The constructivist learner: Towards a genealogy

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Abstract

This thesis traces the genealogy of constructivism in Australian primary mathematics education. I place my focus on the mathematical learner and consider how this learner has been shaped, in turn and together, by three significant forms of the discourse—Piagetian, radical and social constructivism. Motivated by my own experiences as a primary teacher and educational publisher, I investigate how it has been possible for the constructivist learner to become a leading learner subjectivity in mathematics education today and analyse the effects of this predominance.

To study this ‘problem’ of the constructivist learner, I follow Michel Foucault’s genealogical approach to discourse analysis, and undertake a history of the present. Drawing on a range of documents including curriculum frameworks, mathematics education association material and teacher education texts, I study the constructivist learner of three different eras—1965–1975, 1985–1995 and 2005–2015. I examine the conditions of possibility for each learner, consider who this learner is allowed to be, and, who is allowed to be this learner. Taking a step back from taken for granted assumptions about constructivism, I reflect upon what this opens up and closes down for learners and learning.

The thesis analyses the constructivist learner as a shifting subject, emerging from historical-cultural contexts, and in response to theoretical shifts in—and pedagogical recontextualisations of—the constructivist discourse. However, the thesis also finds certain continuities in the conceptualisations: the constructivist learner is engaged, active, a rational thinker and a collaborative problem-solver. I propose that this subjectivity embodies Australia’s hopes for the ideal 21st century citizen and fears for those who fail to attain this ideal. While these aspirations are future-oriented, I claim they attach to our progressivist past as well as our neoliberal present.

In understanding subjectivity as both discursively produced and mutable, I argue that the constructivist learner is neither a natural, nor necessary, subjectivity and that its dominance has closed down the possibility of other learner subjectivities. Rather than arguing against constructivism, I seek a consideration of other types of learners and space for other learning theories.
Declaration

This is to certify that:

i. the thesis comprises only my original work towards the Master of Education except where indicated in the Preface

ii. due acknowledgement has been made in the text to all other material used,

iii. the thesis is fewer than 22,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Rachel Flenley

Preface

Professional, accredited editor Mary-Jo O’Rourke AE provided copyediting and proofreading services, according to the guidelines laid out in the university-endorsed national ‘Guidelines for editing research theses’.
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Chapter one: Introducing the problem

Perhaps the most significant discourse to enter the field of mathematics education in the last fifty years has been that of constructivism (Ernest, 2010; Thompson, 2014). Imported into the field in the 1960s, most obviously through the formation of cognitive psychology, it remains—in the shape of social constructivism—a leading perspective on knowledge acquisition and learning today (Ernest, 2010; Sullivan, 2011b). The seeds for this thesis were sown in the late 1980s, when radical constructivism was emerging as a powerful discourse in Australian primary mathematics education (Lovitt, 1993; Mousley, 1993). As a young student teacher teaching a mathematics lesson in a Year Two classroom, I was castigated by my supervisor for telling the group that the shape I held in my hands was a triangle. I was told in no uncertain terms that my role was not to provide this information. Instead, it was to create opportunities for students to construct this understanding themselves through exploration and personal discovery. This encounter troubled me. As a product of a progressivist 1970s upbringing and education, I viewed the hands-on and open-ended approach of constructivism as both natural and ‘right’, but I struggled with the notion that providing information, at what I saw as a point of need, could be wrong.

Twenty-five years later, while naming a triangle is no longer frowned on in the same way, current learning theories still support the view that knowledge is constructed and perceptions of ‘best practice’ still hold that this process of construction occurs most successfully when students actively grapple with personally problematic situations (e.g. Cai & Lester, 2010; Sullivan, Walker, Borcek, & Rennie, 2015). I now work as a publisher for an online mathematics program and it is the teacher feedback we receive that provided the impetus for this study. In response to requests for ‘interactives’, ‘more problem-solving and reasoning’ and ‘less drill and skill’, I began considering why it is that we primary teachers take constructivist touchstones such as collaboration, activity and problem-solving as self-evidently good. How do these pedagogical rules emerge and why do we hold to them so tightly, often unwilling to allow for the possibility of other ways of teaching and learning? I also began thinking about the shifts that have occurred within constructivism and the effects of these on
learner subjectivity. How we conceptualise the ‘constructivist learner’ today is subtly different to our conceptualisations of previous years, yet we don’t seem to notice that these transformations have occurred, nor acknowledge that they change the rules on who can be successful in mathematics education and how this success can be achieved (Popkewitz, 2009; Zevenbergen, 1994b).

This thesis, therefore, investigates mathematical constructivism. I explore how it has been possible for the discourse to become a leading discourse in Australian primary mathematics education today and consider the effects of this dominance. I place my focus on the learner and offer in this report one narrative on how it is that we have come to view the ‘constructivist learner’ as leading learner subjectivity, and one reading of what might have been gained and lost in doing so. I begin in this chapter with a brief overview of the discourse, followed by an outline of the study.

Surveying constructivism

The idea that learners construct knowledge has been in existence for some time, available to us through the work of theorists such as Immanuel Kant and Giambattista Vico (Noddings, 1990). At its core is the epistemological assumption that knowledge or meaning is ‘actively constructed’, not passively received by the learner (Richardson, 2003). However, there is no one theory of constructivism; Matthews (1999), for example, identifies eighteen forms of ‘it’. Similarly, Phillips (1995) observes the complexities in categorising constructivism, noting that each theory offers interdependent, sometimes commensurate, sometimes contradictory, epistemological, psychological and philosophical positions on the nature of knowledge. Pedagogical constructivism also adds to the complexity. While in the original theorisations constructivism is a theory of knowing, constructivism is often presented in mathematics education literature as a theory of teaching and learning (Airasian & Walsh, 1997; Noddings, 1990). These complexities make constructivism and its history, to borrow Popkewitz’s (2008, p. 20) words, a ‘difficult story to tell’, particularly within the limited confines of a Master’s thesis.

Following McLeod and Yates (2006, p. 38), I use the term ‘subjectivity’ rather than ‘identity’ to draw attention to the constructed nature of the learner. He or she does not have a ‘simple, presumed essence’ but, rather, is formed through ‘a range of influences, practices, experiences and relations’.
One approach to this telling is to use Michel Foucault’s notion of ‘interruptions’, to identify key ‘displacements and transformation of concepts’ (1970, p. 5, original emphases), which allow us to avoid the ‘search for silent beginnings and never-ending tracing back’. In mathematics education, it is generally agreed that three major transformations can be identified—psychological, radical and social constructivism—aligned with psychologists and theorists Jean Piaget (1896–1980), Ernst von Glasersfeld (1917–2010) and Lev Vygotsky (1896–1934) respectively, and that most constructivist theories emerge, in some way, from these (Thompson, 2014). I chose to make these interruptions the focus of this study. To provide some context for their emergence, I now locate them within a chronological framework and in relation to other learning theory ‘interruptions’ of the 20th and 21st centuries. A summary of this work can be found in Appendix 1.

**Pre-constructivism (1920s–1960)**

In the first half of the 20th century, associationism as propounded by Thorndike (1922) dominated primary mathematics education (Lambdin & Walcott, 2007). Learning was conceptualised as the development of stimuli and response bonds. Good teaching therefore involved transmitting manageable ‘chunks’ of information to students, who engaged in drill and practice routines to consolidate knowledge of these bonds. In the 1940s, the progressivist discourse of ‘meaningful arithmetic’ also became influential. This approach, often drawing on Gestalt theory, placed an emphasis on mathematical relationships and real-world learning (Connell, 1980; Lambdin & Walcott, 2007). Key threads from these discourses—hierarchical knowledge development from the former and activity from the latter—paved the way for the acceptance of Piagetian constructivism.

**Piagetian constructivism (1960s–early 1970s)**

The first constructivist interruption saw a shift from the focus on learner behaviour to mental processes. This occurred in the late 1950s–early 1960s and was made possible by the emergence of cognitive psychology as a discipline. Leading psychologist Piaget rejected the conceptualisation of children as *tabula rasa*—blank slates—and the idea that knowledge could be transmitted. Instead, he framed intellectual growth as a constructive and self-organising process on the part of an active and self-aware
learner (Halpeny & Pettersen, 2013). He also proposed a universal developmental progression. Through this work and that of psychologists who followed Piaget, such as Jerome Bruner, educators became newly interested in investigating the mental structures and processes that allowed learners to make meaning (Palincsar, 1998). They sought to provide opportunities for this growth, advocating pedagogies involving play, discovery learning and experimentation.

Piaget’s theories also informed and became closely associated with the ‘New Math(s)’ movement. Bruner was also influential in this regard, with his seminal publication *The process of learning* (1960) an important impetus behind a growing focus on mathematical structures and relationships. This New Math(s) dominated educational practice from the mid–late 1960s until the early 1970s, when it was generally considered to have failed (Steffe & Kieren, 1994). This resulted in a return to a behavioural approach at the classroom level, an approach now informed by the work of psychologists such as B. F. Skinner and Robert Gagné, who stressed the importance of sequential learning sequences and, once again, drill and practice (Walshaw, 2013). At the research level, however, the groundwork for the next constructivist shift was being laid through the work of researchers such as Erlwanger, Smock, Richards and von Glasersfeld (Steffe & Kieren, 1994).

**Radical constructivism (1980s–1990s)**

The next constructivist interruption was the emergence of radical constructivism in the mid–late 1980s. While radical constructivism originates with Piaget’s genetic epistemology, already in existence, it was, as Ernest (2010, p. 41) notes, most fully worked out and brought to mathematics education by von Glasersfeld and colleagues. The most obvious ‘disrupter’ was embedded in their precept that there is no direct correspondence between knowledge and reality and, as such, reality can never be known. All knowledge is therefore considered fallible and idiosyncratic by radical constructivists (Ernest, 1993). This presented a significant break from the absolutist view of knowledge held by mathematicians of the time, one that had been left undisturbed by Piagetian constructivism (Noddings, 1990).

The speed and force with which radical constructivism entered the field of mathematics education and was transformed into pedagogical imperatives
(Kilpatrick, 1987; Thompson, 2014) matched the magnitude of this epistemological and ontological schism. Confrey and Kazak (2006) cite a focus on action, activity and tools, and development of new teaching methods and assessment techniques as key shifts. These new methods offered a direct challenge to the behaviourist approach, with ‘math(s) wars’ between those advocating constructivist reform and those arguing for the maintenance of status quo, taking place in this era (Schoenfeld, 2004). While radical constructivism was able to gain ascendancy over behaviourism particularly at the research and curriculum development levels, it failed to produce notable change in student achievement at the classroom level and gradually ceded power to social constructivism over the 1990s (Confrey & Kazak, 2006).

**Social constructivism (1990s–today)**

This third interruption was a shift from perceiving thinking as a *psychological practice* to the idea that knowledge development emerges from *social activity* and cannot be separated from its sociocultural and historical contexts (Lerman, 2000; Palincsar, 1998). Social constructivism draws on Vygotskian theory—introduced to the West in the late 1970s by educational psychologists Bruner and James Wertsch—and initially entered the field of mathematics education towards the end of the 1980s, gaining prominence over the 1990s (Lerman, 2000). It remains in place as a leading discourse in mathematics education, with ‘ideal’ classrooms characterised by ‘small teams of learners talking to each other, by groups of students voicing their opinions in whole class discussions, and by children and grownups grappling with mathematical problems in real-life situations’ (Kieran, Forman, & Sfard, 2001, p. 1).

**Studying constructivism in Australian primary mathematics education**

Locating constructivism’s trajectories within the field of Australian primary mathematics education during the years of 1965–2015 and examining shifts in the

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configuration of the constructivist learner was the work of this study. There are a number of ways to undertake such work; I chose to draw on the conceptual resources provided by Michel Foucault (1926–1984) and conducted a genealogical 'history of the present'.

This form of critical history begins by identifying a present-day practice that is both ‘taken for granted and yet, in certain respects, problematic’ and then works ‘to trace the forces that gave birth to [it] and to identify the historical conditions upon which [it] still depends’ (Garland, 2014, p. 373). While the work is historical, the aim of a genealogy is not to gain a better understanding of the past but, instead, to understand how the present exists at all and to open up space for considering how this present might be otherwise.

With these aims in mind, the following questions guided my investigation:

- How has constructivism been constituted, reappropriated and reinterpreted in the field of primary mathematics education in Australia?
- Under what conditions and by which practices has constructivism been valued and devalued?
- Which discourses shape the figure of the constructivist learner?
- What learner subjectivity work do these discourses do?
- What other possible constructions have been excluded?
- What is the cost of this exclusion?

The thesis is structured as follows. I have introduced my ‘problem’ in this chapter. In the next, I present my review of the constructivist literature produced over 1965–2015. In chapter three, I bring together selected Foucauldian concepts to examine the ways in which discourses set down the rules for what is possible to ‘be, say and do’ (Gee, 2014) in particular times and places, and outline my study design.

In chapter four, I report on my investigation. I examine constructivism in Australian primary mathematics education in three periods of time—1965–1975, 1985–1995 and 2005–2015—eras in which the effects of each constructivist interruption appear to have been most profoundly felt, although I acknowledge and pay attention to how
each interruption reverberates through those that follow. Drawing on educational documents from each era, I trace the conditions that made the interruption possible, the mechanisms that held it in place and the effects it produced. I pay particular attention to uncovering the rules that govern who the constructivist learner could and should be, and to considering what this means for the learners who do not fit in these spaces.

In chapter five, I hold my empirical evidence against the literature to reflect on the three eras of mathematical constructivism and the learner(s) it produced. In the final chapter, I speculate on who this learner might become.

Creating a space for this imagining—moving the constructivist learner off centre-stage so that we can more easily consider what other learners and ways of learning might have to offer primary mathematics education—is the fundamental objective of this investigation.
Chapter two: Literature review

This chapter is a review of the literature on Piagetian\(^3\), radical and social constructivism in primary mathematics education over the period of 1965–2015. I undertook this work to see how each form of constructivism is represented in the academic literature as a *theory of knowing* and is (re)interpreted in the scholarly and teacher educational material of the relevant era as a *theory of teaching and learning*. As I appraised the pedagogical material, I searched for patterns and regularities in statements made in relation to the learner and his or her learning needs, and I use these discursive threads as organisational referents for this literature.\(^4\) A summary of these threads, their relationship with the theory and common pedagogical (re)interpretations is presented at the end of each shift, and as one document in Appendix 2.

I also review the literature to see what attention has been paid to tracing how it has been possible for the constructivist discourse to become a leading discourse in Australian primary mathematics education and what analyses exist in terms of its impact on learner subjectivity.

**Piagetian constructivism: A theory of knowing**

*Piaget’s stage theory and genetic epistemology*

Two interrelated theorisations have been particularly influential in mathematics education, Piagetian stage theory and genetic epistemology (Steffe & Kieren, 1994).

Piaget’s stage theory posits that all children progress through four universal stages of intellectual development: sensory-motor, pre-operational, concrete operational and formal operational (Tall, 2002). At each stage, children possess certain intellectual resources on which they can draw—knowledge and capabilities that Piaget identifies

\(^3\) I use the term ‘Piagetian’ rather than ‘psychological’ to distinguish between this and von Glasersfeld’s radical interpretation of psychological constructivism.

\(^4\) The literature review assumes the form of a modified thematic review. Discursive threads can be considered to be themes.
as mental ‘schemas’ (Dimitriadis & Kamberelis, 2006). Primary-aged students, the focus of this study, are usually considered to be at the third, concrete-operational stage. In this developmental phase, children can imagine objects they have acted on or events they have experienced previously, and reflect on the results of that activity. They can then categorise these results to create classes of actions or ‘operations’. These then become integrated with other operations to form generalised systems of thought (Tall, 2002).

Following Kant, Piaget conceptualises these schemas as cognitive structures actively built up or constructed by the learner. However, where Kant views these structures as pre-existing in the mind, Piaget views them as ‘products of development’ (Noddings, 1990, p. 8) themselves. His theorisation of this developmental process is called his genetic epistemology. In this, Piaget posits that children are born with a very basic mental schema and then actively build on this through an auto-regulative process called equilibration or adaptation. When new information fits with previous knowledge, it is assimilated into the child’s existing mental schema and the schema grows. When new information challenges existing knowledge, a state of disequilibrium is created. To regain equilibrium, children may alter the information in order to make it fit, ignore it or accommodate it. When accommodation occurs, the schema both grows and changes, and new knowledge is created (Ernest, 2010).

The process is recursive, and the relationship between content and structure interdependent. The mental structures are the products of previous knowledge and in turn become the building blocks for new knowledge (Ernest, 2010). The relationship between the old and new knowledge is finely balanced. If the new information is too different from existing knowledge and prior experiences, the learner, Piaget argues, will be unable to make sense of it. New knowledge always ‘draws its elements from some pre-existing reality’ (1980, p. 89). However, if the knowledge fits too closely, there is insufficient conflict for the state of mental disequilibrium needed for cognitive growth.

Activity and, crucially, reflection on that activity drive this process. Simon, Tzur, Heinz and Kinzel (2004) offer a useful theorisation of this. The learner performs actions on an object, physically and/or mentally, in order to meet some kind of goal. He or she
perceives the results and abstracts the relationship between the activity and the effect. Identifying and reflecting on patterns in these relationships results in mental reorganisation and the creation of new mathematical knowledge.

Piagetian constructivism: A theory of teaching and learning

The developing child

It is Piaget’s stage theory that appears most frequently, and in most detail, in mathematical teacher education literature of the era 1965–1975 (e.g. Australian Council for Educational Research, 1966 [ACER]; Cole, 1966; Copeland, 1970). Texts almost invariably include a synopsis of the theory and are usually accompanied by a description of the Piagetian logico-mathematical concepts (e.g. conservation of quantity, number composition and cardinality). This developmental discourse is often expressed as ‘readiness to learn’ (e.g. ACER 1966; Bruner, 1960), While the use of this term is widespread, pedagogic interpretations vary. Following Bruner (1960, p. 52), some accounts advocate for a spiral curriculum, teaching ‘big’ mathematical ideas at increasing levels of complexity as and when the child shows readiness. In other accounts, this readiness relates to intellectual capacity as determined by Piagetian stages and mastery of previously taught mathematical concepts (e.g. ACER 1966; Copeland, 1970; McNally, 1977). These latter accounts emphasise the hierarchical and sequential nature of knowledge development.

The active learner: Acting on objects

Another significant and widespread pedagogic interpretation of Piagetian theory is the notion that students, particularly young ones, must be active. Structured materials such as Cuisenaire rods and multi-base arithmetic blocks (MAB) on which students are to act—and learn from this action—feature heavily in teacher education material. While the scholarly literature tends to maintain the complexity of Piaget’s theorisation of the interplay between physical and mental activity (e.g. Simon et al., 2004; Steffe & Kieren, 1994), in many teacher texts it is reduced to a privileging of the physical activity and objects themselves (e.g. Cole, 1966; Ginsburg & Opper, 1969).
**A child-centred approach: learning through discovery and experimentation**

Piaget’s genetic epistemology posits that all knowledge is constructed from, and connected to, the learner’s prior knowledge and experiences (1980). This seems to have been widely interpreted as an imperative to restructure the teacher–student relationship. The student’s role is to act—to engage with mathematical materials and/or concepts—and the teacher’s role is to observe the learner, ascertain understandings and then provoke the necessary cognitive conflict to activate the adaptive process. Pedagogical interpretations of this imperative do vary, however, with emphases placed variously. Some accounts argue for a child-driven discovery approach (e.g. Matthews, 1973), while others support a sequential materials-based approach in which teachers carefully monitor student progress against proposed learning continua (e.g. Cole, 1966). Others, drawing from Piaget’s observation that student exchanges are more likely to lead to cognitive development than those between teachers and students (Palincsar, 1998), highlight the importance of small-group learning experiences (e.g. Education Department of Victoria, 1967).

The learning goal remains consistent, however: it is to develop students’ conceptual understanding, with procedural knowledge and ‘rote learning’ pedagogies consistently regarded as inferior (e.g. ACER, 1962, 1966; Cole, 1966; McNally, 1977).
Summary

Table 1  Summary of Piagetian constructivism

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive threads</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Children’s intellectual growth occurs in periods of generalised cognitive patterns.</em></td>
<td>Developmental stages dictate the types of learning experiences that a child should encounter and the learning that can occur.</td>
<td>Developing child</td>
</tr>
<tr>
<td><em>Knowledge cannot be passed on to a learner; it is actively constructed by the learner.</em></td>
<td>Good pedagogy therefore involves physical activity and opportunities for personal discovery.</td>
<td>Active learner</td>
</tr>
<tr>
<td><em>Knowledge construction occurs through the adaptive processes of assimilation and accommodation.</em></td>
<td>Learning experiences must connect to, and then challenge, the learner’s prior understandings and experiences. The teacher’s role is to observe and correctly diagnose understandings, and plan new, appropriate challenges</td>
<td>Child-centred approach Diagnosis</td>
</tr>
<tr>
<td><em>Human intelligence necessarily constructs a standard set of logico-mathematical structures.</em></td>
<td>Mathematical concepts such as conservation and cardinality develop in a fixed hierarchical sequence. Pedagogy (and tools) should be structured accordingly.</td>
<td>Developing child Conceptual understanding</td>
</tr>
</tbody>
</table>

Radical constructivism: A theory of knowing

Radical constructivist theory is based on Piaget’s genetic epistemology and has, at its core, two primary tenets:

1. Knowledge is not passively received but actively built up by the cognizing subject;

2. The function of cognition is adaptive and serves the organization of the experiential world, not the discovery of ontological reality (Glaserfeld, 1989c, p. 182).

The first precept aligns with Piaget’s genetic epistemology, outlined previously. It is the second tenet that departs from previously accepted understandings of this theory.
Thompson, 2014). While an ontological mathematical reality may or may not exist, von Glasersfeld argues it cannot be known; individuals construct their own idiosyncratic representations of the world and have no access to an external reality. Instead, drawing on biological and evolutionary metaphors, von Glasersfeld (1995a) proposes the notion of viability or ‘fit’. The thinking subject tests out his or her theories in and on the environment via the adaptive process envisioned by Piaget. Ideas that are considered viable become new knowledge and the building blocks for future development and action. Radical constructivism, von Glasersfeld (1983, p. 50, as cited in Ernest, 2010, p. 41) argues, thereby transforms the learner:

From an explorer who is condemned to seek ‘structural properties’ of an inaccessible reality, the experiencing organism now turns into a builder of cognitive structures intended to solve such problems as the organism perceives or conceives.

As radical constructivism draws from Piaget’s genetic epistemology, it is a theory of knowing (1995b). It is also essentially a post-epistemological position (Glasersfeld, 1989a; Noddings, 1990) and von Glasersfeld (1989a, 1989b, 1995a) hypothesises about its possible implications for pedagogy more extensively than Piaget. Key propositions are addressed below.

Radical constructivism: A theory of teaching and learning

Mathematical understanding: Multiple realities

Ontological positions⁶ on the subjectivity of mathematical knowledge and the pedagogical ramifications of this premise vary considerably and were furiously debated in the academic literature of the time (e.g. Ernest, 1994a; Kilpatrick, 1987; Phillips, 1995; Schoenfeld, 1992). These debates do not seem to have reached the teacher education resources, but what is clearly present is the sense that in any classroom there will be a multiplicity of understandings and ways of coming to these understandings.

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⁵ The Piagetian constructivism of the previous section is generally thought to have accepted the precept that absolute knowledge is attainable and that true representations of the world exist. This form of constructivism is sometimes referred to as trivial or simple constructivism (Ernest, 2010).

⁶ I take ontological questions to be about the nature of the knowable or ‘reality’. Should an objectivist or subjectivist (or better perhaps, relational) concept of mathematical knowledge take hold?
understandings, and that these should be accepted and valued. Significantly, they should also form the basis on which to teach mathematics (Lovitt & Clarke, 1985; Pengelly, 1985; Siemon & Booker, 1990; Steffe, 1991).

In an influential early article, von Glasersfeld (1989b) argues that knowledge cannot be transferred by means of words unless both speaker and listener hold compatible conceptualisations. Because this compatibility is unlikely or partial at best, he further argues that students who learn through personally oriented activity develop richer understandings than those who learn from textbooks or teacher talk. While some scholarly literature challenges this claim (e.g. Ellerton & Clements, 1992; Ernest, 1993; Noddings, 1990; Richardson, 2003), arguing that no such pedagogical restrictions exist, the message has been strongly taken up and (re)produced in teacher education resources of the era as no transmissive teaching (‘chalk and talk’ or ‘teaching by telling’), no rote learning (‘drill and skill’) and a rejection of pre-prepared materials (Kamii, 1989; e.g. Kamii & Ewing, 1996; Pengelly, 1985, 1989).

The active learner

Confrey and Kazak (2006, p. 18) note that constructivist learning is ‘grounded in action, activity and tools’. Activity is interpreted in three core ways in the literature: mental, physical and social. Early scholarly pedagogic interpretations of radical-constructivist theory tend to focus on mental activity as envisaged by Piaget, and consider how teachers might ‘problematise’ mathematical tasks to create situations of disequilibrium for students (e.g. Cobb, Wood, & Yackel, 1991; Glasersfeld, 1989b; Steffe, 1991). Some of the later literature directly links or conflates this ‘problematisation’ with a ‘problem-solving approach’. Teacher resource texts advocating learning through problem-solving, investigations and/or inquiry are widespread in the literature (e.g. English, 1997; Pengelly, 1989). These investigations are often conceptualised as physically active experiences, students interacting with the environment, objects and technology (e.g. Lovitt & Clarke, 1988b).

von Glasersfeld (1989b) and influential researcher educators such as Cobb, Yackel and Wood (1991; 1990) contend that, since each individual will construct or ‘see’ a mathematical situation differently, teacher–student interaction is required to lift student thinking up to view. Other articles by the same authors stress the importance
of student–student interaction in creating situations of cognitive disequilibrium (e.g. 1992; 1990). These ideas are taken up in the Australian teacher literature, with mathematical educators such as Sullivan (1997) Stephens (1997; 1993), Lovitt (1985, 1988a) and Pengelly (1990) arguing for pedagogic approaches that privilege language-based and collaborative learning activity.

**Student-centred learning**

This precept manifests itself variously in the literature. Some articles focus on the conative implications for pedagogy. For example, von Glasersfeld (1995b, p. 177) argues that all mathematical knowledge is instrumental as well as subjective and therefore ‘students will be more motivated to learn something, if they can see why it would be useful to know it’. He further argues that the ‘power of problem-solving greatly increases if the students come to see it as fun’ (1995b, p. 183). Australian educators such as English (1997), Ellerton (1986) and Lowrie (1999, 2002) contend that student-posed problem-solving fulfils these conditions, while also offering teachers valuable insights into student understanding. Others such as Stephens, Montgomery and Waters (1997) advocate scaffolded student involvement in teacher-led, rather than student-directed, investigative tasks.

Other interpretations of student-centred learning focus on the pedagogic relationship between teacher and students. Walshaw (2013) notes that for radical constructivists, pedagogy is often conceptualised as intervention, a theme which appears regularly in the literature (e.g. Cobb, 1988; Simon, 1995; Steffe, 1991). In these accounts, the teacher is to ‘guide from the side’, working to identify student thinking and misconceptions and, from this, create suitable learning experiences for each student. They must also use assessment practices that provide students with opportunities to represent their internal understandings and the processes they have employed to arrive at these. In the teacher education literature of the 1980s and 1990s, this appears to have manifested itself in the form of practical measures and directives—the use of student portfolios, annotated class lists, peer assessments, performance tasks and student reflection pieces (e.g. Clarke, Stephens, & Waywood, 1992; Clarke, 1996; Rowlands, 1998).
**Summary**

Table 2 Summary of radical constructivism

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>All knowledge is instrumental.</td>
<td>Students need to understand why knowledge might be useful to them. Learning activities must relate to their real-life experiences.</td>
<td>Student-centred learning Engaging the student</td>
</tr>
<tr>
<td>All knowledge is subjective.</td>
<td>Students will 'see' a mathematical situation differently to the teacher. Teachers need to infer students’ existing conceptual networks and provide learning experiences that build on these. (In)formative assessment.</td>
<td>Student-centred learning Diagnosis and intervention Conceptual understanding</td>
</tr>
<tr>
<td>Learning is the product of the active construction of viable conceptual networks.</td>
<td>Rote learning/memorisation does not lead to 'enlightenment' or understanding of broad operative principles. Problem-based learning is essential.</td>
<td>Problem-solver Conceptual understanding</td>
</tr>
<tr>
<td>Mental disequilibrium is required for the growth of new knowledge.</td>
<td>Problematic situations stimulate mental perturbation. However, for students to mentally engage with problems, they must see them as fun and personally meaningful.</td>
<td>Active problem-solver Engaging the student Student-directed learning</td>
</tr>
<tr>
<td>Concepts and conceptual relations are mental structures that cannot be passed from one mind to another.</td>
<td>Students who create their own understandings develop more powerful knowledge than those who learn from textbooks or teacher talk. Conceptual understanding is key.</td>
<td>Student-centred learning Active problem-solver Conceptual understanding</td>
</tr>
<tr>
<td>Social interaction and physical activity are opportunities for reflective abstraction.</td>
<td>Good pedagogy involves physical activity, group work and/or discussion. Good pedagogy is ‘activity-based’.</td>
<td>Active learner Collaborative learner</td>
</tr>
</tbody>
</table>

**Social constructivism: A theory of knowing**

While there are a number of social constructivist schools of thought, most find their roots in the work of Vygotsky (Ernest, 2010; Kieran et al., 2001). Two key theorisations have been particularly significant; his ‘general genetic law of cultural development’ and the related ‘Zone of Proximal Development’ (ZPD). These are outlined below. A brief outline of the uptake of social constructivism in mathematics is also offered to provide some context for the different pedagogic models that emerge in the teacher education literature.
General genetic law of cultural development

The premise of this law is that the individual, acting within their historical-cultural context, transforms socially shared practices into internalised processes and concepts (John-Steiner & Mahn, 1996). This development is mediated through the use of psychological tools, the most powerful of which is speech. For Vygotsky, speech, both internal and external, forms concepts; there is no knowledge outside of speech or the social realm (Daniels, Cole, & Wertsch, 2007). Vygotsky also distinguishes between spontaneous or everyday concepts and scientific concepts. While everyday concepts are in the main taken from interaction with adults, they tend to be highly contextualised and unconnected. When these everyday concepts meet the more structured and scientific knowledge possessed by a teacher or ‘other with more’, mature, connected and robust concepts are formed (John-Steiner & Mahn, 1996).

Zone of Proximal Development

This process takes place in what Vygotsky (1978) terms the Zone of Proximal Development (ZPD). While the ZPD can also be interpreted culturally and collectively, when interpreted as intellectual scaffolding it is:

the distance between the actual developmental level as determined through independent problem-solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p. 86).

Lerman (2001) suggests the ZPD is usefully conceptualised as a symbolic rather than physical or cognitive space, created by interactions between novices, experts, practices and circumstances: It is ‘often fragile’, ‘ever emergent’ and triggered by participants ‘catching each other’s activity’ (2001, p. 103). When this transient space holds for a time, those in it—teachers and learners alike—can become ‘mutually orientated towards socially and culturally mediated meanings’ (2001, p. 104).

Social constructivism in mathematics education

Early versions of social constructivism in the mathematical academic literature tend to draw from Piagetian and radical constructivist theory, and maintain or build on a
cognitive or ‘acquisitional’ (Sfard, 2002) position on knowledge development (e.g. Bauersfeld, 1988, 1992, Ernest, 1990, 1991). A shift towards a ‘knowledge as participation’ (Sfard, 2002) or ‘situated learning’ (Lave, 1988) perspective appears in the literature in the early to mid-1990s, with re-theorisations by Ernest (e.g. Ernest, 1994b) influential. Lerman (2000) suggests this was enabled by an emerging interest in the work of Vygotsky (e.g. Bruner, 1986; Wertsch, 1981) and the conceptual resources being created in three disciplines: cultural anthropology (e.g. Lave, 1991), sociology (e.g. Walkerdine, 1988, 1997) and cultural psychology (e.g. Crawford, 1988). Common to these is ‘the need to consider the person-acting-in-social-practice, not person or their knowing on their own’. (Lerman, 2000, p. 12). As Walshaw (2004b) notes, however, the take-up of Vygotskian ideas has been heterogeneous and many theorists, while aligning their perspectives with social constructivism, maintain an ‘acquisitional’ position on knowledge development. This seems to be the case in much of the teacher education literature in particular, where the individual is often considered the unit for analysis.

Social constructivism: A theory of teaching and learning

**Targeting learner needs: Keeping students in their ZPD**

Interpretations of Vygotsky’s ZPD vary enormously across the pedagogic literature (Lave & Wenger, 2012), although, as in the academic literature, most tend to read it psychologically. Renshaw (1998, p. 87) notes that the most widely quoted definition appears to be ‘the distance between what a child can achieve alone, and what a child can achieve with the assistance of a more advanced partner’. Mathematical educators such as Mousley, Sullivan and Zevenberg (2007, p. 466) focus on a concept omitted from this interpretation, ‘as determined by independent problem-solving’. They take from this the need for a pedagogic approach that promotes mathematical learning through the provision of challenging but appropriately scaffolded problem-solving experiences. Teacher education articles advocating such a problem-solving approach are numerous and have become particularly prevalent in recent years (Cai, 2003; e.g. Cai & Lester, 2010; Roche & Clarke, 2014; Sullivan, 2011b; Sullivan & Davidson, 2014; Sullivan, Mousley, & Zevenbergen, 2006).
Wood, Bruner and Ross (1976) are generally credited with introducing scaffolding to the West, the term acting as a metaphor for the provision of graduated assistance to the novice (John-Steiner & Mahn, 1996, p. 193). Early interpretations tend to promote learning through modelling and imitation (Desforge & Bristow, 1994; Palincsar, 1998), while current teacher education resources highlight the importance of scaffolding through the provision of enabling prompts or task modification, rather than the provision of different tasks for higher/lower achieving students (Holton & Lovitt, 2013; Hunter, 2007; Small, 2012; Sullivan et al., 2015). Learning trajectories—predicting student thinking and planning activities or curricula—are another device designed to keep students working in their ZPD. Previously only appearing in the academic literature (e.g. Mousley et al., 2007; Simon, 1995; Sztajn & Confrey, 2012), this form of instructional design is appearing more frequently now in teacher education literature, particularly that emerging from the United States (e.g. Clements & Sarama, 2004; Confrey, 2012).

*Learning through ‘productive discussion’*

Semiotic mediation—the sharing and development of cultural knowledge and practices through language, signs and symbols—sits at the centre of Western interpretations of Vygotsky’s work (Daniels, 2005). In the field of mathematics education, research educators such as Cobb, Yackel, Wood (e.g. 1996; 1996; 1990) and Lampert (1990) were influential early adopters of a socially-oriented understanding of, and approach to, knowledge development. Following this work and supported by more recent research (e.g. Davis, Elliott, & Garner, 2009; Goos, 2004), much of the teacher education literature of today encourages teachers to create collaborative and discursive learning environments where students engage in ‘collaborative problem-solving’ and ‘productive discussion’ (e.g. Booker, Bond, Sparrow, & Swan, 2004; Davis et al., 2009; Stein & Smith, 2011). In such accounts, ‘talking about mathematics becomes acceptable, indeed essential ... and mathematical discussion, explanation, and defence of ideas become defining features of a quality mathematical experience’ (Walshaw & Anthony, 2008, p. 516).
Learning as a member of a mathematical ‘community of practice’

Lave and Wenger’s (1991) conception of ‘communities of practice’ has been highly influential in the field of mathematics education (Palincsar, 1998). In this theorisation, learning is seen to have four integrated components: experience (constructing meaning), doing (learning certain practices), belonging (being part of a community) and becoming (forming identity) (Wenger, 1998). In a mathematical context, Goos, Galbraith and Renshaw (1994, p. 306) describe this as the ‘adoption of particular forms of language, conventions regarding representations of ideas, methods for resolving differing viewpoints, and procedures for proposing and defending conjectures’.

Support for the implementation of these communities and practices appears consistently in the scholarly literature (e.g. Boaler, 1999, 2001; Cobb & Yackel, 1996; Forman, 2003; Goos et al., 1994; Goos, Galbraith, & Renshaw, 2004; Mousley et al., 2007). In teacher education resources, usage of the term itself is not prevalent, but the general principles remain and the learning approach is widely advocated (e.g. Australian Association of Mathematics Teachers, 2016; Booker et al., 2004; Stein & Smith, 2011; Sullivan, 2011b).

Foregrounding the learner

Another (related) strand of social-constructivist research pays attention to the ways in which political–economic structures and shared cultural systems of meaning create or limit access to learning opportunities for students (e.g. Boaler, 1997, 2002a; Chronaki, 2011; Zevenbergen, 1994b, 1996; Zevenbergen & Lerman, 2001). Educational policy documents and mathematical association statements (Australian Association of Mathematics Teachers, 2006 [AAMT]; Australian Curriculum and Assessment Reporting Authority, 2015; National Council of Teachers of Mathematics, 2014 [NCTM]) appear to be significant conduits for the dissemination of these ideas to teachers, highlighting issues of access and equity faced by particular groups. Recently, articles or texts with a focus on identity formation—how students come to see themselves as mathematical learners and the impact of this—have become increasingly widespread, in both the academic literature (Boaler, 2002b; e.g. Boaler & Greeno, 2000; Walshaw & Brown, 2011; Zevenbergen, 2003) and teacher education material (Boaler, 2015a, 2015b; Sullivan, 2011a).
Summary

Table 3 Summary of social constructivism

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition develops from social and cultural processes.</td>
<td>Learning and development take place in ever-changing socially and culturally shaped contexts. The teacher’s role is to facilitate ‘communities of practice’ and be aware of social, affective, motivational and identity-formation issues within these.</td>
<td>Student-centred learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communities of learners</td>
</tr>
<tr>
<td>Language leads learning.</td>
<td>Students learn through active participation in mathematical discussions and debate. The teacher’s role is to guide these discussions, monitor responses and lead students to more sophisticated mathematical understandings.</td>
<td>The rational, dialogic learner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Student-centred learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developmental learner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Active learner</td>
</tr>
<tr>
<td>Zone of Proximal Development</td>
<td>Teachers should understand what students know and provide differentiated, problematic learning activities that challenge and develop current understandings. Learning trajectories help teachers track progress and plan appropriate instruction.</td>
<td>Student-centred learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem-solver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Developmental learner</td>
</tr>
</tbody>
</table>

Commentaries on constructivism

In this section, I pay attention to the mathematical education literature that comments on constructivism or traces its history.

One strand of commentary concerns the recontextualisation of constructivism (particularly radical constructivism) from a theory of knowing to a theory of teaching and learning. A number of articles—appearing in both scholarly and mathematics association journals—express unease with the prescriptive nature of some pedagogic interpretations (Airasian & Walsh, 1997; Ellerton & Clements, 1992; Lovitt, 1993; Mousley, 1993; Noddings, 1990). These appear, in the main, in the earlier literature. Later literature, particularly the teacher education material, seems more inclined to accept pedagogic constructivism as a ‘given’.
Challenges to this appear in some more recent general educational literature. I have located a number of articles and texts expressing concern over constructivism’s privileging of process over content and the effects of this on students’ ability to develop ‘powerful knowledge’ (Dinham, 2014; Moore & Young, 2001; Scott, 2009; Yates & Collins, 2008). Jorgenson (2014, p. 313) articulates similar reservations in mathematics education, positing that a focus on the ‘social conditions within which learning mathematics occurs is shifting focus away from the core learning of mathematics’.

Another stream of commentary, usually undertaken from a post-structuralist perspective, challenges constructivism’s valorisation of the ‘rational mathematical thinker’ (Popkewitz, 1998, 2001, 2004, 2009; Skovsmose, 2006; Walshaw, 2004b; Zevenbergen, 1994b). Walkerdine (1984, 1988, 1993) and Baker (1998, 1999) pay particular attention to the productive effects of cognitive developmentalism. Other research problematises the subject positions offered to teachers and students in constructivist classrooms (Anthony & Walshaw, 2008; Appelbaum, 2008; Klein, 2000, 2002; Popkewitz, 1998). I have found little evidence of this type of commentary in the teacher-oriented material. It also appears to be comparatively rare in the scholarly mathematical literature, with a significant proportion of the referenced commentaries located in the field of general curriculum studies.

Histories of constructivism in mathematics education also appear to be relatively uncommon. While I have located some tracings of the discourse’s trajectories (Confrey & Kazak, 2006; Lambdin & Walcott, 2007; Leder, 1993; Schoenfeld, 2007; Steffe & Kieren, 1994; Walshaw, 2013), these tend to have an international or US orientation or, were written some time ago and therefore do not reflect more current history. I have been unable to locate comprehensive histories of constructivism in Australia, other than those written as brief, general overviews prefacing another topic of study.

Conclusion

In this review of the constructivist literature of 1965–2015, I have identified key constructivist theorisations. In these, the focus is on knowledge creation, the means by which individuals construct mathematical understanding—in the case of Piagetian and
radical constructivism—or participate in and contribute to the creation of shared understandings—in the case of social constructivism.

I have also identified significant pedagogic (re)interpretations of each theorisation. In the table below, I highlight a few key continuities and discontinuities between these pedagogical interpretations:

Table 4 Key dis/continuities between Piagetian, radical and social constructivism

<table>
<thead>
<tr>
<th>Continuities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning is active (mental, physical, social).</td>
</tr>
<tr>
<td>The learner is positioned as the primary partner in the pedagogical relationship.</td>
</tr>
<tr>
<td>The function of the teacher is to observe, diagnose and intervene in student learning.</td>
</tr>
<tr>
<td>Problem-solving, investigation and inquiry learning are methodologies that enable the learner to develop increasingly sophisticated conceptual understandings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discontinuities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The child who discovers known mathematical truths becomes conceptualised as a producer of mathematical knowledge, and then as a participant in knowledge creation.</td>
</tr>
<tr>
<td>Discovering pre-existing mathematical structures gives way to developing idiosyncratic understandings, which then become socially constructed and mutually shared meanings.</td>
</tr>
<tr>
<td>Social interaction moves from being a trigger for individual mental disequilibrium (cognitive/psychological perspective) to a necessary pre-condition for all knowledge development (social perspective).</td>
</tr>
</tbody>
</table>

In undertaking my review of the literature, I noticed that pedagogic constructivism is presented in a relatively unproblematic fashion, particularly in the teacher-oriented material. While it is sometimes acknowledged that enacting constructivist pedagogies can be difficult, the approach itself is commonly presented as a ‘self-evident good’ and worth striving to master. The constructivist learner is a similarly unnuanced figure, presented as ‘natural’, and shifts in the conceptualisation of this figure generally go unacknowledged. In making these appraisals and noting the lack of historical accounts of constructivism in Australia, I advance the case for a genealogical 'history of the present' of constructivism in primary mathematics education. This approach is outlined in the next chapter.
Chapter three: Conceptual tools and methodology

There are a number of ways to tell the history of constructivism in primary mathematics education in Australia over the past fifty years. As stated in chapter one, I chose to draw on the conceptual and methodological resources provided by Michel Foucault, and undertook a genealogically inspired investigation into the history of the discourse, placing my focus on the how the learner has been (re)configured and the effects of each configuring. In this chapter, I outline important conceptual and methodological aspects of the approach, and explain how these helped open a space for rethinking established ‘truths’ in mathematics education. I go on to explain how I put the approach to work to critically engage with my research problem, the dominance of constructivist learner subjectivity in Australian primary mathematics education today.

Discourse: Truth, power and the subject

So, it is the rules of right, the mechanisms of power, the effects of truth or, if you like, the rules of power and the powers of true discourses, that can be said more or less to have formed the general terrain of my concern (Foucault, 1980, p. 94).

Foucault’s notion of discourse is often considered ‘slippery’ (O’Farrell, 2005, p. 133) so I began by clearing some definitional ground around his conceptualisation of the term. I found his description of discourse as something to ‘be grasped in the form of a system of regular dispersion of statements’ (Foucault, 1980, p. 66) a useful starting point.

Foucault does not use the term ‘statement’ in a linguistic or technical sense. For him, statements are conceptual—they exist as thoughts and ideas—but, importantly, are also given material form as, for example, written texts or pedagogic practices (Foucault, 1980, 1981). Frohmann (2001) notes that for Foucault, the materiality of these statements goes beyond their physicality; they carry ‘weight’, they ‘exert and resist’ pressure, they ‘act’. They work together as a coherent set of statements or discourse—to produce certain knowledge or ‘truths’. In doing so, they ‘systematically form the objects of which they speak’ (Foucault, 1970, p. 49). In other words, these objects are able to exist in peoples’ minds because of the discourse; the discourse does
not simply reflect a pre-existing reality. If we apply this to the figure of the primary mathematics learner, prior to constructivism it was impossible for this learner to be understood as someone who built their own understandings through ‘active learning’. This ‘truth’ was made possible by Piaget’s genetic epistemology, various interpretive statements about the importance of mental, physical and social activity, the texts in which these ideas were materialised, and the ways in which institutions such as schools put the ideas to work.

To understand how constructivism has been able to become such a dominant truth in Australian primary mathematics education, I drew on Foucault’s notion of ‘regimes of truth’. Foucault argues that, at any given time in a particular cultural group or society, there are certain rules or ‘conditions of possibility’ that allow some discourses to become ‘major narratives which are recounted, repeated and varied’ (1981, p. 56), while others ‘blur and disappear’. Central to this theorisation is Foucault’s analysis of the power–knowledge relationship. He sees these as inextricably linked: ‘We are subjected to the production of truth through power and we cannot exercise power except through the production of truth’ (1980, p. 93). While all knowledge involves these power relations, Foucault posits that dominant truths ‘rest on institutional support’ (1981, p. 55); that is, they are enabled by the privileging offered by particular groups and circulate through specific acts of power practised by these groups.

Foucault theorises these power relations variously (O’Farrell, 2005). I focused on his idea of ‘disciplinary power’, as I found it offered a way to think critically about how the learner is produced in and by discourses embedded in the documentary material of this study. Foucault (1984, p. 196) suggests that one ‘great instrument of power’ is normalisation. He argues that normalisation operates by creating a space for differentiation: It ‘imposes homogeneity; but it individualises by making it possible to measure gaps, to determine levels, to fix specialities and to render the differences useful’ (1984, pp. 196–197). In constructing these divisions, it creates an ‘abnormal’ as well as a ‘normal’. To perform this work, it relies on certain technologies or mechanisms, one of which is the examination. Foucault (1984, p. 202) conceptualises the examination—essentially, the creation of data—as a ‘normalising gaze’ by which an individual or population can be produced as a ‘describable, analysable object’, one that can be measured, categorised, compared and modified. The primary aim of these and
other disciplinary practices, argues Foucault (1984), is the creation of ‘docile bodies’ who will both enact and conform to modern dreams of a ‘perfect society’. This society, he further contends, is one that valorises and sustains Enlightenment beliefs in science and reason, accepting only of truths produced by the ‘rational thinker’.

Dominant discourses construct themselves in such a way that it can be difficult to recognise the work they do and to respond freely to them (Parker, 2014). The conceptual tools outlined above allow us to recognise some of the ways these ‘regimes of truth’ assert themselves and to make more informed choices about what we take up from these assertions.

**Genealogy: Critical engagement with the present**

It is one of my targets to show people that a lot of things that are a part of their landscape—that people think are universal—are the result of some very precise historical changes. All my analyses are against the idea of universal necessities in human existence. They show the arbitrariness of institutions and show which space we still enjoy, and how many changes can still be made (Foucault, 1988b, p. 11).

While Foucault (1970, p. 157) assumes it is possible to deduce and describe ‘fundamental arrangements of knowledge’ within a historical period, O’Farrell (2005, p. 54) notes he also assumes that ‘human attempts to create order are always limited and crumbling at the edges’. So as well as examining truth systems’ formations and regulatory practices, he is also concerned with analysing how these systems break down and are replaced or renewed over time—creating new ways of being in the world. Genealogy is the methodology he developed for examining these changes.

While genealogy is a historical research method, it differs from a traditional history in that it eschews conventional cause-and-effect linkages that work to create a continuous, and in Foucault’s eyes false, narrative about how the past has become the present (Isin, 1997). Instead, drawing on and adapting the thinking of other theorists, particularly Friedrich Nietzsche, Foucault (1984) conceptualises history as discontinuous, formed through a myriad of independent, often insignificant and contingent occurrences or ‘events’. For Foucault (1981), every form of human
experience can be considered an event with a beginning and an end, each a segment in a distinct series of events.

In his explication of a genealogical model, Isin (1997, p. 116) notes that a genealogy offers illustrative examples of critical events (episodes), paying particular attention to ‘crucial reversals and discontinuities’. It also looks for those local and specific events that often ‘remained unnoticed and unrecorded’, that help form a counter-memory (Anderson, 2015) to the narratives told by mainstream history. I found these guidelines useful in defining the purpose and scope of my research work, and in recognising the parameters around possible knowledge claims. My task was not to try and explain the past ‘in its entirety’, something Foucault (1984) suggests is neither possible nor desirable, but instead to look under and around the accepted constructivist story and locate a ‘different catalogue of possibilities’ (Green, 2003).

As Isin (1997) further notes, in a genealogy the objects of analysis are not the events themselves, but the relations of power that produce them and the effects of these relations. A genealogy, therefore, is concerned with power or, more precisely, with exposing the regimes of truth ‘where the grounds of the true and false come to be distinguished via mechanisms of power’ (O’Farrell, 2005, p. 69). Foucault’s notion of the dispositif⁷ is central to understanding how these power relations operate and circulate (Garland, 2014). He describes it as:

a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures … The apparatus itself is the system of relations that can be established between these elements (Foucault, 1980, p. 194).

If we return to the figure of the constructivist learner and the possibilities for its existence exemplified previously, when reworked as a dispositif, influential educational institutions, educational policy, governmental regulations and other social, political and institutional factors also become objects for scrutiny.

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⁷ This term is variously translated as ‘apparatus’, ‘grid of intelligibility’, ‘regulatory ensemble’ and ‘power/knowledge regime’ (Garland, 2014; Tamboukou, 1999). I use the term ‘apparatus’ in this thesis.
Foucault often describes his approach as conducting a ‘history of the present’. This involves working with a set of critical questions which Tamboukou (1999, p. 215) expresses succinctly as: ‘What is happening now? What is this present of ours? How have we become what we are and what are the possibilities of becoming “other”?’ A history of the present therefore begins with ‘a certain puzzlement or discomfiture about practices or institutions that others take for granted’ (Garland, 2014, p. 379)—which for me is the current privileging of the constructivist learner—and then seeks to trace the relations that enable this present situation to exist. The purpose is not to think historically about the past or, in my case, to arrive at a final ‘truth’ about whether the figure of the constructivist learner is ‘right’ or ‘wrong’. It is, instead, to render this familiar figure strange, to unsettle its status as inevitable and natural, and to open up space for thinking about how this figure (the mathematical learner) might be considered otherwise.

**Study design**

To do this work and guided by my research questions (I refer the reader to p.6), I took up and adapted the two-stage methodological approach of Williams, Gannon and Sawyer (2013): a genealogical investigation, followed by a discursive analysis of a significant text. I used documentary analysis as my method, working carefully through ‘a field of entangled and confused parchments’ (Foucault, 1984, p. 76)—the ‘local memories’ of mathematics education conference proceedings, teacher texts and journals, and educational policies—to understand how constructivist discourse and learner subjectivities are (re)presented in Australian mathematics education material.

I chose to study the learners of three time periods rather than the Piagetian, radical or social constructivist learner, as my review of the literature indicated that each form of the discourse—while it succeeded its predecessor temporally and gained ascendancy—did not produce an entirely new learner figure. Each configuration appeared to be shaped by an interplay between, new and preceding constructivist discourse/s and broader educational or social ones. A periodised approach allowed me to consider and maintain this complexity. My selection of eras was led by the identification of the landmark documents outlined on the following page; I chose to study the events and power relations leading to and following their publication.
For each of the three eras selected for study (1965–1975, 1985–1995 and 2005–2015), I undertook the following process:

**Stage 1: Genealogical investigation**

I began by identifying key patterns and regularities in the statements made about the learner to get a sense of how they were configured, and considered how this linked to, or broke with, statements made in previous eras (examples of my working method can be found in Appendix 3). I then worked to map the ‘system of relations’—the regulatory apparatus introduced above—that enabled the production and circulation of constructivist ideas and created the ‘conditions of possibility’ for this figure. I constructed a visual representation of this apparatus, attempting to construct the map in a way that did not ‘tame the wild profusion of existing things’ (Foucault, 1970, p. xv), but instead reflected the ‘messiness’ of the data I was dealing with. I then chose to exemplify particular episodes that seem to indicate ruptures with the past and the beginnings of new trends, highlighting significant discursive threads and paying some attention to the power relations underpinning them. These power relations were then analysed in greater depth in the following stage of investigation.

I used documents produced by the following educational bodies as my primary sources of data:

- Australian Council for Educational Research (ACER)
- Mathematics Education Research Group of Australia (MERGA)
- Australian Association of Mathematics Teachers (AAMT)
- Australian Institute for Teaching and School Leadership (AITSL)

I chose these sources because my archival research suggests they were key ‘surfaces of emergence’ for constructivist ideas in Australian primary mathematics education. I also examined popular mathematics teacher education texts and significant

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8 In my analytic work, I chose to use the phrase ‘discursive thread’ instead of ‘statement’, as it is another interpretation of Foucault’s original French term, *énoncé*. Novelist and essayist Barnes (2012) writes about the complexities involved in translating words and ideas, and notes that often the first translation or interpretation ‘imprints’ on the reader and ‘becomes’ the thing. For me, this imprinting has occurred with ‘discursive thread’.
government educational policies from each era. This range helped me create a more reliable and nuanced tracing of the constitution of each learner. Finally, as they were produced by educators and/or institutions of recognised national significance, they carry an authority that might encourage teachers to view them as representing the ‘one true statement about teachers and learners’ (Walshaw, 2013, p. 77) and, as such, inform pedagogic practice and shape learner subjectivity.

Stage 2: Discursive analysis

Drawing on Foucault’s (1984) notion of ‘disciplinary power’ and guided by the questions Parker (2014) suggests we ask of discourse, I then carried out an analysis of an influential text from each of the eras under study. My purpose was to ascertain how the figure of the constructivist learner is constituted within the document, and to analyse key acts of power underpinning this constitution. The texts selected for examination were:


These texts are landmark documents of recognised importance in Australian primary mathematics education. Each is a national curriculum framework document that marks a significant breakpoint in mathematics education, offering a powerful re-envisioning of mathematical learning and the learner. I focused on the sections of each text where the desired dispositions and capabilities of the learner, and the methods by which they might be produced, are laid out.

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9 The popularity and significance of texts is gauged by one or more of the following criteria, as applicable: 1) texts with multiple reprints; 2) references in other texts; and 3) institutional positions held by authors. Occasionally I stepped outside the bounds of the specified timeframes, particularly for the first era where archival material is sparse.

10 Each learner is constructed from common statements emerging from a range of perspectives, not just that of one individual or institution. This ‘repeatability’ (Foucault, 1981) supports their significance. An example of my working method can be found in Appendix 3.
This thesis is a small-scale study and the literature produced on constructivism in mathematics education over fifty years is immense. By necessity, I have been selective about the documents I have paid attention to, and recognise that a different or wider selection may have enabled different knowledge to be produced. And, while I can point to texts generally acknowledged in the practitioner and scholarly material as influential, I do not know the exact nature of this influence, nor how the discourses embedded in the documents were enacted and/or interwove with other discourses in Australian classrooms. A different methodological approach—one incorporating oral history interviews, for example—might generate such knowledge. I have also confined my study to the documents produced for and by mathematical educators, and as such, was unable to take up debates and contestation that occurred in other fields (e.g. the media) around the merits of the constructivist learner. I am also aware that space restrictions and my focus on three ‘interruptions’ required omission of certain complexities within the constructivist positions, resulting in some oversimplifications and conflations. For example, not all psychological constructivism of the 1980s was radical. Similarly, there are a variety of social constructivist theoretical positions (e.g. sociocultural theory and activity theory). I choose to follow Ernest (2010) and treat them as one—social constructivism.

It is expected, however, that this study will provide critical insight into how the discourse of constructivism operates and circulates in Australian primary mathematics education, both historically and today. This insight may serve to help mathematics educators, and educators at large, think critically about why we privilege the constructivist learner and to give consideration to what might be gained and lost by doing so.
Chapter four: (re)Configuring the constructivist learner

1965–1975: The child

In the 1950s, the successful Australian primary student displayed a basic competence with arithmetic and common weights and measures, and demonstrated the ability to solve ‘everyday problems’ (ACER, 1964, sec. 1). While the progressivist movement of the 1940s had left traces in Australian primary education—such as a focus on student-led discovery (e.g. Tasmanian Education Department, 1950)—a behaviourist perspective dominated primary mathematics education in the years immediately prior to the emergence of Piagetian constructivism. Students learned through direct instruction and drill and practice, with arithmetic speed and accuracy a key marker of this success (Blakers, 1978).

In the early 1960s, the authors of the Australian Council for Educational Research (ACER) document, Notes on primary school mathematics (1962, sec. 4), observed that a ‘ferment’ was taking place in mathematics education around the world. They attributed these changes, in the main, to Piaget, whose experiments ‘have given impetus to new thinking ... and have been the primary inspiration for the development of new teaching materials and techniques’. These new pedagogies catered for a new type of learner—an active, developmental one who required individualised learning opportunities so that he or she might understand mathematics:

> It is essential that all children should understand as fully as possible the mathematics they are asked to learn. Understanding comes best when they learn through their own active response, physical or mental, to the experiences that come to them and become aware of mathematical relationships through constructive play, experiment and discussion ... provision needs to be made to provide for individual differences in learning rates, and to ensure that at each stage that each child has developed the readiness to comprehend the mathematics (ACER, 1964, sec. 3.2; emphases added)

In the following analytic work, I locate some ‘conditions of possibility’ for this learner and work to trace its shape.
It's time for a change. The progressivist reform agenda

After decades of austerity, the post-war years were a time of nation-building and affluence in Australia. This led to 'a revolution in rising expectations', with education positioned as a route to prosperity and social advancement in a way not previously envisioned (Campbell & Proctor, 2014). The Eastern bloc nations were perceived as winning the race for scientific and technological supremacy, generating urgent calls for an educational change in Western nations, including Australia. Traditional education, it was argued, was insufficient to the task and 'needs to be revised in the light of modern advances in knowledge and the changing demands of today’s world' (Queensland Department of Education, 1965, p. 4). An approach that focused on discovering (pre-existing) mathematical structures and drew on Piagetian stage theory was considered to offer promise, both internationally (e.g. Bruner, 1960) and in Australia (e.g. Cole, 1966; Rawlinson, 1965).

Political transformations also opened space for constructivist discourse. Until the mid-1960s, schooling had been the domain of the Australian states, but with education now positioned as a valuable economic commodity, the federal government moved to assert control over schools and their programs (Campbell & Proctor, 2014). The most radical transformations occurred in the years 1972–1975 when the centre-left, progressivist Federal Labor (Whitlam) government, using its recently formalised statutory authority, instituted sweeping reforms aimed not just at promoting economic development, but at developing a 'better and more competent community' (Connell, 1993, p. 259).

Curriculum innovation was part of this plan. The Curriculum Development Centre (CDC) was established in 1973 and was an important instrument of change. Building on reform projects of the 1960s, it instigated new programs and funded studies into emerging pedagogies, many of which were informed by Piagetian theory. Examples of such projects are highlighted in Figure 1 below. These findings were then disseminated

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*It’s Time’ was a successful political campaign run by the Australian Labor Party (ALP) under Gough Whitlam at the 1972 election in Australia.
widely through in-service teacher education programs, again often organised by the CDC, or to pre-service teachers through the newly created teacher training colleges (Connell, 1993). Australia’s rapid population growth also contributed to the uptake of new thinking (Campbell & Proctor, 2014). Rising enrolments and the reduction of class sizes that occurred in the 1970s required an expansion of the teaching force. This involved training new teachers, who were often more open to innovative ideas, and recruiting staff from overseas—primarily from the United Kingdom—who brought these ideas with them (Connell, 1993).

**Travelling ideas: The making of a local ‘common sense’**

In my visual representation of the constructivist apparatus of this era, I highlight some key bodies, texts and projects that permitted Piagetian constructivism to emerge in Australian mathematics education, and indicate some routes by which the discourse travelled.

![Figure 1 The constructivist apparatus of 1965–1975](image-url)

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**Figure 1** The constructivist apparatus of 1965–1975
For present purposes, I pay attention to one important set of relations, the interaction between Australian and international educators and academics. Australian educators continued to look to the UK and US for inspiration and direction (Blakers, 1978; Keeves, 1965), and a number of academics and teachers, often on ACER-funded trips, travelled abroad to observe and report back on innovative programs. These programs, some with a progressivist agenda (e.g. the Nuffield Project in the UK) and others with a focus on mathematical structure (e.g. the University of Illinois Committee on School Mathematics), shared a common influence, Piagetian theory (G. Matthews, 1973; McMullen, 1959). They also shared a common agenda—to transform traditional mathematics instruction to better meet the needs of the developmental learner, newly produced by cognitive psychology.

While Australian educators looked to these ideas and to the authority of overseas educators, Blakers (1978, p. 149) notes they did not adopt ‘intact, any of the reform programs produced overseas’, instead drawing on ideas from each. There were also instances where Australian educators were instrumental in the early development of these new pedagogies and the creation of new learner subjectivities—particularly that of the ‘active learner’. For example, Piagetian associate Dienes resided at the University of Adelaide 1960–1967 and worked with local teachers on what Keeves (1965, p. 16) describes as ‘a vigorous and rather radical experimentation program’ at Cowandilla Primary School in South Australia. Former Piagetian student Gattegno also visited Australia on many occasions, working with educators to develop and refine the ‘Gattegno–Cuisenaire method’, which was taken up in curricular documents around the nation (e.g. Education Department of Victoria, 1961) and reproduced in teacher resources texts for an inter/national market (e.g. Chambers, 1964). These regional initiatives (highlighted in Figure 1) held in common a commitment to pedagogic interpretations of Piagetian theory, advocating a learning pattern of ‘play, directionality and practice’ and conceptualising an active, experiential and developmental learner.

The new pedagogies were therefore given a local 'shape' and 'feel' and, because of this, were more accepted by Australian teachers (Blakers, 1978). This speaks to Foucault’s (1980, p. 96) point that power circulates through, and in, 'its more regional and local forms and institutions'. While constructivism was brought to Australia's shores on the
strength of erudite authority, I suggest it was the ‘regionalisation’ of constructivism, as exemplified above, that helped make the constructivist discourse—and its envisioned learner—so ‘repeatable’ in Australian education.

*Coloured rods and segmented blocks: Power relations in ‘active’ pedagogies*

It is on the productive effects of the work of Gattegno and Dienes that I now place my focus. The materials they developed\(^1\) and the pedagogies they espoused became key signifiers of a ‘Piagetian approach’, and an active, structural approach to mathematics teaching and learning soon became a leading one, as evidenced in this statement made by curriculum officers in an ACER 1962 publication:

> The discourse of constructivism used various mechanisms—such as curriculum frameworks and diagnostic assessments—to ‘take hold’ of pedagogy and classroom practice. Truth claims asserted in teacher education texts were also effective tools. I provide an example on the following page. In this teacher resource (Cole, 1966, p. 19), a plan for developing conceptual understanding of numbers to 20 is outlined. In my interpretive commentary alongside this resource, I draw attention to significant discursive threads and claims. These, and their effects on the learner, are examined as part of the discursive analysis following the commentary.

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\(^1\) Dienes is perhaps best known for his place-value material, multi-arithmetic base (MAB) blocks, while Gattegno advanced the development of Cuisenaire rods, designed to represent the rational number system.
In this suggested teaching program, key Piagetian discursive threads are apparent. Learning occurs through exploration and activity on objects.

Focus is placed on the underlying and pre-existing structure of mathematics, which is considered to have been made visible by the materials themselves. The lesson presents the claim that, through explicit teaching and repeated interaction with the rods, students will develop rich mathematical conceptual understanding of the part–part–whole relationships between numbers and of the four operations. Learning is also conceptualised as developmental. There are a number of very clear directives as to when and how concepts should be introduced, and to do otherwise serves ‘no useful purpose’. This development is both individual and universal. Each child is somewhere on a set path.

While explicit teaching is still recommended, the pedagogic driver here is the student’s understanding of these concepts, positioning the teacher as a support to both the student and the mathematics.
The child: A close examination

In this section, I examine the discursive framing of the constructivist learner in the text *Background in mathematics* (1966, 1972). Authored by the officers responsible for state curriculum development and produced by ACER in conjunction with the New South Wales and Victorian education departments, it was an important point of reference for curriculum revisions in the late 1960s and early 1970s (Connell, 1993). I place my focus on Part 1 of the text, 'Mathematics, the child and the curriculum'.

‘The child’s active participation in, and response to, mathematical experiences is fundamental to effective learning’ (1972, p. 32). The discourse of active learning pervades chapter two of the text. The learner is conceptualised as an active being who structures and coordinates ideas ‘in his own unique way’. There is a sense of urgency about the need to cater to this learner: ‘It is essential that he (sic) be given the opportunity to become actively involved in the learning experience that the teacher offers him … to feel, to listen to manipulate … part of the activity is mental—questioning, formulating, rejecting’ (1972, p. 32). The learner learns through sensory experience, but ultimately is a cognitive, rational being who will, through the processes of active discovery and logical reasoning, arrive at universal mathematical principles and structures. This conceptualisation of learner activity performs a number of functions and creates a number of effects. It produces the idea of a universal learner—all children learn through activity—and, as I go on to explain, divides as it does so, privileging some subjectivities and practices, and pathologising others.

The authors state, ‘one of the most successful methods being used in the field of primary school mathematics is based on concrete materials that each child can work with’ (1972, p. 16). Echoing earlier findings, good mathematical pedagogy involves students interacting with materials that direct them ‘towards finding specific mathematical relationships’ (1972, p. 16). A good teacher provides these interactional experiences within a cycle of ‘play, direction and practice’ (1972, p. 33) and a good student is able to arrive at a preordained destination by such means. The effect of such a ‘common sense’ is profound. Other, more passive learning styles and approaches are

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13 Occasionally, I do exceed these limits in order to trace how the learner is to be assessed.
produced as inferior and other destinations delegitimised (Zevenbergen, 1994b, 1996). There is no acknowledgement in the text that such a learning style might favour particular groups of students over others, or that differences based on interests, social or cultural backgrounds, or gender exist at all.

The notion of ‘readiness’ appears consistently throughout the text, acting as what Bernstein (1990) describes as a ‘pacing and sequencing’ disciplinary practice. It is employed by the discourse of developmental psychology to individualise, measure and distribute the learner, and to regulate teacher activity (Walkerdine, 1988). Chapter two is dedicated to explaining Piagetian stage and logico-mathematics theories. Both theories are predicated on the idea of a universal learner, one who progresses through a stage or sequence of child development. They create the subject, the ‘developmental learner’, who is described and defined in terms of cognitive development, the ability to demonstrate this development in certain prescribed terms and, importantly, the teacher’s interpretation of it (Walkerdine, 1984). This learner is a unique individual (symbolised in the text by the use of the singular, ‘the child’), but only insofar as their personal position on the developmental continuum.

These theories both draw legitimacy from and valorise scientific and medical discourses (Popkewitz, 2001, 2004). The learner is someone to be scrutinised and diagnosed through a range of evaluation techniques. The authors of the text recommend clinical interviews, observation, open-ended problems, student self-assessment and written tests that reveal mental processes as well as the product (1972, pp. 252–261). The teacher then intervenes, working to provide ‘both variety and complexity of experiences’ (1972, p. 33). These enable mathematical conceptual knowledge to be consolidated and ultimately generalised, although the authors take pains to warn that, ‘Attempts at the premature statement of a rule could actually retard development’ (1972, p. 17; original emphasis). Teacher and student communication patterns are highly regulated by this child-centred discourse: the child is the focus, the teacher positioned as the ‘guide on the side’.

Certain types of knowledge are also included and excluded by such an approach. Procedural knowledge is marginalised in favour of knowledge framed in terms of flexible, relational understanding of mathematical concepts:
Comprehension of a subject grows from a framework of ideas and relationships, and unless this structure is at the centre of the learning of the subject, the student will find it difficult to develop an adequate understanding. He will soon forget the details of what has been learnt, and he will never have the pleasure of seeing the parts fitting into place (1972, p. 20).

The text goes on to warn against methods that might mean a student ‘has slavishly followed a series of mechanical rules remembered from a previous experience’ (1972, p. 257). Instead, the successful student demonstrates ‘variety and richness in the ideas advanced to solve any given problem’. There will be ‘flexibility in the child’s approach to problems. Thinking is not restricted to a series of rules’ (1972, p. 251). Thus a student who learns by and expresses their learning in terms of these rules, no matter how successfully, is framed as less numerate than a counterpart who operates within the rules established by the discourse of relational understanding.

Similarly, a teacher who teaches procedures using behaviourist methods, or one who fails to promote the new constructivist approach to learning, is constructed as failing their students:

There is little doubt that the patterns of learning that are likely to come in the twenty-first century will demand even greater mathematical knowledge, and the necessary foundation must be laid in schools within the next few years. It is important that the child in school should grasp the reasons for the increased emphasis on, and necessary reforms in, elementary mathematics (1972, p. 21).

This positioning of mathematics as a self-evidently useful good, one that is to be appreciated and valued, appears consistently throughout the text, and is supported by the discourse of ‘21st-century learning’. Even nearly thirty years before the turn of the century, this discourse, with its economic and social inflections, is being used to shape learners, teachers and pedagogy. Together, the discourses of constructivism and 21st-century learning work to construct a powerful regime of truth: It is mathematical ability—the right kind, as defined by these discourses—that will enable students to succeed in ‘the modern world’ and give them access to the ‘rapidly increasing’ employment opportunities in ‘business, industry and science’ (1972, p. 21). The rational and cognitive learner is the one who will be able to take advantage of these opportunities, who will be useful in, and to, society.

The current move away from attempts to merely transmit knowledge in both primary and secondary mathematics classrooms is based on the premise that students must construct their own understandings of mathematics—because useful knowledge cannot be absorbed ready-made from teachers without it being adapted to fit prior understandings of children ... Recently, a push towards cooperative group work in both primary and secondary mathematics classrooms has resulted from a belief that students can come to better understand mathematical concepts through discussion and group exploration of ideas (Mousley, 1990, p. 1: emphases added).

These statements, by mathematical educator Judith Mousley, afford a brief but revealing sketch of the constructivist learner of this era. They also reflect the effects of the radical constructivist interruption. Like those of the previous era, these students ‘construct their own understandings’ but these now ‘adapt to fit’ prior knowledge—von Glasersfeld’s (1989b) (re)theorisation of Piaget’s genetic epistemology informs this claim. The statements also hint at the social constructivist interruption: the individual ‘student’ of the previous era has become ‘students’, ones who learn best through social activity. In this section of analysis, I work to understand how it was that this learner subjectivity came to be, and then to make it ‘strange’.

A shift in agenda: From social progressivism to economic rationalism

The socio-political landscape of the Australia of 1985–1995 was a markedly different terrain to that of the previous period. While, as in the previous era, a centre-left Labor government was in power, this administration spoke not of progressivism, but of ‘economic rationalism’ and ‘global market competitiveness’ (Dudley & Vidovich, 1995, p. 102), with a ‘rhetoric of individual rights, and ideologies of efficiency and choice’ supplanting the ‘social good’ discourses informing previous acts of policymaking (Campbell et al., 2010, p. 244). These threads were also appearing in educational discourse. The worth of an individual and their education was increasingly being measured in economic terms (Campbell et al., 2010; Yates & Collins, 2008). Governments were reclaiming control of the curriculum, which had devolved to schools in the schools-based curriculum development movement under the earlier Labor administration, so that it could serve this new agenda. Boomer, influential educator and director of the CDC, noted at the time that:
Curriculum has also become in the eyes of most Education Ministers a key to economic recovery. No wonder that we see an unprecedented ministerialisation of education in Australia at this time. Education ministers and treasurers are colleagues as never before and education is more strongly politicised than it has been since the first white settlement (1988, p. 243).

The mathematics curriculum was particularly caught up in political discourse, because it maintained its disciplinary position as ‘one of the greatest determinants of vocational and educational advancement’ and was viewed as a key to national ascendancy in these new global markets (Barton, 1995, p. 162). In Australia, as in other Western nations, there had been a return to a behaviourist approach to mathematics education in the mid-1970s, after the much-anticipated ‘New Maths’ failed to deliver improved results (Connell, 1993). In the mid- late 1980s, doubts were also (re)appearing about behaviourism’s capacity to develop the learner who might succeed in this new socio-economic arena (Ellerton & Clements, 1994). These doubts opened a space for a different educational ‘saviour’. Radical constructivist and problem-solving discourses emerging from the US and the UK seemed to offer the promise of this salvation.

**Educational reform: Producing the active problem-solver**

Stephens, Lovitt and Clarke (1990, p. 163) note that the agenda for mathematical education reform was ‘articulated with remarkable consistency around the world’. This consistency can be attributed in part to the widespread influence of the (UK) Cockcroft Report (1982), which recommended a move away from ‘school maths’ to ‘real life maths’ (Doig, 1987), and the international take-up of two texts produced by the US National Council of Teachers of Mathematics (NCTM)—the *Curriculum and evaluation standards for school mathematics* (1989) and the *Professional standards for teaching mathematics* (1991). These two texts in particular proved to be watershed publications, used as blueprints for a new approach to teaching and learning both in the US and beyond (Schoenfeld, 2004). In these, the authors, drawing on a ‘constructivist view of learning’, envisioned a reformed mathematics classroom with a focus on ‘teaching for the empowerment of students’ (1991, p. 3). Students in these classrooms were imagined as confident, collaborative problem-solvers, no longer reliant on teachers or focused on looking for the ‘right answer’, but able to use logic and reason to develop their own rich, connected mathematical understandings. These ideas quickly flowed through to
Australia, with the NCTM documents used as the ‘starting point’ for Australian policy development (Stephens, 1989, p. 4).

Australian classrooms were not considered conducive environments for the production of this new learner. ‘A reconceptualisation of numeracy is necessary. We argue that it is also necessary to reconceptualise teaching strategies that will bring about this new vision’ (Clarke et al., 1990, p. 162). Professional development programs became important mechanisms for reforming teachers so that they might, in turn, (re)form their learners. These opportunities were commonly developed and organised by the growing number of mathematics educators and reached many thousands of primary teachers. The ‘Exploring Mathematics in Classrooms’ (EMIC) program alone provided training for over 2000 teachers in the years 1987–1988 (Beesey, 1989). These programs are highlighted in blue in the constructivist apparatus of the era below.

![The constructivist apparatus of 1985–1995](image)

**Tell us what you know about numbers: Personalising mathematics**

Below is a lesson, ‘Favourite number’ (Lovitt & Clarke, 1988b, p. 257), from a significant teacher education program of the time, the Mathematical Curriculum and Teaching Program (MCTP). Like the illustrative example from the previous era, this activity is focused on developing conceptual understanding of numbers to 20, but the lesson
reflects some powerful discursive shifts. I highlight these in the interpretive commentary, flagging important threads and claims to be picked up and examined in the textual analysis to follow.
Interpretive Commentary

The developmentalism and structuralism underpinning the example of the previous era are noticeably absent. In their place are key radical constructivist threads. Good pedagogy is personalised, open-ended and based on student interests. Opportunities for informative assessment are embedded in the task; it is designed, in part, so that students can 'expose their understandings and misconceptions'. Social constructivist threads are also apparent—priority is given to language-based activity—although knowledge construction is still conceptualised as an individual undertaking.

Student activity remains vital, but, in this example, activity on objects has been replaced by an 'activity-based approach' to learning. The activity appears to be privileged over mathematical rigour. Despite claims that students produced 'sophisticated' understandings of number properties, some of the statements in the '12' work samples, for example, display only tenuous connections with mathematical concepts. This focus on activity and 'process not product' reflects an emerging trend of the time, that it was more important to know how to do things than to know the things themselves (Yates & Collins, 2010).
The mathematical negotiator: A close examination

I now examine the discursive framing of the constructivist learner in chapter three (Enhancing mathematics learning) of the policy document, A National Statement on Mathematics in Australian Schools (1991) (hereafter the Statement). The Australian Education Council, the body representing state education ministers, produced this. As in the previous documentary analysis, my goal is to expose some of the ‘fictions operating as fact’ (Zevenbergen, 1994a, p. 722).

The discourse of radical constructivism is embedded in the ‘Learning principles’ section of the Statement. Piaget’s stage theory, the lynchpin of the previous era’s document, is absent and in its place is his genetic epistemology. Learning is ‘active and productive’. Students ‘construct their own meanings’ based on ‘the ideas, objects and events which they experience’ and by the processes of ‘action and reflection’ (1991, pp. 16–17). With this shift away from Piaget’s stage theory comes a shift in the prominence and nature of the developmental discourse. The idiosyncratic and productive nature of learning—one of the two core tenets of radical constructivism—is accentuated and the notion of a fixed developmental path, so present in the previous document, plays a reduced role.14 The teacher’s role is to support and engage this learner. In particular, good pedagogy privileges individual ‘knowledge construction’, ‘build[s] upon existing understandings’ (1991, p. 16) and ‘respect[s] students’ experiences’ (1991, p. 18).

Embedded in this seemingly inclusive discourse of radical constructivism are significant tensions (Zevenbergen, 1996), which play out in the Statement and the exemplar lesson. Despite the claim that students’ mental constructions are to be valued and represent legitimate mathematical knowledge, those that do not fit with the a priori understandings of school mathematics are constructed as misconceptions to be challenged. While mathematics has become ‘negotiable’, seemingly making it more accessible, students must negotiate a path between the knowledge legitimated by educational authority and their own constructed understandings. As Zevenbergen

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14 While the role has decreased, the developmental discourse is still present in other parts of the document—particularly in Part II, where the learning scope and sequence are laid out. However, the discourse is expressed in terms of what students can or should be able to do, reflecting the interweaving of child-centred developmentalism and economic instrumentalism that occurred in the era (Yates & Collins, 2008).
(1994a, 1994b) notes, this process advantages students whose social/cultural background fits more closely with the schooling culture, as they are more likely to construct knowledge and skills that align with those legitimated by the educational institution. I speculate here that constructivist principles can serve to ‘hide’ the cultural advantage that some student groups bring to the curriculum; they serve to consolidate class- or gender-active effects.

Such effects are also advanced by the valorisation of risk-taking and problem-solving that occurs in the Statement. The successful mathematical learner is one who is ‘willing to have a go’ and ‘try a new or different way of doing things’ (1991, p. 17). The Statement warns that those who ‘encounter continued success on personally easy or rote tasks … become less and less able to take the risks needed for higher level learning’ (1991, p. 20). These students, ‘more likely to be girls than boys’, require teacher intervention so they might ‘learn to seek imaginative solutions to problems in constructive ways, rather than avoid all the stress and struggle’ (1991, p. 21).

Zevenberg (1994b) observes that students who are generally less successful in mathematics—girls and students from low socio-economic or non-English speaking backgrounds—are often made very visible by, and constructed as the ‘problem’ in, psychological mathematical discourses. The intention behind this practice usually emerges, Popkewitz (2009) notes, from real efforts to correct wrongs. This aim is clear in the Statement; practical strategies and programs to assist girls and students from non-English speaking backgrounds, in particular, achieve in mathematics appear throughout the document. Such aims, however, have their own shadow. They act to normalise certain objects and subjectivities, and exclude others (Popkewitz, 2009; Zevenbergen, 1994b). Mathematics itself and the successful students—often white, middle-class boys—are naturalised by the discourse and exempt from scrutiny. Their alignment with success remains in place and their right to this success unquestioned, further perpetuating their advantage. The less successful students, particularly the ones not transformed by intervention measures, are ‘othered’ by their failure to assimilate and to take up new risk-taking subjectivities, further perpetuating their disadvantage.
Popkewitz (1998, 2009) argues that the aim of these shaping practices is to develop particular types of individuals, ones who can serve the needs of the modern state. While this imperative appeared in the document of the previous era, here it has been intensified, fuelled by the discourse of economic rationalism:

The raising of levels of confidence and competence in mathematics is essential for widespread scientific literacy and for the development of a more technologically skilled workforce. The former is necessary for the ‘personal competence, social cohesion, employment prospects and the free flow of comprehensive information that makes democracy workable, the latter for the economic competitiveness without which we will lose the basic economic preconditions for a democracy’ (1991, p. 6).

Here, the unsuccessful learner is conceptualised as actually dangerous—without rehabilitation, this learner threatens democracy itself. This ‘threat’ then creates the need for added vigilance. The discourse of surveillance is a constant and vaguely oppressive presence in the Statement. While the need to monitor students was certainly present in the document from the previous era, it was couched more in terms of seeing what children knew and understood. Now, the discourse is about watching for, and averting, failure.

Feedback and a range of assessment practices that ‘reflect all of the goals of the school mathematics curriculum’ are vital if this failure is to be avoided. This imperative is also framed in terms of equity: ‘Assessment is used to make decisions about students which will affect their future learning and their educational and occupational options. Clearly, it should be fair, valid and reliable’ (1991, p. 21). Pen-and-paper tests, it is argued, favours some students’ learning styles and strengths and disadvantages others, and is an inadequate measure for ‘the new content of school mathematics’ (1991, p. 21). A wider range of informative assessments is seen to offer the promise of this equity.

Following Foucault (1984), I offer a different reading of this. While employing a wider range of assessment methods certainly allow students to express knowledge in a wider range of ways, they are not, as the Statement suggests, merely neutral and fairer reflections of a broader ‘reality’. Learners are produced, measured and distributed by assessment practices. A broader range of practices exposes the learner to greater scrutiny, allowing them to be more easily broken ‘into components such that they can
be seen, on the one hand, and modified on the other’ (Foucault, 2009, in Ball, 2013, p. 44). Unless consideration is paid to the ‘shaping’ nature of this scrutiny—the type of knowledge and learner it seeks to legitimate and those it seeks to exclude—for some students, those who fall outside the boundaries, a greater number of assessment practices can simply produce more ways to fail.

Vygotskian discursive threads are also embedded in the document; language is conceptualised as a mediating tool for learning new ideas: ‘Mathematical concepts are not developed in the absence of mathematical language’ (1991, p. 17). The role that others play in the development of knowledge is also accentuated: ‘Through discussion with peers, teachers and others, students may adjust their conceptions by gaining new information’ (1991, p. 19). However, as in the exemplary lesson, learning is conceptualised as the individual acquisition of knowledge, not participation.

Another strand of social-constructivist theory is evident in the Statement: the attention paid to students’ social/cultural backgrounds and learning contexts, and the different opportunities these offer to students in terms of equity and access: ‘While students in any particular classroom will have much in common, they also bring to the classroom a wide range of different experiences which should be valued and accommodated’ (AEC, 1991, p. 18). The productive and limiting effects of this recognition have been touched on above and are returned to in chapter five.

2005–2015: The engaged and productive learner

Learning mathematics then is necessarily an active process; the concepts and processes are too complex and the ideas often too abstract to allow them to be simply accepted through reading and telling ... Learning is also a social activity and both the mathematics and the manner in which it is learned are influenced by the way children interact with each other and with their teachers. Children not only construct meaning through the experiences they have with materials and problems, but also through examining and reflecting on their own reasoning and the reasoning of others (Booker et al., 2004, pp. 6–7: emphases added).

In this excerpt, drawn from a popular teacher text of the era, we see obvious continuities with the constructivist learner of the previous accounts. Children construct understanding through problem-solving and physical activity. Learning is
student-centred and builds on prior experience. Ontological, epistemological and pedagogical differences, while subtle, do exist, however, and are significant. Mathematics does not take the infallible, structural form given to it in the teacher resource documents of the Piagetian era, nor is it individually ‘produced’ as often represented in the radical-constructivist era material. Here, while mathematics exists as a ‘thing’, it is also *shaped* by children and the ways they engage with it—knowledge and learners are mutually constitutive. Dialogic reasoning is also given greater prominence. These are effects of the social constructivist ‘interruption’, and how these shape the learner of 2005–2015 is the focus of this next section of analysis.

*Producing the 21st-century citizen: An inter/national agenda*

The 21st century, much hypothesised about in earlier eras, is now a reality. The neoliberal discourses of competition and globalisation, emergent in the previous period of analysis, dominate both national and international landscapes (Rizvi & Lingard, 2009; Yates & Young, 2010) The commodification of education has also continued, in a process Biesta (2009) labels ‘learnification’—a shift evident in Australian educational policy. The ‘students’ of previous eras are often conceptualised as ‘learners’, and teachers and schools are to ‘facilitate’ and ‘provide’ educational experiences which ‘promote personalised learning that aims to fulfil the diverse capabilities of each young Australian’ (Ministerial Council for Education Employment Training and Youth Affairs, 2008, p. 7 [MCEETYA]).

Interestingly, these individualistic and free-market discourses have resulted in increased *centralisation* of decision and policy making in Australian education (Campbell et al., 2010), a move that on the surface seems to runs counter to the character of the discourses. However, when viewed as an act of power relations, the federalisation of educational policy makes more sense; it functions to ‘push down’ the progressivist discourses of the 1970s still at work in schools and elevate those of neoliberalism, an agenda shared (in varying degrees and ways) by both major political parties. This centralisation has resulted in significant new initiatives. In 2008, the *Melbourne Declaration on Educational Goals for Young People* (MCEETYA, 2008) outlined the first national commitment by state education ministers to a common curriculum, resulting in the first national Australian Curriculum, the national testing
program, National Assessment Program—Literacy and Numeracy (NAPLAN) and the My Schools website which publishes the school-based results of these tests.

These initiatives continue a recognisable pattern in Australian education: gazing beyond the nation’s shores towards the policies, practices and, increasingly, the achievements of other nations (Williams et al., 2013). International testing schemes such as the Programme for International Student Assessment (PISA) are now considered important markers of a nation’s ability to compete in a global knowledge economy (AAMT, 2015; Biesta, 2009). As Australian students fall in these rankings (AAMT, 2015), learners—high and low achievers alike—are being closely scrutinised in order to identify the skills and characteristics of the successful mathematical learner.

In a recent review of Australian mathematics education by the Australian Academy of Science (AAS) (2015, p. 22), this successful learner is constructed as one who exercises the ‘21st century skills of communication, collaboration, creativity, and critical thinking’, an imagining also apparent in other educational policies (e.g. ACARA, 2015: General capabilities; MCEETYA, 2008). Social-constructivist threads inform this shaping. However, this successful ‘21st century learner’ is also spoken into being by other discourses. The neoliberal discourse of ‘responsibilisation’, which constructs individuals as self-directing and autonomous beings responsible for their actions and situation regardless of context (Liebenberg, Ungar, & Ikeda, 2015), is one example. Another discourse shaping this learner subjectivity is that of brain-based learning (BBL), ‘one of the most rapidly traveling discourses and highly funded pursuits of the moment’ (Baker, 2015, p. 168). In this, learners are often assigned success or failure through the binary of a ‘fixed or growth’ mindset (Dweck, 2008, 2012). This intermingling of discourses goes some way to explaining the continued dominance of constructivism; key ‘rallying calls’ now belong to, and are renewed by, a multitude of powerful traditions.

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15 BBL shares a close relationship with constructivism, BBL positioning itself as ‘the science’ behind cognitive psychology (e.g. Sousa, 2014; Willingham, 2008). Prominent social-constructivist mathematical educators such as Boaler (e.g. 2015b) have aligned themselves with BBL and Dweck (chief theorist of the mindset theory) in particular, further consolidating these discourses.
Creating communities of learners

Web 2.0 digital technologies now emerge as a major conduit for the flow of educational ideas. Mathematical educators continue to appear as significant (re)interpreters of constructivism, but in this era their influence often travels through their online presence. Virtual ‘communities of practice’ which offer professional development programs, multimedia examples of ‘best practice’ and opportunities for teachers to learn from and with other educators around the globe are now commonplace. Examples are highlighted in blue on the representation of the constructivist apparatus of the era below.

Figure 6 The constructivist apparatus of 2005–2015

This participatory approach to knowledge-making extends beyond the world of teacher education; classrooms are now commonly conceptualised as ‘communities of learners’ in which teachers and students work together to construct mathematical meaning. This notion rests on the constructivist premise that knowledge–building is a communal practice, with social interaction the catalyst for powerful cognitive (re)organisation. Guided inquiry sessions—where teachers pose carefully crafted problems and use collaborative learning situations and discussion to lead students to increasingly sophisticated mathematical understandings—are technologies frequently advocated (e.g. Small, 2012; Stein & Smith, 2011; Sullivan et al., 2006, 2015). However, in these and other teacher education material, while the approach is framed in
participatory terms, the focus often remains on the *individual acquisition* of knowledge, suggesting an interweaving of radical and social constructivism.

Below, I provide an example of this approach in operation in an Australian primary classroom. The lesson is drawn from the ‘Illustrations of practice’ section of the Australian Institute for Teaching and School Leadership (AITSL) website. Like the examples from previous eras, the activity is designed to draw out and extend students’ conceptual understanding of numbers to 20. And, as in the previous sections, I identify key threads and claims to be examined in the discursive analysis to follow.

16 AITSL is a teacher accreditation and training body. Two core functions are the development of regulated professional standards for Australian teachers and school leaders, and the provision of research-supported training and development opportunities.

The discourse of student-centred learning is embedded in Standard 1 and Focus Area 1.2—the teacher’s role is to know and understand their students and how they learn. Social constructivism shapes the enactment of this discourse; the lesson is deliberately non-verbal to cater to the learning needs of the predominantly Indigenous students.

Social constructivism also underpins the epistemological assumptions of the lesson; knowledge construction is a social, not individual, undertaking. **Collaboration** is constructed as a self-evident good, with (non-verbal) communication conceptualised as key to new knowledge development.

Another social-constructivist thread is apparent—students are *scaffolded* and *extended*. Piagetian stage theory also intertwines with this thread—action on concrete materials precedes and supports the development of abstract thought. As in the lesson of Era 2, process is privileged over production of correct answers. This, it is presented, will enable students to develop critical thinking skills, a ‘touchstone’ continuing from the previous era.

*Interpretive commentary*

![The no-language method](image)

**Standard 1: Know students and how they learn**

**Focus area 1.2: Understand how students learn**

Teacher comments:

"I wanted the students to learn collaboratively. Usually that collaboration will expand their thinking because they question each other and take each other to new learning that perhaps they wouldn’t have done on their own."

"I am aware of the students who need scaffolding and extension through their past learning with me... So the ones who needed scaffolding had the concrete materials provided and I modelled very heavily how to work out the solution."

"I saw some really great things there. I saw lots of knowledge.... Together we know lots and lots about the number eight. We were using everybody’s knowledge to discover the answer."

"We’ve made explicit to the students that it’s the process we are looking for, not necessarily the answers and that expectation then develops their critical thinking. So I am not looking at finding a correct answer, I’m looking at the process.”

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Figure 7 Era 2005–2015 Pedagogical exemplar and interpretive commentary
The engaged and productive learner: A close examination

In this section, I examine how the constructivist learner is constituted in the Australian Curriculum: Mathematics (AC: M) (2015). I place my focus on the Rationale, Aims, Key ideas and General capabilities that precede the Content and Achievement standards.

Like the constructivist learners of the previous eras, this learner is ‘active’ and learns through ‘inquiry and active participation in challenging and engaging experiences’ (Rationale, 2015). However, the child-centred threads shaping previous conceptualisations now interweave with the neoliberal discourses of personal agency and 21st-century citizenship introduced previously. Learners are purposeful subjects who ‘investigate, represent and interpret situations in their personal and work lives’ and as ‘active citizens’ (Aims: 2015). Learners are held responsible for their own learning by these statements, with ‘active participation’ a key performance indicator of whether they are performing this responsibility.

Ecclestone (2013) observes that ‘active citizenship’ has become a form of cultural capital, a means to safeguard the learner against failure and future problems, and a way of contributing to national economic goals. In both educational and public discourse, this citizenship appears to be becoming even more closely aligned with achieving mathematical and/or scientific success. I point to the hope being placed and the significant investments being made in interdisciplinary Science, Technology, Engineering and Mathematics (STEM) programs (Fitzallen, 2015) and the close attention being paid to Australia’s mathematical PISA standing (e.g. AAMT, 2015) as supporting evidence for this claim. The ‘truth’ that it is the mathematically able learner—this rational, cognitive being—who has the most to contribute to society has now become a firmly embedded ‘common sense’ and thus more ‘dangerous’. Its acceptance diminishes the value of other types of learners and learning (e.g. experiential, sensory and affective), and narrows the possibilities for who can be considered an ‘active citizen’. Those unable or unwilling to take up this particular subjectivity may find themselves with reduced social, cultural and economic ‘capital’ (Bourdieu, 2011) in adult life and the workplace.
A new discourse has appeared in this document, that of ‘proficiencies’. These are drawn from the (US) National Research Council’s (NRC) (2001) competency framework and appear in the AC: M as the ‘Key ideas’ (Key ideas: 2015). While the term itself is new, the proficiencies themselves are recognisable constructivist threads. The understanding proficiency highlights the constructivist ‘truth’ common to all eras—relational/conceptual understanding is the ultimate form of understanding. The problem-solving proficiency is also familiar. In the fluency proficiency, the legitimacy of procedures and algorithms has been reinstated, but these procedures are malleable, shaped by learners who ‘choose appropriate methods and approximations’ and carry out procedures ‘flexibly, accurately, efficiently and appropriately’ (Key ideas: 2015). The fourth proficiency, reasoning—the ability to think critically, explain this thinking and transfer knowledge from one situation to another—is given greater prominence than in previous eras.

I now work to problematise social constructivism’s valorisation of the rational, dialogic learner—expressed most clearly in this fourth proficiency and played out in the lesson exemplar—and contest two truth claims. The first is the assumption that all students will move smoothly to greater knowledge and more sophisticated mathematical understandings through social interaction with each other or ‘another with more’. What is absent from the account and, it is often argued, from Vygotskian theory in general is an acknowledgement of the complexity of social learning situations, which van Oers (2002, p. 67) notes are often ‘pervaded by conflicts, misunderstandings, obscurities, and ambiguities’. While students can indeed clarify and extend each other’s thinking, they can also distract, obfuscate and confuse and, particularly in small-group situations without close teacher involvement, this can go unnoticed. Power imbalances may also legitimate some students’ voices and exclude others, with the group only valuing what Bakhtin (1981) calls ‘the privileged voice’, perhaps the student whose discourse most closely mirrors that of the teacher, or the one who can express themselves fluently using the language of mathematical logic. Students who express their knowledge ‘procedurally’ rather than ‘relationally’, are disadvantaged by these ‘natural learning’ situations, produced as less, rather than differently, able. Crucially, the approach may then exclude these students from the learning process itself, further widening the gap between the ‘normal’ learner and those othered by the discourse.
The second concern I raise also relates to knowledge creation. I argue that there is often insufficient acknowledgement of how highly skilled teachers must be to create a classroom filled with ‘productive discussion’. Considerable evidence exists to suggest that many primary teachers lack the mathematical content knowledge (MCK) and the mathematical pedagogic content knowledge (MPCK) to provide the necessary rigour needed for productive discussions (AAS, 2015). Other evidence also suggests that primary teachers, often unknowingly, tend to prioritise student comfort over knowledge (Groves, Mousley, & Forgasz, 2006; Stein & Smith, 2011). While attention is currently being paid to developing teachers’ disciplinary knowledge (e.g. AAS 2016), I suggest that continued valorisation of social learning leaves insufficient ‘space’ for the legitimisation of other approaches that may result in comparable or higher levels of knowledge creation.

The fifth proficiency of the NRC framework, the possession of a ‘productive disposition’, appears in the AC: M in various forms. For example, the General Capabilities state that learners should ‘develop the skills to work independently and to show initiative, learn to be conscientious, delay gratification and persevere in the face of setbacks and frustrations’ (2015: General capabilities). Success in mathematics is therefore anchored not only to measurable mathematical achievements, but also to a particular subjectivity—the student with ‘grit’, a ‘growth mindset’. While encouraging students to persist in solving problems has obvious educational merit, this ‘common sense’, when interrogated further, becomes more complex and less ‘self-evidently good’.

Stokas (2015) notes that in the US this renewed focus on developing learners’ character is connected to increased social and economic inequality. Similar conditions are also recognised in Australia, where falling achievements in general, and the gaps between students of high and low socio-economic status in particular, are the subject of much concern (AAMT, 2015; Gonski et al., 2011; Stanley, 2008). In aligning mathematical success with the ability to tolerate mental discomfort and/or to engage in positive

\[\text{\footnotesize\textsuperscript{18}}\]

\[\text{\footnotesize\textsuperscript{18}}\] The authors of the AC: M omitted ‘productive disposition’ when it adopted the other proficiencies, as it was considered that it could not be assessed, a prerequisite for inclusion. The premise of the proficiency is supported, however (Sullivan, 2013).
thinking, much of this success or failure is then located with the learner, 
backgrounding other crucial factors such as access to resources and opportunities. I 
suggest the ‘dark side’ of this practice needs to be more fully considered if current 
achievement imbalances are to be rectified. Classifying students using simplistic 
binaries that fail to recognise the fluid nature of learner subjectivity or the complex 
nature of mathematical success are unlikely to close these gaps, and may indeed serve 
to further entrench them.
Chapter five: (re)Considering constructivism

In this chapter, I return to my original ‘puzzlement’ and reflect on the questions: What counts as constructivism in Australian primary mathematics education? Who is the constructivist learner and how is he or she shaped? How is this learner (still) here? I do not seek to offer definitive answers to these questions because, as Tamboukou (1999) notes, a genealogy does not look for ‘final truths’. Instead, drawing on the insights created in the preceding analysis and the literature review of chapter two, I offer one reading of how of our present came to be—of how constructivism came to be a leading ‘common sense’ in mathematics education and its learner, the preferred student subjectivity. I also reflect on who this learner can (and should) be, and what this imagining opens up and closes down.

What counts as constructivism in Australian primary mathematics education?

The origin or emergence of a thing and its ultimate usefulness, its practical application and incorporation into a system of ends are worlds apart ... anything in existence, having somehow come about, is continually interpreted anew, requisitioned anew, transformed and redirected to a new purpose by a power superior to it (Nietzsche, 1887, cited in Isin, 1997, p. 115).

Constructivist theories, as originally devised by Piaget (e.g. 1977, 1980), von Glasersfeld (e.g. 1984, 1995b) or Vygotsky (1978), are explanatory theories about how children come to know, ‘philosophical explanation[s] about the nature of knowledge’ (Airasian & Walsh, 1997). They do not, in themselves, sanction any particular pedagogy or approach (Mousley, 1993; Noddings, 1990; Richardson, 2003). They are also tentative. Piaget’s theories developed and changed over time, and Vygotsky’s early death meant that a number of his key concepts remained under-theorised and were viewed as problems ‘yet to be solved’ (Simon, 2006, p. 364).

However, the constructivism that has emerged in the empirical material is neither explanatory nor tentative, but pragmatic, pedagogic and prescriptive. I found that any explanatory theoretical text was consistently accompanied by pedagogic recommendations (e.g. ACER, 1966; Copeland, 1970; van de Walle & Karp, 2014) constructed as natural and inevitable outcomes of the theory. In many cases the
explanatory theory was omitted altogether, with the pedagogic reconstitution constructed as representative of the original (e.g. AEC, 1991; Cole, 1966). The indeterminacy underpinning knowledge, as propounded by Piaget and Vygotsky and the early interpretive scholars, has also been evacuated and the categories have hardened: learning must be active and student-centred. Formal algorithms (before a certain age) are dangerous. Curriculum content must be ordered to match seemingly natural developmental progressions.

Interestingly, I found that as constructivism’s dominance has increased, references to constructivism in the empirical material have decreased, until now it is rarely mentioned at all (e.g. AAMT 2015; ACARA, 2015). It has been black-boxed, ‘made invisible by its own success’ (Latour, 1999). Constructivism now offers the roadmap to mathematics education in Australian primary teacher material, with its preferred pedagogies and assessment methods taking up much of the ‘good practice’ space and its learner offered as the ‘successful learner’ subjectivity.

**Who is the constructivist learner?**

The analytic work of the previous chapter shows this learner changing across space and time. ‘The child’ of the Piagetian era becomes the ‘mathematical negotiator’ of the second era and the ‘engaged and productive’ learner of today. However, certain subjectivities transcend these shifts and a strong narrative has emerged: The constructivist learner is an active learner who constructs rich, conceptual mathematical understanding when engaged in dialogic/collaborative problem-solving activity. A teacher guides this learner ever ‘onwards and upwards’. This empowered learner then possesses the keys to future employment opportunities, economic prosperity and social standing. In this section I pull apart this story and examine the ways key inter-related discursive threads—activity, developmentalism and student-centred learning—have worked to configure this learner. My aim is not to strip the narrative of any value, but to show that it is a story—one that might be told otherwise, or along with others.
The ‘active problem-solver’

In the original theorisations, the constructivist learner actively builds knowledge through the mental processes of reflective adaptation (Piaget, 1980) or semiotic mediation (Vygotsky, 1978). In the empirical material, this learner is initially reconceptualised as an active knowledge-builder who learns through play, experimentation and discovery. In the case of younger learners in particular, this activity involves interaction with concrete, preferably structured materials (e.g. ACER 1962; Copeland, 1970). Today, the learner is a ‘self-motivated, self-responsible and reasonable’ figure (Popkewitz, 1998, p. 542) who learns through solving ill-defined problems in learning communities (e.g. Booker et al., 2004; Sullivan, 2011b). These shifting subjectivities and key discursive technologies—pedagogic practices—used to produce these learners are represented in the diagram below:
Figure 8 The active, developmental learner 1965–2015
The ‘active problem-solver’: (de)Constructing the subject

Although the ‘active learner’ has been conceptualised differently over the eras, this historicity is generally not recognised in the empirical material, nor is the productive function of the discourse acknowledged. Each incarnation is presented anew as natural, homogenised and unproblematic, and each version of the story is consistently framed in emancipatory terms: pedagogies based on activity—physical, social or mental—will free students from the oppression of transmissive teaching and enable the inevitable development of powerful mathematical skills and understandings.

Challenges to this story can be located in the wider educational literature. For example, Popkewitz (2009, p. 303) argues that:

To talk about the child as, for example, a ‘problem-solver’ … invokes not merely categories to help children become better and more successful. These categories embody particular principles about what is seen, thought about, and acted on in schooling. The ‘political’ of schooling lies here: in the shaping and fashioning of what is (im)possible.

Following this, I suggest that the discourse of activity makes it impossible for the ‘passive’ learner to be produced as successful. Foucault argues that discourse functions as a disciplinary practice that ‘compares, differentiates, hierarchizes, homogenises and excludes. In short it normalises’ (1984, p. 195; original emphasis). In Australian primary mathematics, the active problem-solver is now the ‘normal’ educational subjectivity for learners. The child who doesn’t fit these (historical and changing) rules is ‘othered’.

Popkewitz (2008, 2009) further theorises this ‘dividing practice’, using the notion of abjection to go beyond the inclusion/exclusion binary. Thinking with abjection, while the discourse of activity ‘others’, it also feels compelled to include these very same individuals, because those who sit outside the ‘normal’ pose a threat to modern, enlightened society. Technologies must be employed to bring the abjected back into the fold, thereby neutralising their threat. We see this at work in the empirical material, where students must ‘become actively involved in the learning experience that the teacher offers him’ (ACER 1966, p. 29) ‘have a go’ (AEC, 1991) and ‘engage’ (ACARA, 2015; Sullivan, 2011b). These practices all work to ‘norm’ the abnormal—the passive, the disengaged, those not ‘taking responsibility’ for their learning.
While the empirical material consistently frames these imperatives in the rhetoric of equity and freedom, following Popkewitz I posit that there is more to this norming practice than acknowledged. The desire to ‘make all children the same and on equal footing’ stems, Popkewitz (2008, p. 4) argues, from ‘the double gestures of hope and fear’: Hope that an inclusionary society of rational problem-solvers will build an enlightened, prosperous modern society; and fear of the students who do not fit this norm, the ‘dangerous individuals and populations’.

*The ‘active problem-solver’: Challenging pedagogic ‘truths’*

The discourse of activity also makes it impossible for ‘passive’ pedagogies to be produced as effective. I found little support for ‘teaching by telling’ or the use of worksheets or textbooks in the empirical material. In Australian primary mathematics education, good pedagogy is firmly equated with ‘active’ pedagogy, particularly (collaborative) problem-solving. This lies in contrast with at least some of the academic literature which, drawing on the original Piagetian and Vygotskian theorisations, reminds us that knowledge construction does not depend on particular pedagogies (Airasian & Walsh, 1997; Klein, 2000; Noddings, 1990).

Recent scholarship in the broader educational field provides corroborating evidence for the use of a range of pedagogic approaches, with the work of Hattie and colleagues (2008, 2012; 2013) appearing particularly influential (Dinham, 2014). Interestingly, in Hattie’s (2012) meta-analytical analysis, the effect size of pedagogies that correlate with and support Piaget’s original developmental theorisations ranks 4/150, while key pedagogic-constructivist touchstones, such as problem-based learning, teaching new concepts and ideas *through* problem-solving, and the use of manipulatives, are presented as having a low or medium effect at best. Hattie’s scholarship is currently informing pre-service teacher education programs and shaping the work of prominent institutions such as AITSL, and it will be interesting to watch out for where this enters the field of mathematics education, and if and how it disrupts the ‘active learner’ discourse.
The ‘developing child’

Walkerdine (1993, p. 452) describes developmental psychology as one of the ‘grand metanarratives of science’. The compelling story of a child moving cognitively onwards and upwards when appropriately surveilled and supported is so powerful and so deeply embedded in educational discourse it is, as Hoskin observes (1985, as cited in Walkerdine, 1993, p. 454), very difficult to believe this ‘textual child’ does not necessarily exist. However, examining the shifts that appear in its story helps us see developmentalism as a ‘product of human invention’ (Baker, 1999, p. 825) and, as such, open to further change.

I found that in the first era (1965–1975), the discourse is primarily circulated through Piagetian stage and logico-mathematical theory; in this story, the learner is constructed as one who moves universally along a preordained continuum, guided by a vigilant and supportive teacher (e.g. ACER 1966; Copeland, 1970). In the second era (1985–1995), the developing child becomes less predictable. The one path has (ostensibly) become many, requiring teachers to broaden their ‘gaze’ so they can watch, monitor and respond to twenty-five students on idiosyncratic paths (e.g. AEC 1991; DJ Clarke, 1992). In the final era (2005–2015), the developing child, while seemingly a ‘social learner’, is produced and measured against individual ZPDs, learning trajectories, and mandated curricula and testing schemes (e.g. ACARA, 2015; Mousley et al., 2007). These shifts are indicated in Figure 8 above.

Normalising the developing child: The work of curriculum

Like the active-learner discourse, the developing-child discourse works to create the ‘normal’ subject (Baker, 1998; Popkewitz, 1998; Walkerdine, 1993). The mathematical curriculum is an important regulatory technology employed in this work. In the course of my archival research, I found that not only are norms established by the various curricula, but the space in which the learner can be considered ‘normal’ has reduced considerably over the eras. Once expressed in terms of bands or broad stages (AEC, 1991; First Steps, DETWA 2004), normality is now defined in yearly progressions (ACARA, 2015) and in the case of Queensland (QLD DET, 2016) has narrowed even further to school-term distinctions.
I see the multiple and uneven effects of this ‘tightening’ in my work as a mathematics publisher. One consistent concern expressed by teachers is whether, or how, an activity we offer fits within the precise boundaries of a regional curriculum. If it is seen to transgress these, even in superficial ways, the activity is often not taken up. I argue that this strict adherence to curricular norms can deny students access to important opportunities for mental growth, and builds unnecessary and unhelpful barriers around who the ‘normal learner’ is permitted to be(come).

**Normalising the developing child: The assessed learner**

Foucault (1984, p. 196) notes that while normalisation ‘imposes homogeneity’, it also individualises by ‘making it possible to measure gaps, to determine levels’. Assessment practices are technologies used to measure these gaps, to produce the ‘calculable person’ (Foucault, 1979). In the empirical material, the pen-and-paper tests used to classify and distribute students in the preceding behaviourist era are positioned as insufficient in themselves, revealing as they do only limited snapshots of student cognition. The developing-child discourse demands that more of the child is raised above the ‘threshold of description’, that ‘the child’s very demeanour, attitude, action is monitored, the object of a benign but surveillant gaze’ (Walkerdine, 1993, p. 454). Suggested measures taken from the policy or policy advisory texts (ACER, 1966, pp. 238–246; ACARA, 2015; AEC, 1991, p. 22) are highlighted in Figure 8 above.

For present purposes, I pay particular attention to an influential discursive thread in the developing-child narrative, that of diagnosis. The thread, as the name suggests, draws on the authority of scientific expertise, expressing itself in medical terms that function to preclude doubt and challenge. In the first era of study, diagnostic assessments appeared as powerful tools for classifying and distributing students. The proliferation of testing schemes produced or recommended by ACER (1966, 1972) provide corroborative evidence for this claim. In the second era, the diagnosis of misconceptions emerged as a priority (DJ Clarke, 1992; Confrey & Kazak, 2006), intensifying the need for practices such as open-ended tasks, through which students revealed their idiosyncratic understandings, and annotated class lists, for documenting these and other aspects of learners’ mental ‘condition’ or conative state. In the current era, diagnostic/developmental discourse is a significant presence in the teacher education and academic literature alike, often expressed in terms of developmental
continua, learning trajectories (Mousley et al., 2007; Sullivan, 2011b; Sullivan, Mousley, & Jorgensen, 2005; Sztajn & Confrey, 2012) or clinical interviews (Hunt, 2015). Through these technologies, little escapes (or should escape) the teacher’s normalising gaze. The developmental-learner discourse works effectively to ‘capture and fix’ both the learners and the object, mathematics itself, entrenching them in an ever-increasing ‘network of writing’ (Foucault, 1984, p. 201). Students who are diagnosed as deviating too far from established norms are then to be ‘fixed’ by the watchful teacher, pedagogy as intervention being another important technology at work.

Walkerdine (1993) and others (Baker, 1998, 1999; Popkewitz, 2009) argue that this discourse is firmly embedded in modern education, a claim supported by the empirical material, and what might be ‘beyond’ developmentalism is hard to imagine. Baker (1999) also highlights an inherent paradox in such imagining—thinking what might be beyond or ‘better than’ developmentalism actually traps us in developmental thinking. She suggests that a different line of thought might be useful, one that directs us to think about why developmentalism matters so much, a point which speaks to the societal ‘hopes and fears’ attached to the learner explored previously. Thinking of developmentalism with Lykke’s (2010) conceptualisation of ‘post’—as both transgressing and exceeding—might also be helpful: What does developmentalism offer us that we might want to keep? How does it limit us and what might we reject? Are there ways we can use its tools differently and with different intent?

**Shifting the focus: Student-centred learning**

Student-centred learning is another constructivist ‘self-evident good’ very apparent in the empirical material (e.g. ACER, 1966; AEC, 1991; Sullivan, 2011b). The shifts in learner subjectivity and the pedagogic practices valorised by this discourse are summarised in the figure below. The images of classrooms provide additional corroborating evidence of the shifts, encapsulating what learning often looked like for students of each era.

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99 A push for teaching itself to be considered a clinical practice is also gathering momentum in teacher training institutions (e.g. Alter & Coggshall, 2009; McLean Davies et al., 2013) further embedding the discourse.
Figure 9 Student-centred learning 1965–2015
What is held in common across all conceptualisations is the positioning of the learner as ‘the sun about which the appliances of education revolve’ (Dewey, as cited in ACER, 1964, sec. 1). While the discourse has also influenced curricula and assessment practices, I focus here on its effects on the relationships between student, teacher and mathematical content.

The discourse of student-centred learning privileges students’ knowledge, needs and sociocultural backgrounds. It shifts the focus from the teacher and mathematical content to the learner, and demands that we answer questions such as: Who are these students? What can they do? How can we help them learn? In this repositioning, for teachers ‘much control is lost both over curriculum content and pedagogical interaction’ (Mousley, 1990, p. 60). In the empirical material, this is presented in the main as a natural good, an expression of democratic egalitarianism that rescues the learner from the ‘homogenous elitism’ (Burton, 1995) of the traditional mathematics curriculum and pedagogic approach.

On one level, students do gain from this shift. If we accept the premise that knowledge is constructed—which current neuroscience appears to support (Bransford, Brown & Cocking, 2000; Hinton & Fischer, 2010), albeit with a growing recognition that learning is not merely a cognitive process but affective as well (e.g. Immordino-Yang & Damasio, 2007; Immordino-Yang, 2011)—then presenting students with material that is too disconnected from current knowledge and experience is pointless. However, the discourse generally fails to recognise how difficult this is to establish, a point well made by Ellerton et al. (2012) in their discussion about the constraints and affordances of asking (leading) questions. The discourse also demands much more. We need to engage, stimulate, guide and track each learner. This is a seductive ‘siren call’ and difficult to argue with on a theoretical level, but the ease and frequency with which it is espoused, particularly in the teacher education material, belies the challenges of implementation. This can raise false expectations on the part of teachers, students and parents, resulting in significant intra- and inter-personal tensions (Brown & McNamara, 2011), and might, I suggest, contribute to the ongoing (common)sense that mathematics education is failing.
I also suggest that there may also be greater hidden costs to the discourse. In the previous chapter, following Yates and Collins (e.g. 2010), Young (2010; e.g. 2014) and Jorgenson (2014), I argued that a focus on the learner and processes may be hindering the development of ‘powerful’ knowledge and that it might be time to rethink both the focus and the binary itself. There seems to be an unfortunate irony here, that in prioritising the student, the discourse may in fact be depriving students of the knowledge they need to function successfully in the world. This is a personal cost, but one also likely to be shared by wider society.

How is this learner (still) here?

This ‘active, developing learner’ did not emerge from nowhere. It has historicity, connections and disconnections with prior learners. It was also formed as a result of a ‘particular constellation of forces that shape and define things’ (Isin, 1997, p. 116).

One key dynamic appears to be the rise of mathematical educators, which the literature dates to the 1970s and 1980s (Connell, 1993; Haynes, 1996). My genealogical work supports this, although I suggest that the documents written by educators such as the curriculum officers based at and working with ACER (e.g. Keeves, 1962, 1966; 1965) locate the influence of ‘non-mathematicians’ in Australian primary mathematics education even earlier. I found much of the constructivist language used in these early documents to be similar to that embedded in the most recent documents, suggesting a line of continuity.

As argued previously, mathematical educators have not merely reproduced the original theories for a teacher audience, but have transformed a theory of knowing into a theory of teaching and learning. Lerman (2000), following Bernstein (1996), describes this process as recontextualisation—a process that, he further suggests, is often ideological. DiSessa and Cobb (2004) support Lerman’s contention, arguing that many constructivist ‘translators’ present their interpretations as ‘the’ truth about constructivism, often with little empirical evidence or through the use of unwarranted generalisations. In Foucauldian (1980) terms, we would describe this as a power/knowledge practice, its function being to ‘shut down’ other possible truths. What I have found particularly interesting is the use of certainty as an instrument of power, particularly in the early radical-constructivist documents where the object of
mathematics itself was challenged and re-envisioned. Thompson (2000) notes that
control, rather than insight, is often the goal of mathematical interest groups, and
absolutism allows individuals and organisations to say, ‘You are uncertain, we are
certain, therefore we are right’ (2000, p. 416). In the teacher education material, I
found that few authors have resisted the tactical advantage this position offers. It is
powerful work indeed; as a pre-service teacher at a college of advanced education in
the late 1980s, I was immersed in pedagogic constructivism. It has taken me well into
this study to realise in full that the pedagogic practices presented as
‘Piagetian/Vygotskian’ are in fact reinventions aimed at shaping teaching and learning
practices in accordance with particular interpretations of constructivist theory and
agendas.

One danger of highlighting the role of educators in this way is to overplay the role of
the knowing subject, to see our present as resting on ‘profound intentions and
immutable necessities’ (Foucault, 1984, p. 89). Here, I offer an example of the role
chance has played in the take-up of constructivism in Australian primary mathematics
education. Blakers (1978) notes that the 1964 ACER conference which produced the
highly influential Background in mathematics (1966, 1972) convened originally, in the
main, to discuss the changes that would occur through the introduction of decimal
currency. However, these hardly ‘rate a mention in the proceedings’ (Blakers, 1978, p.
152). Instead, the conference ‘created a special opportunity’ to discuss ‘desirable
changes’ to primary mathematics education, and it was only decided at the end of this
meeting to produce the 1966 text (later reprinted in 1972 with decimal revisions). Using
this example as illustrative, my point is that, while it can be tempting to consider the
rise of constructivism as planned or inexorable, this is not the case. The
constructivism(s) that we now take for granted rest on the results of this and many
such events of chance, error, deviation and conflict. Stories of these events, while hard
to locate, do exist (e.g. Blakers, 1978; Schoenfeld, 2004) and help us to challenge the
sense of inevitability—that we are on a planned march of progress—embedded in the
accepted story.

Wider sociocultural discourses are also part of the ‘profusion of tangled events’
(Foucault, 1984, p. 89) that have contributed to the current dominance of
constructivism. I now lightly trace federalism in Australian mathematics education and
its intersecting discursive threads to support this statement. As identified previously, moves by successive federal governments to ‘take hold’ of education are evident in the empirical material (e.g. ACARA, 2015; AEC, 1991; Karmel & Quality of Education Review Committee, 1973; MCEETYA 2008). These documents cast a ‘normalising gaze’ across the nation, working to construct the successful student as active, productive and engaged. While these threads belong to the discourse of constructivism, they are also shared with other, often contradictory discourses such as neoliberalism and progressivism. Fendler (2003, p. 17) argues that a ‘confusing morass of meanings’ enhances, rather than diminishes, the power of a discourse; in this case and through this interdiscursivity, the constructivist learner belongs to a ‘critical mass’ of society, despite the fact that there are in fact, multiple versions of this learner. Strike (1987, p. 481) describes this succinctly, likening constructivism to democracy—it ‘is presumed to be a good thing, whatever it is. That any two people mean the same thing by it, is in doubt’.

What is also held in common and similarly firmly established (e.g. ACER, 1966; ACARA, 2015; AEC, 1991) is the ‘common sense’ that it is the autonomous, rational learner who can be the acceptable learner-citizen and mathematical aptitude, the measure of this success. A sub-plot of this narrative is the failure of ‘traditional’ (behaviourist) mathematics to create this learner and the continued faith in constructivism’s capacity to do so. It is interesting that, after so many years and with a continued decline in mathematical results (OECD, 2014), constructivism is still allowed to position itself as this saviour. One key reason seems to be that the discourse is often constructed as unimplemented or implemented poorly (e.g. AAS, 2015; AAMT, 2015). Confirming or refuting this claim is beyond the scope of this study. I can only say that the concept pervades the literature, particularly the teacher education literature, where the ‘engaged problem-solver’ is still conceptualised as being held back, primarily by inadequate, ‘old-fashioned’ teaching.

This interdiscursivity also exposes continuities between the constructivist learner and learners of prior eras, and offers other possible explanations for the learner’s continued existence. Scott (2009) argues that, while constructivism is often positioned as breaking with the past, the constructivist learner has links with the progressivist learner of the late 19th century, initially envisioned by Rousseau a century previously, a
point made by Piaget himself (1970) and others such as Baker (1998, 1999) and Popkewitz (1998, 2008, 2009). Because of these continuities, Popkewitz (2009) also counsels against reading today’s rational learner solely as an ‘economic’ figure produced in response to current neoliberal demands for a ‘global 21st century citizen’. He argues that the political, social and moral imperatives informing progressivism—developing responsible, reasonable and manageable citizens—are still attached to today’s learner. Analyses such as these help explain why we hold so tightly to the constructivist learner and why we associate the figure with ‘salvation’. Not only is the figure familiar and thus more ‘natural’, it also embodies deeply held societal beliefs and aspirations about the ideal modern state and its citizen that go back hundreds of years, dreams that we still hold to today.

Finally, in this discussion of why the constructivist learner is still here, I draw attention to the analysis undertaken by Confrey and Kazak (2006), who, drawing on Lakatos (1976), define constructivism as a grand paradigm surrounded by a protective belt of theories and empirical studies. Changes have certainly occurred at these theoretical and empirical levels, as evidenced by the shifts from Piagetian to radical to social constructivism (and the myriad variations within each of these), but core constructivist precepts—the construction of new knowledge through activity, the developmental nature of this process and the positioning of the student at the nexus of teaching and learning—remain fixed. In the following chapter, I speculate on what might ‘unfix’ them.
Chapter six: Concluding thoughts

Reprise

This study investigated constructivism. I sought to understand how it has been possible for it to become a leading discourse in Australian primary mathematics education and traced its transformations over the years of 1965–2015. I considered how the discourse has worked to produce the mathematical learner of today, and critically analysed the effects of this work.

In chapter one, I explained my impetus and reasons for conducting the study. I argued that constructivism, in creating new possibilities for the mathematical learner, has also closed down others. I also argued that the learner figure, and the practices privileged by pedagogical constructivism, are generally conceptualised unproblematically in the mathematics education literature—particularly that written for a practitioner audience—and seem to read from a common script. In chapter two, I held the literature presenting constructivism as a theory of knowing against the literature presenting constructivism as a theory of teaching and learning in order to understand how constructivist theories have been variously (re)constituted in the hands of key interpreters and to locate significant patterns and regularities in this interpretive work.

In chapter three, I discussed how undertaking a history of the present enabled me to think differently about constructivism and its learner(s). In chapter four, I examined documentary evidence produced in three decades—1965–1975, 1985–1995, and 2005–2015—and located some of the historical and social trajectories that enabled Piagetian, radical and social constructivism to, in turn and together, take hold in Australian primary mathematics education over these years. I considered how key discursive threads—activity, developmentalism and student-centred learning—work to shape learner subjectivity, and reflected on the effects of this work. These findings were distilled in the preceding chapter.
Reflection

Before I began this work, I accepted the premise that a ‘constructivist approach’ was the ‘right way’ to teach and the constructivist learner, the optimal student, although with the vague sense of unease that prompted the study. I also viewed constructivism, in the main, as a unified ‘thing’, assigning differences to geographical interpretations or some teachers just ‘not really getting it’. By drawing on conceptual resources provided by Foucault (e.g. 1980, 1981, 1984), and those working with his ideas (e.g. Baker, 1998, 1999, Popkewitz, 1998, 2008, 2009, Walkerdine, 1988, 1993; Walshaw, 2004a; Zevenbergen, 1994a) I have been able to look at and reconsider these assumptions and uncover other ‘familiar, unchallenged, unconsidered modes of thought’ (Foucault, 1988a, p. 154). This has resulted in some significant ontological and epistemological shifts. I touch on a few here.

I now view the constructivist learner differently. Whereas previously I looked on an active, curious and developmental learner as natural, I now consider this learner a produced and unstable figure, shaped by constructivism and other discourses in response to changing historical and cultural conditions, and societal hopes and fears. I also no longer view this figure as the ‘ultimate’ learner. While I recognise its value—for some students, the subjectivity ‘fits’—for others, it doesn’t, or only some of the time, in certain circumstances. When they fall outside the boundaries, students are produced as lesser—not just different—by the discourse, making it difficult for them to be/come a successful student. I also see that the rules created by pedagogical constructivism defining ‘good’ teaching and learning have resulted in ‘hard’ categories and binaries (e.g. student-centred/teacher directed learning, problem-solving/rote learning) which can limit opportunities for mathematical knowledge development. In regard to this latter point I see these limitations as significant for all students, not just those most obviously ‘othered’ by constructivism. Relaxing these rules, opening up other ‘layers’ of the teaching ‘toolbox’ and choosing different tools for different jobs, is something I now advocate confidently for when interacting with teachers in my role as educational publisher.

Another shift concerns how I consider new ideas. While I am more open to considering the value of other types of learners and learning theories, I find myself more critical and measured in my appraisal. I am now aware of how discourses in
general, and ‘regimes of truth’ in particular, work to shape how and what we know about mathematics education and its learners, and am less susceptible to this influence. I am also more alert to the danger of replacing one ‘ultimate learner’ with another.

Imagining the post/constructivist learner

Foucault argues that we undertake genealogies not just so we see our present differently, but so that we might turn this present into the past (Roth, 1981). I end this thesis by speculating on what a new present might be, on who the constructivist learner might be/come. When I imagine this figure, again drawing on Lykke (2010), I see it as more than the current constructivist learner, rather than a different entity altogether—a post/constructivist learner. Such a conceptualisation allows for continuities and discontinuities, which as this study has attempted to show, are elements of any ‘new’ figure. I now lightly sketch some possible figures emerging in the current scholarly literature, one offering challenge to cognitive constructivist theorisations, the other to pedagogical interpretations of the discourse.

The constructivist learner (as rendered psychologically) is a cognitive, intentional and rational being. Some recent literature suggests that the possibilities of a learner who is more than cognitive is being considered in mathematics education, one who learns through and with their senses, their body, their affective reactions to events and experiences (e.g. Clarke, 2015; Immordino Yang & Damasio, 2007; Roth & Walshaw, 2015; Roth, 2014; Walshaw & Brown, 2011; Walshaw & Cabral, 2005). A range of psychological/social positions are taken by these authors, and their understandings of the mind/body relationship vary, but they all open up some space for considering an experiential, sensory learner and what this learner might have to offer mathematics education.

For example, Roth (2011, 2014) in challenging the Piagetian position that it is only intentional action that leads to knowledge construction, argues that we might also consider the value of the non-intentional learning. Rather than being solely focussed on a specific cognitive outcome, the learner allows themselves ‘to be affected’ by their senses and experiences. In these encounters—when relating with others, the environment, and objects—new knowledge is developed, knowledge that could not be
intended or created through cognition alone. Similarly, Appelbaum (2008) argues for a pedagogic approach in which the teacher also enters into these encounters, suspending prior goals and focussing on the pedagogic opportunities created in and by these encounters. As a classroom teacher, I valued these moments—and the spontaneous knowledge development that occurred—and see value in giving this learner ‘room’ to develop.

Other possibilities might emerge from challenges to pedagogical constructivism. Such challenges come from those advocating a ‘back to basics’ movement—particularly prevalent in the political field (e.g. Department of Education and Training Media Centre, 2016)—but also from those advocating a ‘forwards to fundamentals’ move, and/or a focus on the development of ‘powerful knowledge’ (e.g. Christodoulou, 2014; Dinham, 2008, 2014; Hattie, 2012; Jorgensen, 2014; Yates & Collins, 2010; Young et al., 2014) Historically, a strictly behaviourist or ‘back to basics’ approach has not resulted in significant educational gains (AAS, 2015), and I posit it is perhaps unlikely to be more productive now. However, a post/constructivist approach that both accepts theoretical constructivism, and rethinks what we mean by—and the value of—constructivist precepts such as ‘student-centred learning’ and ‘student engagement’, might open space for a re-envisioned mathematical learner, one made more, not less, ‘powerful’ by this repositioning.
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Mathematics: Perspectives from Classroom Practice and Current Research.


### Appendix 1: Key learning theories of the 20th and 21st centuries

#### Table 5  Key learning theories of the 20th and 21st centuries

<table>
<thead>
<tr>
<th>Interruption</th>
<th>Key Theorists</th>
<th>Epistemological position</th>
<th>Characterised by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associationism/Connectionism 1920s–1930s</td>
<td>Thorndike</td>
<td>Behavioural</td>
<td>• a focus on learner behaviour&lt;br&gt;• breaking mathematical ideas into manageable 'chunks' and sequential delivery of chunks&lt;br&gt;• transmission/reception model of teaching&lt;br&gt;• drill and practice</td>
</tr>
<tr>
<td>Meaningful Arithmetic 1940s–1950s</td>
<td>Gestalt theory&lt;br&gt;Brownell&lt;br&gt;Fehr</td>
<td>Relational</td>
<td>• emphasis on mathematical relationships&lt;br&gt;• real-world and incidental learning&lt;br&gt;• activity-oriented approach</td>
</tr>
<tr>
<td>Psychological constructivism 1960s</td>
<td>Piaget&lt;br&gt;Bruner</td>
<td>Constructivist</td>
<td>• a focus on individual cognition&lt;br&gt;• a rejection of the idea that children are <em>tabula rasa</em>— blank slates&lt;br&gt;• learning through activity, personal discovery and experimentation&lt;br&gt;• focus on the structure of mathematics</td>
</tr>
<tr>
<td>Behaviourism 1960s–1970s</td>
<td>Skinner&lt;br&gt;Gagne</td>
<td>Operant conditioning</td>
<td>• a focus on <em>behaviour</em>&lt;br&gt;• transmission/absorption model of teaching&lt;br&gt;• programmed, sequential instruction</td>
</tr>
<tr>
<td>Radical constructivism 1980s–1990s</td>
<td>von Glasersfeld</td>
<td>Constructivist</td>
<td>• a focus on individual cognition&lt;br&gt;• student-owned mathematical knowledge&lt;br&gt;• a focus on action, activity and tools&lt;br&gt;• rejection of transmission/reception pedagogical model</td>
</tr>
<tr>
<td>Social constructivism 1990s–2010s</td>
<td>Vygotsky, Lave, Wenger</td>
<td><strong>Participatory</strong></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>------------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Learning is a culturally and historically situated practice. Knowledge develops through participating in shared knowledge-creation experiences.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• a focus on the <em>social contexts</em> of learning and the ways in which individuals internalise these</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• dialogic learning</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• classrooms as communities</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• importance of a ‘more knowledgeable other’ in learning contexts</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 2: Summary of literature review findings

Table 6  Summary of Piagetian constructivism (1965-1975 literature)

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s intellectual growth occurs in periods of generalised cognitive patterns</td>
<td>Developmental stages dictate the types of learning experiences a child should encounter and the learning that can occur.</td>
<td>Developing child</td>
</tr>
<tr>
<td>Knowledge cannot be passed on to a learner; it is actively constructed by the learner</td>
<td>Good pedagogy therefore involves physical activity and opportunities for personal discovery.</td>
<td>Active learner</td>
</tr>
<tr>
<td>Knowledge construction occurs through the adaptive processes of assimilation and accommodation</td>
<td>Learning experiences must connect to, and then challenge, the learner’s prior understandings and experiences. The teacher’s role is to observe and correctly diagnose understandings, and plan new, appropriate challenges</td>
<td>Child-centred approach</td>
</tr>
<tr>
<td>Human intelligence necessarily constructs a standard set of logico-mathematical structures</td>
<td>Mathematical concepts such as conservation and cardinality develop in a fixed hierarchical sequence. Pedagogy (and tools) should be structured accordingly.</td>
<td>Developing child</td>
</tr>
</tbody>
</table>

Table 7  Summary of radical constructivism (1985-1995 literature)

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive threads</th>
</tr>
</thead>
<tbody>
<tr>
<td>All knowledge is instrumental</td>
<td>Students need to understand why knowledge might be useful to them. Learning activities must relate to their real life experiences.</td>
<td>Student-centred and student-directed learning Engagement</td>
</tr>
<tr>
<td>All knowledge is subjective</td>
<td>Students will ‘see’ a mathematical situation differently to the teacher. Teachers need to infer student’s existing conceptual networks and provide learning experiences that build on these. (In)formative assessment is required.</td>
<td>Student-centred learning Diagnosis and intervention Conceptual understanding</td>
</tr>
<tr>
<td>Learning is the product of the active construction of viable conceptual networks</td>
<td>Rote learning/memorisation does not lead to ‘enlightenment’ or an understanding of broad operative principles. Problem-based learning is essential.</td>
<td>Problem solver Conceptual understanding</td>
</tr>
<tr>
<td>Mental disequilibrium is required</td>
<td>Problematic situations stimulate mental perturbation. However for students to mentally</td>
<td></td>
</tr>
</tbody>
</table>


Table 8  Summary of social constructivism (2005-2015 literature)

<table>
<thead>
<tr>
<th>Theoretical construct</th>
<th>Common pedagogical (re)interpretations</th>
<th>Discursive thread</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognition develops from social and cultural processes</td>
<td>Learning and development take place in ever-changing socially and culturally shaped contexts. The teacher’s role is to facilitate ‘communities of practice’ and be aware of social, affective, motivational and identity-formation issues.</td>
<td>Student-centred learning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communities of learners</td>
</tr>
<tr>
<td>Language leads learning</td>
<td>Students learn through active participation in mathematical discussions and debate. The teacher’s role is to guide these discussions, monitor responses, and lead students to more sophisticated mathematical understandings.</td>
<td>The rational, dialogic learner</td>
</tr>
<tr>
<td>Zone of Proximal Development</td>
<td>Teachers should understand what students know and provide differentiated, problematic learning activities that challenge and develop current understandings. Learning trajectories help teachers track progress and plan appropriately.</td>
<td>Student-centred learning Problem solver</td>
</tr>
</tbody>
</table>

for the growth of new knowledge.  

engage with problems, they must see them as fun and personally meaningful.  

Engaging the student  

Student-directed learning  

Concepts and conceptual relations are mental structures that cannot be passed from one mind to another.  

Students who create their own understandings develop more powerful knowledge than those who learn from textbooks or teacher talk. Conceptual understanding is key  

Student-centred learning  

Active problem solver  

Conceptual understanding  

Social interaction and physical activity are opportunities for reflective abstraction.  

Good pedagogy involves physical activity, group work and/or discussion. Good pedagogy is ‘activity-based’.  

Active learner  

Collaborative learner
Appendix 3: Working method snapshots (data collection)

<table>
<thead>
<tr>
<th>Year</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2003</td>
<td>prediction that research dealing with socio-cultural issues will assume greater significance over next 50 years Jones, MERGA review 2004, p. 371</td>
</tr>
<tr>
<td>2006-2011</td>
<td>Reflections on MERGA 2004-2007 research review</td>
</tr>
</tbody>
</table>

Figure 10  MERGA 4-year reviews of mathematics education research in Australasia (chapter headings)

| Figure 11  Discursive pattern searches in educational documents 2005-2015 |
Figure 12  Google Books Ngram Viewer: Search 1


Figure 13  Google Books Ngram Viewer: Search 2


Figure 14  Google Books Ngram Viewer: Search 3

Frequency of the terms ‘productive disposition’ and ‘growth mindset’ in the Google corpus of English books from the years 1965 to 2008. Smoothing of 3.
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Author/s: Flenley, Rachel

Title: The constructivist learner: towards a genealogy

Date: 2016

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