative solutions to a problem.

Grossman et al. (2019, p. 44) described the PBTL process as providing opportunities for learners to "study a challenging problem, engage in sustained inquiry, find answers to authentic questions, help choose the project, reflect on the process, critique and revise work, and create a public product". Grossman et al. (2019) also described four core practices of project-based teaching essential for successfully implementing PBTL. What distinguishes Grossman et al.'s (2019) description of PBTL from E3 (2022) and PBLWorks (2022) is the emphasis placed on the teacher's role during PBTL.

Based on the definitions above, some core characteristics of PBTL are evident. These are discussed next.

6.2 Core characteristics of PBTL

The pedagogy of PBTL has been explored for many years. There are core characteristics that distinguish PBTL from projects and other teaching pedagogies. An understanding of these characteristics can assist teachers in designing

PBTL projects that best fit their classrooms. The core characteristics of PBTL are discussed below.

- PBTL involves solving real-world problems and learner agency is foregrounded (PBLWorks, 2022; UQx LEARNx, 2018). It is an authentic pedagogy because learners are presented with a real-world problem relevant to their lives or contexts that they need to inquire about and find possible solutions for. The PBTL process foregrounds learner agency as it provides a platform for learners to express their perspectives, take responsibility for finding solutions, and showcase their presentations to their peers, experts or community members (Blauwkamp, 2019).
- PBTL is an activity-based pedagogy (Grossman et al., 2019; E3, 2020a). This implies that the project consists of various teacher-designed activities related to a real-world problem that learners engage with while executing the project. The teacher creates learning opportunities and activities for learners to practise their knowledge and skills as they work through activities by experimenting and investigating during the project. These activities support learners in creating their final product, which solves the real-world problem.
- Another characteristic of PBTL is that it balances flexible teaching and self-directed learning (Arora, Saxena & Gangwar, 2017; Larmer, Mergendoller, & Boss, 2015; PBLWorks, 2022; UQx LEARNx, 2018). Teachers plan and design a project that creates multiple opportunities for learners to question, apply and showcase their learning. In PBTL, learners engage in self-directed learning because they are provided with opportunities to make decisions about the PBTL process. For example, deciding on potential products, solutions or presentations they want to design and create to solve the real-world problem or expressing their views about possible processes to follow when problem-solving occurs within the PBTL process.
- Self-directed learning in PBTL allows learners to think deeply about how to tackle real-world problems through investigating the problem, collecting information and doing research, analysing their findings, and evaluating insights to present solutions. Although self-directed learning is promoted in PBTL, learners still require support from the teacher as they work on content and tasks. During the PBTL process, the teacher monitors and provides scaffolding to individual learners and groups as needed. Scaffolding is the support and reinforcement teachers offer learners to help them improve on

a concept or skill within the project (Field, 2021). This support is gradually reduced and removed as learners' progress.

- Another characteristic of PBTL is that it is relevant to all grades (UQx LEARNx, 2018) because all learners have the potential to solve a real-world problem. This means that it is the teacher's responsibility to design a project and create tasks that are age appropriate and will help learners solve the real-world problem.
- PBTL is curriculum driven (Barron & Darling-Hammond, 2010). PBTL projects are designed to align with curriculum outcomes related to the subject and grade. This means that learners will encounter central principles or concepts linked to the curriculum that will assist them in solving the real-world problem. Designing PBTL around curriculum standards guides teachers in creating tasks that are age appropriate for learners. Also, as learners engage in the PBTL project, they develop curriculum knowledge and skills.

The core characteristics noted above are relevant to all schooling contexts as they emphasise the availability of resources, classroom size or the different curriculum or assessment requirements found within schools. We understand that every classroom is unique, but teachers can use the core characteristics discussed above to assist them to plan for PBTL in their classrooms despite the differences. Based on the core characteristics, we formulated a definition of PBTL for this chapter:

Project-based teaching and learning is an activity-based pedagogy relevant to any grade that balances flexible teaching and self-directed learning while solving real-world problems that relate to the curriculum.

6.3 The difference between PBTL and "dessert" projects in the classroom

Many teachers are familiar with using projects. A project is usually used as a form of summative assessment that learners must complete at the end of a unit to display their learning – the focus is on the end-product. For example, learners can complete a portfolio, or create a poster or artefact to showcase their understanding of a topic (E3, 2022; Larmer et al., 2015). The purpose of a "dessert" project is to provide learners with an opportunity to show their learning of the curriculum topic once all content has been covered. These projects are referred to as "dessert" projects because they occur once a curriculum topic has been completed (Larmer et al., 2015).

Conversely, PBTL is a pedagogy that focuses on the process of learning and creating a solution. In PBTL, learners need to collaborate and solve a real-world problem and through their continuous inquiry and problem solving they learn about the topic. Learners will then demonstrate their acquired knowledge and skills through formative and summative assessment tasks.

In the next section, we look at two prominent PBTL frameworks.

6.4 Two prominent PBTL frameworks

There is no single or standard way in which PBTL is explained or represented. Various authors utilise visual representations to explain the salient points of PBTL implementation. These are referred to as frameworks (Grossman et al., 2019) or models (Larmer et al., 2015). In this chapter, we refer to these as frameworks. Firstly, we discuss two frameworks we drew from to create the framework that follows later in this chapter. Thereafter the framework that combines elements from these frameworks is presented. The reason why the elements from the two frameworks have been merged is because both frameworks provide valuable insights into the role of the teacher and learner to successfully complete a PBTL project. After presentation of the framework, the elements within the framework and how these can be used for planning implementation are explained.

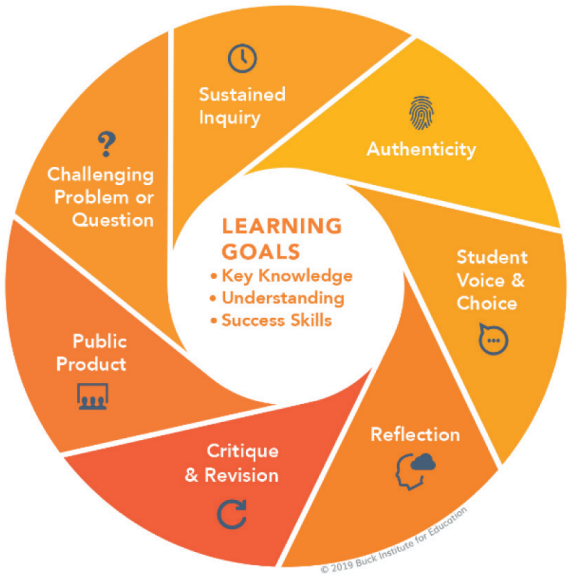

Figure 6.1 BIE's seven essential project design elements (The Buck Institute for Education, 2019, used with permission.)

The Buck Institute of Education (BIE) created the first framework, namely: Gold Standard PBL (project-based learning), often cited in the literature to guide the incorporation of PBTL in classrooms (Arora et al., 2017; Boss & Marzano, 2014; Markham, Larmer & Ravitz, 2003). The gold standard PBL includes seven elements (see Figure 6.1 below) for designing a PBTL project. Goals within this framework are focused on the learners' development of "knowledge, understanding, and success skills" that prepare learners for life after school (Larmer et al., 2015, p. 35). Thus, the BIE developed the framework as a standard consisting of what they view as "the best research-based and classroom-proven project design elements and instructional practices" (Larmer et al., 2015, p. 34). Figure 6.1 summarises the Gold Standard Project-based Learning.

The second framework designed by Grossman et al. (2019) highlights the teacher's role in implementing PBTL. This framework unpacks core instructional goals that support teachers to effectively implement PBTL in the classroom. The four primary goals are: supporting deep disciplinary content learning, engaging learners in authentic work, supporting learner collaboration and an iterative culture where learners are always prototyping, reflecting, redesigning, editing, and trying again (Grossman et al., 2019).

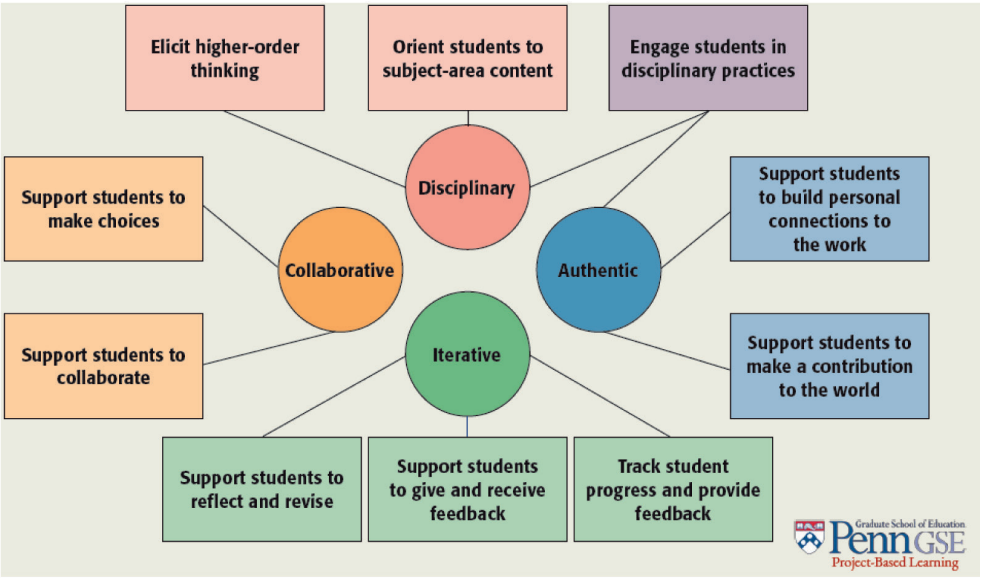

Figure 6.2 Core practices of project-based teaching (Grossman et al., 1019, used with permission)

6.5 A framework for PBTL

We have created a framework that draws on the frameworks mentioned above. To do this, the elements in the two frameworks that would be most useful to teachers who want to implement PBTL were identified. The inclusion of elements from the Grossman et al (2019) framework is due to the emphasis placed on the teacher's role in implementing PBTL. All four core goals are included within our framework because these can guide teachers while planning. The inclusion of elements from BIE's seven essential project design elements is due to the explicit inclusion of what learners should be working on during the PBTL process. All seven elements are embedded within our framework. Teachers could use these when planning for learners' tasks and the processes to be included within the PBTL project.

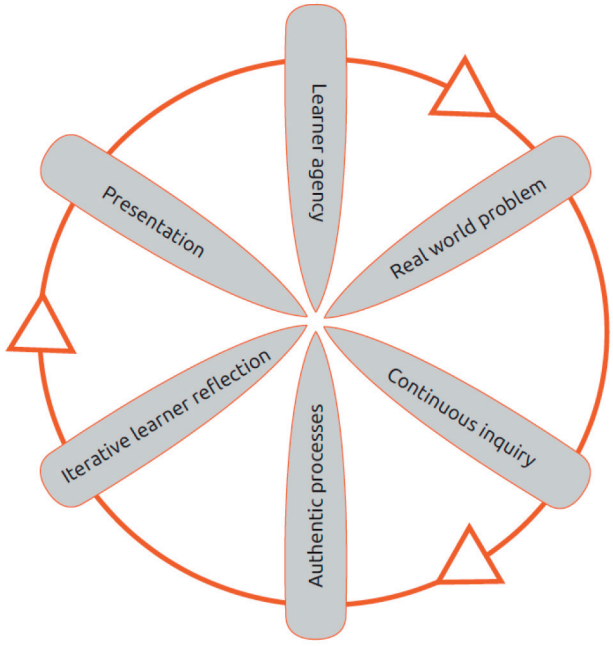

Figure 6.3 Framework for planning PBTL

Each element will be unpacked below.

6.5.1 A real-world problem

The project should be based on a real-world problem. This problem should be solved through learners' engagement in the PBTL process. It should be relevant to the learners' or the community's needs implying that it is a problem that learners or the community are facing, one resembling what professionals like politicians,

environmentalists or scientists do (Krajcik & Shin, 2014). This adds "personal authenticity" (Larmer et al., 2015: 41) or learners' personal investment (Krajick & Shin, 2014). Using a real-world problem provides value because it helps learners "to link the key ideas, questions and knowledge" to the project's focus, and assists the teacher to find relevant tasks that could support learners to answer the real-world problem (Larmer et al., 2015).

When planning to include a real-world problem, teachers should consider the challenges learners or community members face in relation to a specific curriculum theme or focus, and present this as the real-world problem that learners should solve. Teachers can also provide an opportunity for learners to observe their environments within the community to assist them in identifying a real-world problem experienced that relate to a curriculum theme. If learners are involved in determining the real-world problem, it could make learners feel they have ownership of the problem.

The real-world problem should also be age appropriate, applicable to learners' interests/lives, thought provoking and open-ended with multiple possible answers that cannot be "Googled" (Larmer et al., 2015). To spark ideas, the teacher could ask questions that explore a debatable issue, intriguing topic, or a problem to be solved. The real-world problem is not cast in stone and can be revisited and changed as new information emerges. See Chapter 1 on the inclusion of curiosity to improve attention and engagement and Chapter 3 on using questions to support dialogue.

6.5.2 Continuous inquiry

PBTL is an inquiry-based pedagogy (Barron & Darling-Hammond, 2010), therefore continuous inquiry is included as an element in the framework. Inquiry-based pedagogies include the use of questioning to determine learners' exploration of a topic (Goodman & Berntson, 2000). Continuous inquiry within PBTL is an iterative process that is not simply looking for information to answer a question but involves asking varied questions, conducting research to answer questions and repeating this process throughout the project. This can also develop learners' deeper understanding because throughout the continuous inquiry learners are constructing their understanding based on their "experiences and interaction" (Krajick & Shin, 2014, p. 277) and the engagement in authentic processes discussed below. This could result from continuous inquiry because the construction

and reconstruction of understanding involves new experiences and ideas and previous knowledge and experiences (Krajick & Shin, 2014, p. 277).

All of this will assist in solving the real-world problem. This process is both the teacher's and learners' responsibility because the teacher should guide learners' inquiry, using the iterative reflection process and the teacher should monitor learners' progress. Learners are responsible for researching the real-world problem, which could lead to multiple questions throughout the process that need answering.

Grossman et al. (2019, p. 45) suggested the importance of eliciting higher-order thinking. To do this, teachers should continuously challenge learners to "analyze data, synthesize information, evaluate their work, and justify their claims." This continuous process will not only assist learners in developing higher-order thinking but also in formulating questions throughout the process that will guide them in solving the given problem. Teachers should also plan to have various resources available to learners to find answers to their questions and formulate new questions. See Chapter 4 for more information on the use of inquiry.

6.5.3 Authentic processes

Authentic processes include authentic contexts and tasks that learners engage in to assist in solving the real-world problem (Larmer et al., 2015). Krajcik and Shin (2014, p. 275) suggested that PBTL allows learners to learn by doing, to apply ideas and to solve problems which provide learning activities that are similar to those found within the real-world. They also explained that acquiring a deeper understanding of disciplinary content is supported through learners engaging in disciplinary practices and activities (Krajick & Shin, 2014). Authentic contexts require the inclusion of scenarios in the class that reflect what occurs in the real world. Authentic tasks refer to the tasks and tools that individuals who work in the field similar to that of the real-world problem would use and encounter (Larmer et al., 2015). Thus, to include authentic tasks, Grossman et al. (2019) suggested that using methods found in real-world disciplines allow learners to "do" the subject instead of learning about it – making it more authentic for learners.

To plan for including authentic tasks, the teacher can consult experts to describe the processes and scenarios that are used to solve problems/address issues in the real-life situation. The teacher can then provide learners with smaller tasks and access to tools used in a real-world scenario that will assist them in solving the

real-world problem. For example, the teacher can engage learners in tasks such as presentations of initial planning and progress made to solve the real-world problem or the correspondence with individuals who might be affected by the possible solution.

To plan for including authentic contexts, the teacher can invite an organisation or institution that is connected to aspects of the problem to describe working environments and ways of working on projects similar to that of the real-world problem to learners. The teacher can then use the context provided to include smaller problems or questions resembling the authentic context to guide learners in solving the problem.

6.5.4 Learner agency

Emphasising learner agency is integral to PBTL. This implies that learners should be given ample opportunities to make decisions on how to solve problems in relation to the real-world problem or how group work is distributed among members. If the teacher instructs learners on how things should be done, learners will follow directions and not be provided an opportunity to display their agency (Larmer et al., 2015).

Providing opportunities for learner agency creates the freedom learners need to act and reflect on their experiences (Larmer et al., 2015). The teacher's role is to determine the appropriate opportunities and make the decisions about how learners could exercise agency. These opportunities are based on what learners could manage, which opportunities learners can learn the most from, and what necessary guidance and support would be available to learners (Larmer et al., 2015).

To plan for including learner agency, teachers should teach learners about the importance of their agency before launching the PBTL project. Teachers should explain the purpose of learner agency as it could help learners understand what responsibilities come with having agency. Once learners understand the purpose of their agency, teachers can include opportunities throughout the PBTL processes for learners to share their questions, interests, decisions, and challenges experienced. To further encourage learner agency, teachers should support and guide learners to collaborate, make decisions together, define their roles and responsibilities within the group, and prompt the group to draw on each other's

perspectives, knowledge, skills and experiences. This can be done by explaining, modelling or discussing how to identify group members' individual strengths, weaknesses and monitoring group interactions and communication (Grossman et al., 2019).

6.5.5 Iterative learner reflection

Iterative reflection implies continuous thought and consideration of processes, completed tasks, strengths and weaknesses to determine next steps and possible improvements. It is important in PBTL because learners learn more when they reflect on experiences (Larmer et al., 2015). Iterative reflection assists learners and teachers in developing a deeper understanding of their learnings, the quality of work completed, the inquiry process, solving of problems and examining the project's progress (Larmer et al., 2015). Through iterative reflection, learners provide critique and feedback to their peers, allowing identification of inter-personal group dynamics which could support or inhibit progress, and learner-identified progress or challenges (Larmer et al., 2015).

To plan for iterative reflection, teachers should provide multiple opportunities for learners to reflect. Some elements that could be included to enable reflection is tracking learners' progress, providing feedback, and supporting learners to give and receive feedback. The importance of these three inclusions is due to the complex and extended projects (Grossman et al., 2019) that learners engage with during PBTL and the necessity for teachers to support them in how to improve on their work.

When planning to track learners' progress and provide feedback, teachers need to use questions or prompts to assist learners in identifying problems or necessary changes. This could lead to instant feedback or scaffolding learners to look at specific areas and identify challenges themselves. Including this during planning can help teachers to support learners in determining potential interventions for successfully moving to the next steps based on feedback from the teachers or their peers.

To assist learners in practising iterative reflection, the use of a gallery walk could be helpful. Learners or groups post their drafts (prototypes) on the classroom wall and their peers walk around providing comments on sticky notes. During gallery walks learners are not only required to provide feedback through the use

of sticky notes but also receive feedback when reading the sticky notes placed on their drafts (prototypes). This could be a valuable activity as teachers explain how to give and receive feedback when discussing the expectations of the gallery walk. The teacher can then model how they give and receive feedback to further support learners in understanding the expectations of the activity.

Teachers can also create opportunities for iterative reflection by using tasks that involve learners journaling about their learning trajectory, whole-class discussions, surveys, summary writing, mind maps and progress reports combined with guiding reflective questions to consider how to improve their work or group relations. Teachers should also include opportunities to show learners how they track progress, reflect, give and receive feedback (Grossman et al., 2019).

6.5.6 Presentation

PBTL results include a presentation made by the learners during which the answer or solutions to the real-world problem is explained. Based on the PBTL project an audience consisting of other learners, teachers, parents, community members and experts who were consulted during the PBTL process can be included. The inclusion of experts in the presentation audience allows for an authentic context because individuals who deal with challenges and scenarios similar to that of the real-world problem can question and provide feedback to learners (Larmer et al., 2015).

To plan for a presentation, teachers should guide learners on how to create a presentation that highlights their understanding and the solution to the real-world problem. This could be done in many ways, some examples are a gallery walk, a video or a report. More suggestions can be found in Appendix 3. Chapter 7 provides some practical examples of how to include PBTL in your classroom.

6.6 How to assess PBTL?

Assessment is an integral component of PBTL. In the previous section, PBTL was characterised as an activity-based pedagogy, implying that learners engage in various activities and assessments throughout the PBTL process. Assessment in PBTL can range from peer evaluations to self-assessment, or teachers and experts assessing learners' progress. The use of formative assessment in PBTL allows learners to reflect, critique and receive feedback from the teacher, and provide

feedback to other learners to improve their performance and review their work (Larmer et al., 2015).

Formative assessment, also referred to as assessment for learning, is ongoing (continuous) assessment that monitors learners' progress, identifies learner challenges and provides feedback (Formplus, 2022). Formative assessment could include a baseline assessment that determines learners' prior knowledge of the topic. In PBTL, the teacher designs multiple formative assessments to provide feedback that will improve learners' work towards completing the final presentation or summative assessment (Larmer et al., 2015).

The use of continuous assessment allows teachers to assess whether learners are acquiring the content, curriculum knowledge and skills needed to complete the project (Miller, 2011). Summative assessment is used to evaluate learning at the end of the project (Centre for the Enhancement of Teaching and Learning, 2021). Summative assessment also assesses how learners' learning has developed during the PBTL process. It includes the development of conceptual understanding, skills and presentations.

Kolk (2018) suggested four stages to facilitate formative assessment in PBTL. She also suggested assessment tools that can be used in each stage. The initial stage includes a baseline assessment to determine what learners already know about the topic. Teachers can use assessment tools to get learners thinking about real-world problems or issues that concern them. Teachers can then use the baseline results to design and plan for ways to facilitate learning, for example, what they want learners to learn, how they will assist learners to reach learning expectations, or how groups will be assigned in order for learners to work effectively.

Next, during the brainstorming and research stage, the teacher assesses learners as they brainstorm their ideas and formulate research questions they would like to explore. For example, graphic organisers and mind maps are tools teachers can use to assess learners' ideas and questions. Learners can include questions about the real-world problem and sources they will consult for answers during this stage.

The next stage is the planning stage. Learners plan on how they will design and create their presentations. During this stage, the teachers create tools that will assist learners in sharing how they plan to answer the real-world problem (Kolk, 2018). The teacher can use gallery walks or small group presentations to assess

how well learners are managing a project and the progress they have made. These tools also allow learners to give and receive peer feedback.

Lastly, as learners design and create their presentations, the teacher can use formative assessment tasks like quizzes, or tools such as rubrics and checklists to support learners in developing an understanding of academic content and skills. Continuous assessment of learners' understanding of content and skills can provide teachers with information on which groups require additional assistance to complete their presentation. For example, the teacher creates checklists that learners use to give details of what they learned, the challenges learners experienced and what they want to do next. This is an effective tool for monitoring individual learners and groups as the teacher is able to track and give individual assistance according to learners' needs within each group.

An example of an assessment tool that is often used in PBTL is a rubric. Rubrics can be used as assessment tools for both formative and summative assessments. PBLWorks (2022) highlighted several ways rubrics can be used. For example, a rubric can be designed to assess learners' development of skills or understanding of content after a short unit, or to assess learners' presentation of their final presentation.

Rubrics assist in communicating the learning goals to learners and guide them in identifying expectations and what they need to improve and drive their learning. Rubrics can be designed before or during a project with or without learners. When designing a rubric, the rubric expectations must link with the project's driving question. The core elements (content or skills) that the teacher wants to assess should align with the content or skills learners have already been taught. Rubrics, if designed properly to include detail of expectations, could provide in-the-moment feedback to learners on the multiple aspects of the task being completed. Learners can then identify the aspects of the criteria they need to improve on for the next task. For more information on including PBTL assessment refer to Chapter 8.

6.7 The benefits and challenges associated with PBTL

There are benefits and challenges associated with project-based teaching and learning. Being aware of the challenges can assist with planning for PBTL as it could help to prevent or minimise them by making the necessary accommodations.

First, we will look at the benefits of including PBTL as a pedagogy. After that, we explore the potential challenges.

There are various benefits of PBTL. The onset of the fourth industrial revolution (4IR) and the necessity for competencies for a fast-changing world and an entrepreneurial mindset (see Chapter 5) support the inclusion of PBTL because it is an inquiry-based pedagogy. Inquiry-based pedagogies are beneficial because they support the development of inquiry, problem-solving and application of knowledge, which are related to competencies for a fast-changing world (Barron & Darling-Hammond, 2010).

PBTL could also support deeper learning (Boss & Marzano, 2014). Deeper learning enables individuals to transfer and apply knowledge in a situation different to that in which the knowledge was learnt (National Research Council, 2012). During PBTL, learners need to think deeply and apply their learnings and skills continuously throughout the PBTL process (Janse van Rensburg & Goede, 2019) and learners also need to apply their learnings based on connections made between disciplinary knowledge and disciplinary practices to scenarios they have not yet encountered (Krajcik & Shin, 2014).

PBTL, if designed and implemented well, could improve learners' emotional engagement in the classroom (Boss & Marzano, 2014). Due to the inclusion of learner agency and personal authenticity, learners' emotional engagement in the classroom is increased (Arora et al., 2017; Larmer et al., 2015). Learner agency provides learners with the opportunity to communicate their thoughts and suggestions, and to make decisions that influence the PBTL processes. This recognises the learners' need to have some freedom to make their voices heard and contribute to decisions. This increases learner motivation (Larmer et al., 2015).

The personal authenticity included in PBTL also increases learner motivation as learners see the value of their efforts and the practical application of their work (Larmer et al., 2015). The element of authentic processes is beneficial to learners as learning is more meaningful when placed in real-world scenarios (Krajcik & Shin, 2014).

Another benefit of using PBTL is that it could support interdisciplinary work. This implies that multiple subjects or disciplines could be integrated into one PBTL project. This could assist learners in making connections across subjects and could contribute to an integrated understanding of their learnings (UQx LEARNx,

2018). The interdisciplinary nature of PBTL could assist learners in using skills and knowledge gained in one subject in other subjects, thus transferring learnings between contexts and thereby supporting deeper learning.

UQx LEARNx (2018) noted another advantage of PBTL, namely that it provides a levelled playing field where learners of different ability groups work toward a common goal. After all, PBTL allows for flexible teaching, providing an opportunity to develop projects suitable to learners' abilities and interests (Kendall, Etheredge, Moody & Cooper, 2014).

In South African classrooms, we have learners who speak many different languages and come from varied backgrounds (Spaull & Pretorius, 2019). The use of group work in a PBTL project provides a collaborative environment that allows learners to communicate with five to seven classmates instead of thirty or forty. This could be an excellent platform for learners to practise using the language of learning and teaching (LoLT) which could be different from their home language. This could assist with decreasing of performance anxiety because communication occurs in smaller groups (E3, 2020a).

PBTL uses purposefully selected small groups in which learners work. This is beneficial because some of the challenges associated with overcrowded classrooms can be mitigated by using small groups for PBTL (West & Meier, 2020). This could also assist the teacher to use group assessments. Classroom spaces may be small as a result of overcrowding but utilising bigger spaces within the school or rearranging classroom furniture could provide the space conducive to group work.

In summary, the benefits of including PBTL in a classroom is the development of competencies for a fast-changing world, the fostering of deeper learning, increased learner motivation, engagement, interdisciplinarity and the meaningful use of group work. PBTL also affords learners the opportunity to practise speaking and listening in a language other than their home language, and teachers' assessment load could be reduced due to groups submitting assessment tasks rather than individual learners.

There are also challenges associated with implementing PBTL. Integrating multiple subjects in a PBTL project can make monitoring and assessment of learning difficult because various subjects' curriculums are included (UQx LEARNx, 2018). To mitigate this, subject teachers could work together in determining the

curriculum inclusions of each subject and base the assessments on the curriculum inclusions.

Another challenge of implementing PBTL is the less-structured learning environment (UQx LEARNx, 2018). This could be hard for both learners and teachers. Learners who struggle with a lack of structure or who are not intrinsically motivated (UQx LEARNx, 2018) may find PBTL stressful. Teachers might struggle to maintain productive classroom management because of the increased learner agency, group work and tasks that take place over a longer period of time and the complexity of the tasks (Mergendoller & Thomas, 2005).

There are two components that complicate classroom management in PBTL (Morgan & Slough, 2013). The first is to create activities within the PBTL process that will maximize learning and the positive behaviour of learners (Morgan & Slough, 2013). This requires careful planning that enables the learners to learn as much as possible while remaining engaged and therefore behaving in a manner that contributes to an orderly classroom environment.

The second component is the varied elements associated with collaborative work (Morgan & Slough, 2013) which is central to PBTL. Morgan and Slough (2013, p. 103) suggested planning for training learners within groups on the roles within groups and the goals and rules when working within groups, how to monitor team progress and what accountability implies when working in groups. The teacher should also plan how to regain order if chaos ensues.

In summary, there are challenges associated with implementing PBTL in a classroom such as the assessment of respective subjects when various subjects have been integrated, as well as maintaining an orderly classroom environment. However, there are numerous benefits to including PBTL and careful planning could assist teachers in mitigating the challenges.

Summary

This chapter explored project-based teaching and learning as a pedagogy. We looked at the definition of PBTL, its core characteristics and the differences between PBTL and "dessert" projects. To support teachers in planning for PBTL implementation we drew on PBTL frameworks that provided detailed descriptions of elements unique to PBTL. We explained the benefits of including PBTL. A major

benefit is that PBTL can be used to create significant learning experiences for learners (see Chapter 1). Since PBTL reflects real-world problems/issues, it provides opportunities for learners to practise those skills necessary for the fast-changing world. Due to these benefits teachers are encouraged to experiment with PBTL.

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Questions to think about

1. What role does PBTL play in your own teaching practice/teaching approach?
2. What role could PBTL play in the development of an entrepreneurial mindset?
3. How do you think inquiry can be foregrounded in your planning for PBTL?
4. How can you design assessments for PBLT using assessment tools already in your classroom?

Chapter 7

An exemplar of project-based learning from South Africa

Susannah Morcowitz & Margie Worthington-Smith

Introduction

This chapter gives some insight into how some of the practices and their theoretical underpinnings presented in preceding chapters have been implemented in the South African context. In this chapter, we will hear from South African teachers how they have used a project-based teaching-for-learning approach that has been informed by the South African context as well as selected aspects from the science of learning literature.

This chapter is divided into two parts, each framed as a question:

- How has the South African context presented the foundations for the teaching-for-learning approach presented in this exemplar?
- How have relevant insights from the science of learning been used to inform and grow the teaching-for-learning approach?

The second question draws on examples from South African classrooms as well as presenting teaching tips that teachers can apply in their classrooms.

Before these questions are addressed, it will be helpful to set the scene for why this teaching-for-learning approach has been implemented by highlighting some initiatives and policies of the Department of Basic Education (DBE) aimed at preparing learners for a changing world. If the purpose of (13 years of) schooling is to prepare learners with the skills, attitudes, values, mindsets (collectively referred to as competencies) and knowledge that they will need to thrive and navigate successfully in a rapidly changing world, we suggest that the schooling process needs to consider its role in sustaining, growing, and launching learners on their life-long learning journeys. A way of doing this is by providing learners with the tools to thrive as "entrepreneurials" – people who create value for others by finding innovative solutions to problems – in a rapidly changing world (DBE-E^3 2022).

This chapter provides the reader with anecdotal insight into how the DBE's intentions for embedding the entrepreneurial mindset have been applied in some schools and how this has impacted the learners with encouraging effect. Early feedback leads us to make the reasonable assumption that, should learners participate in environments where the teaching-for-learning approach that the DBE-E^3 programme is implementing is in place, they will be better prepared to create value and be innovative after school.

7.1 The South African context

In this section, four initiatives and policies within the South African schooling context that laid the foundations and created opportunities for the emergence of this teaching-for-learning approach are referenced.

These initiatives and policies include:

- **The Entrepreneurship in Schools (EiS) Programme:** Since 1994, there have been many policies and amendments focused on preparing young people with the skills they need to succeed in a changing world. Starting in 2011, a think tank called the Entrepreneurship in Education Technical Task Team (EETTT) spent seven years researching how the education sector could assist with reducing youth unemployment. This culminated in the establishment of the Entrepreneurship in Schools (EiS) initiative in 2018, which was later known as the DBE-E^3 programme. E^3 is a DBE innovation programme in the Director General's Office. Its goal is to prepare learners with the skills they need for a changing world so that they will be able to engage in the economy meaningfully and actively either in **E**ntrepreneurial activities, finding **E**mployment or continuing with further **E**ducation (DBE-E^3, 2020, p. 1).
- **Aims, purpose, and principles: Curriculum and Assessment Policy Statement (CAPS) Grades R-12.** The intentions of the CAPS is to prepare learners with the skills to identify and solve problems, work effectively in teams, organise and manage themselves, collect and analyse information and communicate effectively. These are stated in the Aims, Purpose, and Principles section of the CAPS (DBE, 2011 p. 5). While these are not explicitly defined as constituting the entrepreneurial mindset, these competencies and the skills of teamwork, communication, and problem solving are important skills that make up the entrepreneurial mindset.

- **The existing third term school-based assessment project:** Currently the third term assessment is a project. This provides a very important and useful (strategic) entry point to support teachers in using project-based teaching for learning as an approach for learners to practise their entrepreneurial mindsets.
- **GEC Assessment project:** In addition to offering learners the opportunity to practise their entrepreneurial mindsets, the DBE is widening its assessment criteria (especially in grade 9) to include not only academic progress but also the competencies that characterise the entrepreneurial mindset (DBE, 2021).

These initiatives and policies within the South African education system created a context for the formation of the DBE-E^3 programme (formerly EiS) and the emergence of the teaching-for-learning approach that aims at preparing young people with the skills they need to succeed and thrive when they leave school. To find out more about these DBE initiatives listed above, please see Appendix 4.

7.2 Insights from the Science of Learning

How have insights from the science of learning literature been used to inform and grow the DBE-E^3 teaching-for-learning approach in South Africa? The intention of this chapter is not to repeat the insights from the science of learning literature covered in other chapters (especially Chapter 1 and 2), but to highlight how some of the principles derived from the science of learning literature have been used to inform a South African approach to teaching-for-learning and to provide some real-life examples and practical tips. In this section, we will illustrate how the DBE-E^3 teaching-for-learning approach incorporates some elements of the principles of the science of learning. In particular, we examine how a supportive environment for optimal learning is set up, using productive instructional strategies such as project-based teaching for learning to grow learners' abilities to become lifelong learners after they finish school. See Figure 7.1 below.

7.2.1 Supportive environments for optimal learning

How do we set up a supportive environment for optimal learning? Implications derived from the science of learning literature indicate the type of teaching and learning environments that are needed to support the development of the whole child. We saw in Chapter 2 that learning is not purely cognitive but also involves emotions, and that one role of the teacher is to create a classroom climate that is conducive to learning.

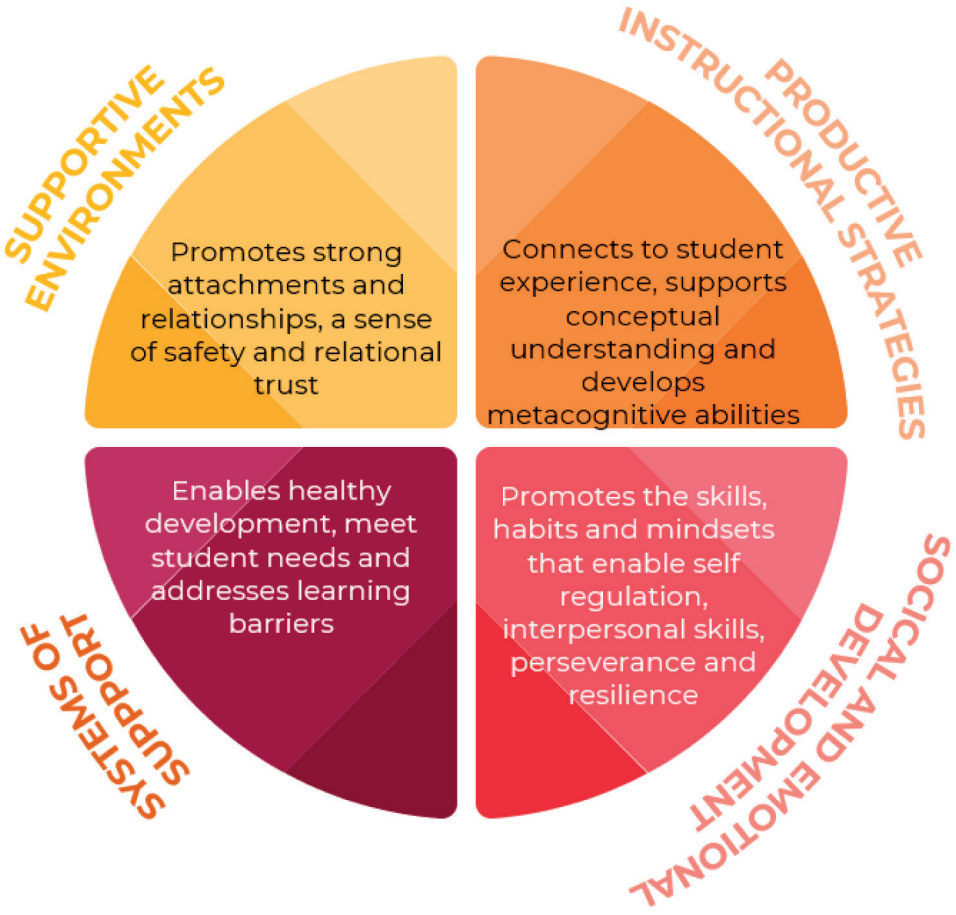

Figure 7.1: The science of learning principles of practice (Adapted from Darling-Hammond et al., 2019).

A supportive environment for optimal learning allows learners to feel safe to collaborate, inquire, make mistakes and learn from them (Darling-Hammond et al., 2019). The elements of a supportive learning environment that Darling Hammond et al. (2019) and Osher et al. (2020) suggest are key are: building positive relationships between teachers and learners, getting to know learners well, and building trusting relationships. We also saw in Chapter 2 that environments conducive to learning need to be places where learners feel psychologically safe, to feel free to be able to make mistakes and to learn from these.

7.2.1.1 Teacher example: supportive environments

Let's look at an example from *Fatima Ajimudin at Laerskool Dutoitspan* that demonstrates how she endeavoured to create a supportive environment:

> *In my classes, I give learners the opportunity to share their opinions. I always ask my learners 'what do you think about this?', 'what would you have done?', 'how would you …?' However, we need to create an environment of tolerance and trust where learners feel safe to share their opinions.*
>
> *When I first started teaching, I found it very difficult to support learners to feel safe to share. I looked at this and eventually got the impression that the reason learners didn't initially share was because*
>
> - *they didn't feel good enough,*
> - *they didn't have a good impression of themselves,*
> - *they had not been told that they can do things.*
>
> *I don't know if this is only in South African schools, but this is what I have found across several schools in my career.*
>
> *We need to build relationships with our learners, to really get to know them. It's not good enough to say, 'you there in the back'. We need to see each learner we teach as a somebody. We have a meme: 'speak to your children as if they are the most important and the smartest person and that is what they will become'. Because I had six children and was a stay-at-home mum, I really began to understand that children need someone to understand them and believe in them.*

7.2.1.2 Teacher tips: creating a supportive environment

Here are some suggestions for things you can try in your classrooms to create a supportive environment. What else can you think of?

- Body language matters! A smile goes a long way. We saw in Chapter 2 that emotional contagion (the spread of emotions from one person/people to another) can be triggered by facial expressions, and if positive, like a smile, can positively support learning.
- Take time to listen more and speak less.

- Show learners you are also human; acknowledge mistakes and show how you have learnt from them.
- Show that you really care about your learners.
- Get to know them as individuals, what do they like, what their interests are.
- Be a role model, your actions become what they learn.

7.2.2 Productive instructional strategies

What productive instructional strategies can be used to optimise learning and grow learners' entrepreneurial way of being? There are different instructional strategies that teachers can use that will lead to learners developing the skills, competencies, values, attitudes, and knowledge that they need to succeed in a changing world. However, the DBE-E^3 programme has chosen to use project-based learning, because as was stated above, the school-based assessment for the third term is a project.

We will address the question above by splitting it into two parts:

- **project-based learning** (PBL) as an appropriate instructional strategy to support motivation, competence, and self-directed learning (some of the elements of an entrepreneurial mindset) (Darling-Hammond et al., 2019.)
- **the methods** aimed at ensuring that optimal learning takes place

7.2.2.1 Project-based learning (PBL)

We saw in Chapter 1 that the brain is malleable (Darling-Hammond et al., 2019). The structure of the brain changes in response to learning and vice versa. This is important for teachers because it means that learners can learn and improve, even if they find something difficult. Once teachers understand this, they can design significant learning experiences using the project-based teaching for learning approach to provide learners with the opportunity to improve their learning.

Krajcik and Shin (2014) explain from a situated learning perspective that to form "usable understanding", *knowing* and *doing* cannot be separated from opportunities for learners to solve problems and make their own decisions as they solve real-world and relevant problems. Project-based learning is an example of a productive instructional strategy that enables learners to apply their knowledge to solve real-world and relevant problems. It is not the only approach that can support "usable understanding", however. Project-based learning is an

approach that forms part of the existing school-based assessment. Project-based learning also provides an approach that effectively unlocks the intentions of the CAPS curriculum, it is suitable to all grades (Chapter 4) and cultivates learners' entrepreneurial mindset because it mirrors the way entrepreneurial people think and act (see Chapter 5).

7.2.2.2 Teacher example: Project-based learning

Let's look at an example from a Grade 6 Maths project from Brebner Primary School, presented by Michelle van den Nieuwenhof:

I wanted to create my own project-based learning project. My first step was to create a ***real-life, relevant and authentic problem****. This was quite a challenge for me. One day I was attending a sale of repossessed vehicles when the idea came to me. So many vehicles get repossessed in our country and immediately I thought maybe I should do a lesson on 'how to buy a car?' or 'can I afford a car?' My driving question for the project was 'How can I buy a car' or 'Can I afford to buy a car?' Now that I had my idea, I was able to approach my principal. Thankfully for me, I have a principal who is really open-minded. I sat down and I got halfway through my story when he said to me, "Michelle you go for it." The only condition was that learners still needed to do all the CAPS assessments.*

The next step was to make sure I covered all the PBL design elements, so I used the Buck Institute of Education PBL model as it was well known to me. The most important thing was that whatever I did, it had to be CAPS aligned. So, all my academic planning and all my worksheets and everything was CAPS aligned.

I already had my driving question, "How can I buy a car?" I then considered how this question would be sustained over time. How was I going to do this? Every week or every second week, I would introduce a new aspect to buying a car. For example, car prices, then insurance, building a garage and fuel consumption. So, to sustain inquiry I kept on introducing new things or new points about buying a car.

The next thing I considered was how I would enable ***learner autonomy*** *or student voice and choice. Well, here they had a voice because they could ask questions. Part of the project was that they had to design questions to ask the car dealers or to ask the insurance company or the bank. My final part of the project gave them a lot of voice and a lot of choice. With buying the car, they*

also had to make a decision. I actually gave them pay slips and then they had to choose which car would suit their budget.

Reflection *Initially it was a problem for me because I wasn't quite sure how I would get the learners to reflect on everything. I worked with the English teacher, and we used English reports as part of the reflection for the project. For* ***iteration****, there was continuous revision of math principles and things that they had to do.*

The public product *We had a final evening where we invited the parents, the school governing body, the learning facilitator, the car dealership who helped us (I'll get back to that a bit later) and then the banks. So, in the report-back there was a lot of public product involved, and the learners could thank the companies. A lot of their creativity was exposed in the report-back right at the end of the project. For 'public product' you need to use businesses around you. What I did was I used a local car dealer and also a local bank. The local car dealer was really open to everything and really made it very, very easy. And the bank was then very happy to come and speak to the learners and also give them information about the insurance section of the project. Once I had gone through the whole design element circle, I saw that I had everything covered and I then just linked this to the CAPS.*

7.2.2.3 Teacher tips: designing your own project

If you would like to plan your own project-based learning project, here are 12 questions you can ask to get started:

1. What curriculum content do I want to cover in my project?
2. What skills or competencies do I want my learners to develop and grow through this project?
3. What real-life and relevant situations can I think of that relate to Questions 1 and 2?
4. Using real-life situations, how can I turn this into a challenge or problem for learners to solve?
5. What sort of products or services do I want learners to come up with? Note: This will help you to see if your chosen challenge will work, and if it is age-appropriate for your learners. When learners do the project, they need to choose what they want to create.

6. How can I create opportunities for collaboration through the project?
7. How can I support learners to make their own decisions in the project?
8. What are the sequences of events that will happen in the project, i.e., what activities are learners doing and in what order?
9. How can I create clear, concise, and easy-to-follow instructions that help my learners use autonomy in how they run the project?
10. When, where and how will feedback, reflection and iteration happen during the project?
11. Do I have enough time to run this project during school hours?
12. What ideas can I come up with for learners to be able to share their experience in some form of public exhibition, and are these ideas feasible?

7.2.3 Methods to optimise learning

How can we optimise learning and grow the entrepreneurial way of being? Darling-Hammond (2020), David Osher et al. (2020), and Zosh et al. (2018), identified five features that are conducive to optimising learning. In Chapter 5, we saw how these features are important in cultivating the entrepreneurial ways of being children use before they start school. These feature in learning environments that are active (minds on), engaged (not distracted), and meaningful (learners are able to apply prior knowledge and transfer learnings to the outside world). In addition, the learning environment is socially interactive and allows for opportunities for iteration and joy. You might recognise these from Chapter 4 as some of the characteristics ascribed to guided play.

The DBE-E^3 teaching-for-learning approach is built on the work of Zosh et al. (2017, 2018), Darling-Hammond (2020), and David Osher et al. (2020), and identifies seven elements that are essential in activating project-based learning so that learners have opportunities to grow their entrepreneurial mindsets. DBE-E^3 used these seven elements to create the acronym S.P.E.C.I.A.L. using core words from each of the elements: **S**ocially interactive, **P**urposeful, **E**njoyment, **C**uriosity, **I**teration, **A**ctively **E**ngaging, **L**earner autonomy. These seven elements support the project-based learning process. Let's look at how this happened in the classroom of Michelle van den Nieuwenhof during her maths project-based learning project.

7.2.3.1 Teacher example: implementing S.P.E.C.I.A.L. in the classroom

Socially interactive – interacting or working together with others to achieve a goal

*The elements of S.P.E.C.I.A.L brought the project to life. Group work and **social interaction** are very important. It was hard to compile suitable groups, but what I did was identify 8 learners that had good empathy skills, and were kind, but firm. These were my 'human resource managers' – one for each group. They helped the group to solve problems and work collaboratively, for example if one learner really struggled, the human resource manager would rally the team to support the learner. I spent time coaching the human resources managers to explain how things worked.*

It was worth the time. Within each group there were different roles and responsibilities, I called them portfolios. All the different portfolios could meet on a regular basis and share their learnings with people from different teams. For example, if all the secretaries met, they began to realise they were not alone and could share problems and solutions with each other.

Purposeful – building on prior knowledge and connecting what is learnt in the classroom to the real world

*Finding **purpose** and making sure that the project remained relevant to the learners was really important. For example, if I created a project on solar powered cars, many of the learners might not find relevance or purpose in that. However, they were very keen on finding out how to buy a car, because it was something that they could relate to.*

Enjoyable – the deeper sense of joy we feel when we work hard and finally master a challenge

One group really struggled to work out the fuel consumption of their chosen vehicles – this is a grade 6 class, so it wasn't an easy task. One group member went to another group to get more information.

*You could literally see the lights come on when he explained back to his group – they felt like they could conquer the world. Throughout the project, there were different moments that the learners **enjoyed**, and this would then motivate and encourage the other learners.*

Inspires **C**uriosity – discovering information and exploring one's interests

> *Curiosity was one aspect that I could have worked on more. For example, I would have liked for the learners to ask more questions and explore more elements related to the topic, e.g., electric cars. This was the first time they were doing this, so there is plenty of room for iteration of the project for me and the learners.*

Iterative – trying, learning, applying learning, and each time doing something better and better

> *Iteration evolved spontaneously. I think that if you plan your project properly, it will happen. For example, when we created our scale version of our garages for our cars, one project came up too small, they eventually worked out that they rounded their numbers down. While the rule is anything below 0.5 would be rounded down, in reality, they realised they needed to round up and adjusted accordingly.*

Actively engaging – persisting through distractions; being fully absorbed in the activity

> *In my classroom there was a constant hum of activity. I was often in trouble with other teachers as the learners did not want to go to other classes because they were so actively engaged in my maths class.*

Enables **L**earner autonomy – making decisions about learning and being self-directed

> *Learners need to be able to make decisions, knowing that decisions have consequences. In making their own decisions, learners had to decide how to find the answers to the problems they were solving. For example, in my project, each group was given a 'pay slip' from which they had to research and choose which pay slip would best suit their budget. Throughout the project, the learners had to design questions to ask the car dealers, the insurance company or the bank.*

7.2.3.2 Teacher tips: activating S.P.E.C.I.A.L. in the classroom

1. Socially interactive

Social interaction is about interacting or working together with others to achieve a goal.

Social interaction is important because:

- Learners help each other when they work together, so there are more 'teachers' in the classroom, and fewer people fall behind.
- Learners can develop a better understanding of the class content because they ask more questions.
- Learners have the opportunity to develop empathy because they have a better understanding of each other when they work together.
- Learners are better prepared for the real world – in the real world, people have to socially interact when working together.

Here are some examples of how you could include more social interaction in your class:

- Create opportunities for discussions where learners work together in small groups.
- Used paired work and peer-to peer-feedback.
- Give learners opportunities to listen to each other.
- Use teamwork or group work.

2. Purpose

'Purpose' is the reason why we do things or why something exists. We are likely to focus on information or activities that we find purposeful, meaningful, and useful. Purpose relates to meaningful learning, helping learners to connect information or an experience to something they already know (Chapter 4).

Teaching with purpose in mind means helping learners understand 'why'. Why do we wear a school uniform? Why do we need rules? Why is reading important? Why do we even go to school? As soon as learners discover real purpose or meaning in what they do and can connect what they learn and do at school to their lives outside of school, motivation improves, and stronger learning takes place. As learning connects to learners' lives, learning has purpose and meaning. There is a good reason for learning – it unlocks the motivation to learn.

Here are some examples of how you could include more purpose in your class.

- Bridge learning from school to learners' lives outside of school and what they already know. Find out what learners know and link it to that, e.g., if you are

teaching the concept of "time", find out who can tell the time, what they use to tell time, find out how long it takes for learners to get to school, what does it mean to be early or late, what makes them late, what time do they get up in the morning and go to bed at night? Ask the class why time is important, and what would happen if there was no time?

- Make it real. For example, bring fractions to life by slicing oranges, or portioning out juice.
- Listen to learners' voices. Ask them what they think. Ask them why they think we learn about trees or compound interest or chemistry or percentages or poetry.
- Connect to their future. Ask how, or if, the information they are learning is important for them if they want to become an entrepreneur, study further, or find employment.

3. Enjoyable

The element of **enjoyment** in the context of a S.P.E.C.I.A.L. learning environment does not mean fun and games. It means the deeper sense of joy we feel when we work hard and finally master a challenge (Zosh et al., 2017, p. 19). There is natural joy in learning, and we often see it in young children.

Have you ever seen a child stand up and take a step for the first time, or tie a shoelace on their own? Do you remember the joy on their face? That is the joy we are referring to here. We want learners to feel that same deep sense of satisfaction of putting in the effort to overcome a challenge or solve a problem.

Ways of including enjoyment in the class

- Your attitude towards learning goes a long way. In Chapter 2, we saw the importance of creating an environment conducive to learning, and how cognition and emotion cannot be separated. Very simply, we saw that emotional contagion (the spread of emotions from one person/people to another) is both a positive and a negative thing in a classroom. Teachers are role models and, as such, need to consider the emotions they project during the class. By projecting joy and enjoyment in class, you will set a positive tone in your classroom. Consider your facial expressions and your body language, what do you think these might say about how you are feeling? Your words and your body language need to support the same message.

- A problem-solving approach to teaching and learning such as project-based learning is useful for creating opportunities for joyful learning. It provides learners with opportunities to work on solving authentic, meaningful problems, and working collaboratively as they persist through challenges to solve the problem. "Sometimes frustration with a problem is necessary to feel the joy of the breakthrough when it is finally solved" (Zosh et al., 2017, p. 19). Working collaboratively in a group provides support so that no one needs to feel overwhelmed by a challenge (this will kill the joy). Through project-based learning, there are opportunities for iteration and reflection as learners try and learn and try again until they succeed.

4. Curiosity

Curiosity is about exploring and ultimately understanding the world. Curiosity is sparked by a need to explain the unexpected and to discover more about the unknown.

Research into curiosity has referred to it as a foundation for active engagement (Dehaene, 2020, see also Chapter 1). Studies also show that young children can ask hundreds of questions every day, all driven by their curiosity about and need to understand their world.

Ways of including curiosity in the class

- Let learners see and hear you being curious about what you are teaching. Curiosity is catching! Role model curiosity.
- Acknowledge and value learners who demonstrate curiosity – show them that it matters.
- The path of curiosity leads from one question to another; so teach learners how to ASK lots of different types of questions. Don't worry if you don't know the answers. We saw the importance of supporting learners to ask questions, and how this drives both curiosity and intrinsic motivation to learn in Chapter 3.
- Start the lessons with a question that sparks some thinking. For example, if teaching about "time", start the lesson with the questions, "What if we had no clocks or watches and no time except for daytime and night-time. What would our lives be like?"

- Problem-solving approaches such as project-based learning stimulate curiosity because there are problems to explore and solve.

5. Iteration

Iteration (repeating) is part of the natural learning cycle. Trying, failing, learning from mistakes, and trying again is the way people learn – each time doing something better and better and learning from this process.

In real life, we cannot get things right the first time. We have to make mistakes and learn from these.

Ways of including iteration in the class

- Have a discussion with learners about failure and mistakes. Start the conversation with questions such as, "Can failure ever be a good thing?" or "What if no one ever failed?" or "What if the inventors of aeroplanes gave up after their first try at a flying machine failed?"
- Introduce the word "YET". Changing your choice of words from "Your sum is wrong" to "You didn't do this sum right, yet", gives learners a feeling that they are on a learning journey that is not yet finished.
- Iteration depends on getting feedback that guides improvement.
- Problem-solving approaches such as project-based learning includes opportunities for feedback, reflection, and iteration.

6. Active engagement

To be active or to act is to do something and be involved. When people are actively engaged with an activity, they are fully focused and absorbed in what they are doing. You know those times when a child is so deeply involved in what they are doing they don't even hear you call? That's an example of active engagement.

As we saw in Chapter 1, being actively engaged in learning is a crucial pillar of learning. Active engagement is about what happens in our brains while we try to understand something. It is unlikely that learners will learn if they are passively receiving information from a teacher.

Ways of including active engagement in the class

- Create opportunities for learners to interact socially and work together to solve problems.

- Enable learners to connect what they learn in school to their life outside of school.
- Encourage learners to ask questions because they are curious.
- Make sure they have lots of opportunity to iterate and to try and try again to improve a product.

7. Learner autonomy

Learners have autonomy when they get to make decisions for their learning and become self-directed. For example, self-directed learners do not wait passively for teachers to give them information and resources to fix their mistakes, or to create study timetables – they take action to find the information to solve the problem, fix the mistake, etc.

Ways of growing learning autonomy in the class

- Try to hand over as much (appropriate) responsibility to learners as possible. For example, if a group of learners working on a project-based learning project comes to you with a problem, respond with a suggestion: "How might you solve this problem?" or "What other information might you need to solve this problem?" or "What else can you think of to …?"
- Enable learners to ask their own questions. We saw in Chapter 3 that there are many benefits to learners asking the questions, leading to stimulating learner curiosity and intrinsic motivation to learn.
- Use approaches like project-based learning to strengthen learner autonomy. We saw in Chapter 4 that in project-based learning "learners engage in self-directed learning because they are provided with opportunities to make decisions about the PBTL process".

Summary

This chapter has taken us on a journey that looks at an example of a teaching-for-learning approach that has its roots in the South Africa educational context and is informed by the science of learning. We saw how the DBE has made a commitment to entrepreneurship education and to preparing young people with an entrepreneurial way of being so that they can succeed in a rapidly changing world. We then explored how insights from the science of learning informed the teaching-for-learning approach by looking at:

- A caring environment and how it is essential for optimal learning. A caring environment is essential for learning to happen. It enables learners to feel safe to make mistakes and learn from these during their learning journey,
- Project-based learning as one instructional approach that provides learners with opportunities to solve complex problems, communicate effectively and over time become self-directed (Darling-Hammond et al., 2019, p. 13). The process of project-based learning mirrors the way entrepreneurial people think and work and enables learners to practice and grow their entrepreneurial way of being, and
- The methods, how the elements of Social Interaction, Purpose, Enjoyment, Curiosity, Iteration, Active engagement and Learner Autonomy (S.P.E.C.I.A.L.) activate project-based learning.

This South African exemplar is included to show that it is possible to make the reasonable assumption that should learners participate in environments where these principles and methods of supporting learning are in place, they will be better prepared with the skills they need for a changing world (i.e. the entrepreneurial way of being).

> *It created great excitement towards learning. For the first time, learners were really positive about learning. They didn't sometimes even realise they were learning. They were discussing things young kids would never discuss. The learners today really need a different approach towards teaching, and I think the most difficult thing is the majority of teachers just don't realise that. We still teach how we were taught.*
>
> *Teacher, Michelle van den Nieuwenhof*

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Questions to think about

1. After reading the teacher stories in this chapter, what ideas do you have for projects that can create significant learning experiences for learners? Remember, you can refer to the 12 steps when planning your own project.
2. How do you think you could practically bring more S.P.E.C.I.A.L. learning elements into your classroom, the wider school environment or even your personal life?
3. What, if anything, surprised you about the DBE-E^3 teaching-for-learning approach?
4. After reading this chapter, what advice would you give to a fellow teacher who told you she was frustrated that her learners were not interested in her lessons?

Appendices

Appendix 1: Teaching techniques

This serves as a teaching toolkit related to the principles articulated in Chapter 1.

Note the following:

- Though teacher actions/teaching techniques are stated in relation to each principle, the principles and their possible implications for teaching, including the tools/techniques, are intertwined. Many also relate directly or indirectly to Chapter 2.
- Always use tools/techniques in a thoughtful way. Be mindful that no technique is a silver bullet. Teaching is multi-faceted and complex. Many factors play a role in teaching, including the nature of the subject matter, the age of learners, the background and existing knowledge of learners, the size of the class and the personality of the teacher. There are no recipes for teaching and no "best" teaching practices/ actions (teaching methods/ techniques). Teaching decisions and practices should always take account of purpose and context.
- We recommend that you read Chapter 3 in conjunction with this.

How can I elicit, review and build on learners' existing knowledge/previous learning?

- Ask open questions to elicit learners' existing knowledge/previous learning to ascertain what they already know/understand, what they partially know and what they misunderstand. Involve all learners in answering questions.
- Involve learners in reactivating previous knowledge through revision of previous work that is related to the new learning content, using open questions or quizzes.
- Identify gaps or misconceptions in learners' prior knowledge through diagnostic assessment activities and address these before introducing new knowledge.
- Show learners at the beginning of a lesson an attention-grabbing image/ picture related to the learning content and ask them: What do you notice? What do you wonder about? This will give you some insight into their current understanding and it may also serve to pique their curiosity.

- Ask learners to make individual and collective "knowledge dumps". This means asking them to tell you everything they know, or think they know, about the theme/topic before you begin teaching them.
- Make the connections between new content and learners' existing knowledge explicit throughout the lesson.
- If learners know very little about a subject/topic, "create" prior knowledge by providing them with a framework in which they can "place" new knowledge. A graphic depiction, pictures or a short video could be helpful.
- Use familiar examples throughout the lesson to help learners link new things/ideas to what they know.

What should I do to capture (and recapture) learners' curiosity and attention and direct their thinking to focus on the core content that they are supposed to be learning?

- When designing a lesson, start with what learners should know and/or be able to do by its end. Make the learning goal/aim explicit to learners, phrased as a key question. Why a question? Because meaningful open questions spark curiosity, which is important to focus attention. Also – if you as the teacher keep the focus question in mind throughout the lesson, it helps you and the learners to accomplish the aim/objectives.
- Build the lesson around the key question. Phrase the question in a way that will engage learners' curiosity. The lesson then provides an "answer" to the key question. Ensure that the key question has the right level of difficulty to engage the learners and to stretch them while respecting their limitations due to their existing knowledge about the theme/topic. Pay attention to the "why" of the question, which relates to purpose – share the why (so what?) with learners (see Chapter 2).
- Design the lesson to tell a story. The key question serves as the conflict/issue of the story. Read more about this: https://www.aft.org/periodical/american-educator/summer-2004/ask-cognitive-scientist
- Ask learners to generate questions that they may have about the topic. Use these questions as an entry point or indicate how the questions will be addressed in the lesson.
- Use the beginning of the lesson to grab learners' attention (as a hook) in relation to the key question that the lesson addresses – thus what you want

them to think about in the lesson. A good hook provides anticipation, taps into learners' existing knowledge, and helps learners to focus on the content you are about to teach. The hook could, for example, be presented as a puzzle to learners, through telling a relevant story, showing an applicable intriguing picture or video clip and having learners share their thoughts about these.

- Engage learners in predictive activities prior to teaching the learning content. Predictive activities could include inviting learners to answer open questions about what they are about to learn or experience (before teaching them); showing them a video clip or pictures in relation to the key question and asking them to predict what they will learn; requiring them to solve a problem that is beyond their current ability level, but that they would be able to solve by the end of the lesson or series of lessons.
- Require learners to attempt to solve a problem, followed by talking about their thinking processes, before teaching them the solution. Trying to solve a problem before being taught the solution leads to better learning, even when errors are made in the attempt. This is referred to as generative learning.
- Use provocative questions purposefully throughout the lesson to stimulate curiosity and effortful (hard) thinking.
- Incorporate novelty and surprise to highlight key ideas. This can, for example, be done through using provocative questions and statements, interesting images, relating the lesson to current events, using relevant anecdotes, using humour or cartoons, playing music related to the topic, using rhyme and rhythm.
- Emulate techniques used by advertisers to gain the attention and interest of their audience, for example, do a "commercial" about the theme/topic.
- Invite students to tell personal stories of how the topic relates to their lives or ask them to brainstorm how they might be able to apply the new learning both now and in the future.
- Involve all learners in answering open questions through full class participation techniques.
- Allow thinking time after asking a question before requiring an answer.
- Use "small" stories/anecdotes to illustrate key points.
- Use learning tasks that guide learners to focus their attention on the meaning of content.

- Involve learners in tasks that require them to make their learning explicit/ visible through drawings, graphic representations, etc.
- Create opportunities for elaboration. Elaboration is the process of giving new learning content meaning by expressing it in your own words and connecting it with what you already know. This can be done, for example, by asking learners to explain how the new learning content relates to what they already know, explaining it to a peer, or explaining how it relates to their life outside of class.
- Listen carefully to learners' responses and build on their responses.
- Guide learners' attention using questions and remarks that focus on core ideas, stimulate their thinking, imagination and interest, and make them want to delve deeper and learn more – in other words – harness their curiosity.
- Help learners to find relevance of learning content by using real world examples and applications for the content being taught. A potential problem with examples is that the learners may remember the concrete example, but not remember the underlying idea/concept. If one is not knowledgeable about a topic/subject, it is difficult to make connections from concrete examples to ideas. Therefore, teachers must purposefully and explicitly support learners to make these connections.
- Use multiple examples and prompt learners to compare and examine the features that are common to each. Also use contrasting non-examples to draw learners' attention to the boundaries of the concept/idea.
- Require learners to elaborate on the similarities and differences among examples and non-examples.
- Require learners to sort examples and non-examples and to explain the reasons for sorting the examples in a particular way.
- Model using a few examples of how to solve a given problem, making your thinking explicit, followed by giving learners similar examples to be solved.
- Create opportunities for learners to integrate the ideas that you teach them with concrete examples of their own.
- Require learners to generate summaries (orally or written) of key ideas, for example restating concepts in their own words and elaborating on the concepts by generating examples of them.
- Create opportunities for learners to apply learning in new situations.

- Use concepts/mind maps to show learners the connections between concepts or ask learners to construct concept maps/mind maps to illustrate connections.
- Help learners to impose meaning on hard-to-remember content through using stories and imaginative mnemonics. See: https://www.aft.org/sites/default/files/periodicals/willingham_0.pdf about using mnemonics.

How should I teach to ensure that learners' working memory is not overloaded and to aid retention of knowledge in the long-term memory?

- Present new learning content in steps/chunks/stages/segments interspersed with assessment for learning tasks. This is particularly important if learners have limited background knowledge of the topic.
- Direct learners' attention to the most relevant learning content/key ideas you want them to learn.
- Slow down when dealing with complicated learning content and regularly use assessment for learning tasks to gauge understanding.
- Help learners to link new learning content to what they already know.
- Help learners to link new learning content to their own lives.
- Use multiple modalities when presenting new material e.g., complement talking with visual representations (including only relevant detail) that correspond with the talking (dual coding).
- Use retrieval practice activities regularly to reinforce important knowledge.
- Create opportunities for learners to regularly practise important knowledge/skills (spaced practice), coupled with checking and feedback. Note that practice should not be equated with mere repetition or drilling. Practice is purposeful. It implies performing (an activity) or exercising (a skill) regularly in order to improve proficiency. Also, good feedback is informative, i.e., specific, focused on specific features of the task rather than the learner, explanatory and focused on improvement (provide suggestions how to improve).
- Check for understanding throughout the lesson, using carefully chosen open/higher order questions that require explanation.
- Ask learners to jot down the most important ideas you have covered, followed by asking them to get together in groups of two, three or four to compare and discuss what they found to be the key ideas.
- Help learners to create graphic organisers, drawings, acronyms, and other mnemonic devices to aid retention. Creating e.g., graphic organisers, acronyms,

rhymes and songs are effective to support retention because they involve analysis (e.g., in how concepts connect in graphic organisers, for example), identification of key words to assemble into short, memorable chunks and repetition of information as students work out lyrics and acronyms.

- Use summarisers throughout and at the end of a lesson to relate to the "bigger picture" and to consolidate learning.
- Close class by asking learners consolidation/synthesis questions.

Note: The recent book by Doug Lemov, "Teach like a champion 3" (2021) includes some techniques that relate to some of the ideas put forward in Chapters 1, 2 and 3 of this book. I recommend this edition.

Appendix 2: Synthesis, summary or reflection questions and questions to improve metacognition

Synthesis, summary or reflection questions are valuable open questions in that they invite learners to identify and reflect on important ideas or their experiences. Gravett, (2022) gave the following as examples:

- What are the two most important ideas/new things that that you have learned in this lessons? Explain why they are important.
- I expect you to share with your mother/sister/brother/aunt/grandma what you have learned today. What will you tell/him her?
- What about your thinking, learning, or work today did you enjoy most (or brought you the most satisfaction)? Why?
- What lessons did you learn from failures or errors today? Where did you encounter difficulties in today's lesson, and what did you do to deal with it? How will you use the lessons learned today in the future?
- What did you find difficult or challenging today? Why? How did you deal with the difficulty?
- What made you curious today? Why?
- What were some things that I did today (as teacher) that was useful to you to help you learn?
- What were some things that you did today that helped you to learn?
- What were some things that you did today that helped your classmates to learn?

- What did your classmates do today to help you learn?
- How will you use what you have learned today in future?

Questions to improve metacognition (Gravett, 2022)

Teachers can encourage the development of metacognition in the classroom by requiring learners to use metacognitive strategies at key stages of a task. This is also useful when learners work in groups on an assigned task.

- Before a task, learners should be prompted to ask themselves: Is this similar to a previous task – if so, in what ways? What do I want to achieve? What should I do first?
- During the task: Am I on the right track? What can I do differently? What help do I need (when stuck)? Who can I ask for help?
- After the task: What worked well? What could I have done better? How can I apply this to other situations?

More questions to stimulate metacognitive strategies when learners engage in a task that could be shared with learners to help them monitor their learning:

- Comprehension (What is the task about?)
- Connection (What are the similarities/differences between this task and ones you have performed in the past?)
- Strategic (What are the strategies/tactics/principles/steps needed to solve the task, and why should I use these?)
- Reflection (What am I doing right now? Why am I doing it? Does the result make sense? Can I solve it differently?)

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Appendix 3: Types of presentations for PBTL

Presentations include a type of live performance	Learners can present a project in the form of writing for a particular audience	Media and technology products	Constructed products
Speech Debate Storytelling Public event	Research report Letter Training manual Blog Brochure Scientific study/ experiment Field guide	Audio recording/ podcast Slideshow Drawing/ painting Video/ animation Web pages(s) for website Computer program/app	Small-scale model Consumer product Device/machine Vehicle Scientific instrument Museum exhibit Structure

Appendix 4: How has the South African educational context provided a foundation for the teaching-for-learning approach in the exemplar?

It is important to view this approach within a broader context. This teaching-for-learning approach has the potential to activate the entrepreneurial mindset and equip learners with the skills and competencies they need to cope with the demands of a rapidly changing world. As such, it is well aligned with the intentions of educational change advocates both locally and internationally.

Globally, the WEF (Wilson et al., 2009) suggests that "entrepreneurship education is essential for developing the human capital necessary for the society of the future; it is not enough to add entrepreneurship on the perimeter ... it needs to be at the core of the way education operates." This belief was echoed by South African President Cyril Ramaphosa who said: "As a country we have identified youth employment as one of our foremost priorities ... we need to harness their energy ... to meet the challenges of the present and the future. That is why we are providing young people with pathways from learning to earning." President Cyril Ramaphosa: Response to debate on SONA 2021.

Embedding entrepreneurship into the curriculum

Since 1994, the Department of Basic Education has instituted a number of different policies and amended them aimed at educational reform. In 2011, a think-tank, then known as the Entrepreneurship in Education Technical Task Team (EETTT) was established to research how the education sector could significantly reduce youth unemployment. The formation of E^3 was the result of the think-tank with the teaching-for-learning approach emerging through E^3's investigation into how education can better prepare learners with the skills they need to participate in **E**ntrepreneurial activities, find **E**mployment or continue with further **E**ducation.

Historical context of the Journey of Entrepreneurship in Education at the end of this chapter

1997

The introduction of outcomes-based education in 1997 (known as C2005), in its design feature, ushered in entrepreneurship as a phase organiser. This meant that all learning areas (subjects) across all grades were required to integrate

entrepreneurial skills and knowledge as practical activities in their lesson plans. This was a ground-breaking directive. The aim was to equip learners with real-life skills for personal development and to promote the idea of sustainable economic growth and the development of the community. However, the challenges experienced during the implementation of C2005 prompted the revision of the curriculum in 2000.

2000

This led to the first curriculum revision: the Revised National Curriculum Statement (RNCS) Grades R-9 and the National Curriculum Statement Grades 10-12 (2002). This led to the introduction of new subjects like Economic and Management Sciences from grades 4 – 9, Business Studies, Consumer Studies and Tourism in grades 10-11, to mention just a few. Unfortunately, this led to more of a focus towards a subject-driven approach to entrepreneurship rather than embedding entrepreneurship across all subjects.

2009

A second review process was commissioned in 2009. As per the recommendation of the Ministerial Task Team, the two National Curriculum Statements, for Grades R-9 and Grades 10-12 respectively, were combined into a single document in 2012, known as the National Curriculum Statement (NCS) Grades R-12. Ongoing implementation challenges resulted in another review in 2009 which culled EMS as a subject in the intermediate phase (grades 4-6). Currently EMS is taught only in the senior phase (grades 7-9).

2012 – Present

The National Curriculum Statement for Grades R-12 provides clearer specification of what is to be taught and learnt on a term-by-term basis. The National Curriculum Statement Grades R-12 represents a policy statement for learning and teaching in South African schools and comprises the following: (a) Curriculum and Assessment Policy Statements (CAPS) for all approved subjects listed in this document; (b) National policy pertaining to the programme and promotion requirements of the National Curriculum Statement Grades R-12; and (c) National Protocol for Assessment Grades R-12.

2011 and HRDC mandate

The Human Resource Development Council (HRDC) established the Entrepreneurship Education Technical Task Team (EETTT) through an initiative of the Presidency. This became known initially as Entrepreneurship in Schools (EiS) and now is DBE-E^3 (Entrepreneurship, Employability and Education of the Department of Basic Education (DBE)). The intention was to research entrepreneurship across four departments (Higher Education and Training (and TVET colleges), the Department of Trade and Industry, the Department of Small Business, the Department of Basic Education). In 2014, the HRDC mandated the DBE to implement Entrepreneurship in schools. The goal is to prepare learners with skills for a changing world.

The aims and objectives of the CAPS

The need to prepare learners thoroughly with skills and competencies for life after school is one of the main aims of the CAPS. This is evident in the Aims, Purpose, and Principles section of the CAPS National Curriculum Statement Grades R-12 which indicates that learners who leave school should be able to:

- **identify** and **solve problems** and make decisions using critical and creative thinking;
- work effectively as **individuals** and with others as **members of a team**;
- **organise** and **manage** themselves and their activities responsibly and effectively;
- **collect, analyse, organise** and **critically evaluate** information;
- **communicate** effectively using visual, symbolic and/or language skills in various modes.

While these aren't articulated specifically as the entrepreneurial mindset described in Chapter 5, they are nonetheless critical elements of this mindset and reference the entrepreneurial qualities that are needed for success in education, employment or entrepreneurship.

School-based assessment, project-based learning in the third term

A variety of forms of assessment are recommended in the CAPS, with Term 3's assessment being in the form of a project. The GET Life Orientation School-Based Assessment Guide defines projects as: *"… an assessment task that requires*

considerable effort, used to enable learners to apply their knowledge and skills, carried out in groups. Involving collecting, analysing and/or evaluating data and information that will result in the synthesising of the findings into a written product that may be reported, modelled or performed by the learners. Learners will generally collect data/ resources/information outside the contact time to perform the task."

Capitalising on this opportunity, the DBE-E^3 programme has integrated project-based learning into the teaching-for-learning approach. Project-based learning creates opportunities in the classroom that mirror the thinking and learning processes characteristic of successful entrepreneurial people. This is important because growing an entrepreneurial mindset takes practice, so what better place to create opportunities for learners to develop and enhance their entrepreneurial skills than throughout their 13 years of schooling (DBE-E^3, 2022).

Measuring competencies as a formal assessment

In addition to offering opportunities for learners to develop their entrepreneurial mindsets, project-based learning offers teachers the opportunity to measure or quantify learners' development more broadly than is currently done. Through project-based learning, the so-called "soft skills" that make up the entrepreneurial mindset can be evaluated and tracked. With this in mind, the DBE, together with a number of stakeholders, is testing and learning ways in which these competencies and skills can be measured and reported on formally. Widening the assessment criteria to include not only academic progress but also competencies that characterise the entrepreneurial mindset provides a context that confirms and supports the teaching-for-learning approach.

This section has described the initiatives within the South African education system that created a context for the formation of E^3 and the emergence of the teaching-for-learning approach that prepares young people with the skills they need to succeed and thrive when they leave school.

TEACHING FOR LEARNING IN A FAST-CHANGING WORLD

The genesis of this open-source book is the need for a text about teaching for pre-service and in-service teachers that foregrounds learning, by drawing on the literature of the science of learning. This book draws on multiple perspectives on the science of learning using the very latest research. The first two chapters serve as a broad underpinning for the rest of the book.

This book aims to prepare teachers for the rapidly changing world in which they have to teach. The authors see a clear link between a focus on learning and the preparation of teachers for a future that is volatile, uncertain, complex, and ambiguous, often referred to by the acronym VUCA.

Learning is foregrounded in the book, but always in relation to teaching. Lesson design is explored using dialogue and inquiry. The importance of playfulness is foregrounded to create and environment conducive to learning. Another contribution in this book is the focus on supporting teachers to develop an entrepreneurial mindset in learners across all disciplines. Project-based learning (PBTL) is deemed as a particularly useful inquiry-based pedagogy that connects knowledge gained within the classroom (curriculum knowledge) and real-world problems. The last chapter of the book brings together some threads from other chapters and presents an exemplar of project-based learning in South Africa.

Readers should find stimulating and relevant ideas on teaching for learning in a fast-changing world. Teachers could implement these ideas reflectively in their own classrooms, or in the case of pre-service teachers, in planning lessons and when teaching during school practicum.

The DBE- E^3 programme supported the development of this book, funded by the LEGO Foundation.