

How are learning theories used in national curriculum development?

Research Reports

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15 October 2024

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How to cite this publication:

Ireland, J., & Majewska, D. (2024). *How are learning theories used in national curriculum development?* Cambridge University Press & Assessment.

Introduction

Schunk (2013) suggested that learning theory and educational practice should complement one another but argued that for various reasons the two have not been linked as closely as might be expected. As a bridge between theory and practice, arguably curriculum documents should demonstrate how learning theories have been used in developing the curriculum. Sometimes it is difficult to ascertain from these sources the degree to which some international curricula have been based on learning theories. It is possible that some curriculum developers do not use learning theories in their curriculum designs, or that the use of such theories is implicit rather than explicit.

This work aims to explore the use of learning theories in curriculum development and gather evidence for what good practice in this area looks like. By exploring the academic literature in this area, we hope to find information that curriculum documents do not provide.

The following research questions were therefore proposed:

1. Is there evidence of learning theory being used in national curriculum development?
2. How is learning theory used in national curriculum development?
3. How should learning theory be used in national curriculum development?

To allow for the issues to be explored in sufficient depth, we decided to focus on the curricula of two jurisdictions. Working from a list of countries/jurisdictions which had recently undergone curriculum redevelopment (OECD, 2020a, p.33), we conducted a simple literature search to identify those which appeared to have sufficient academic literature for analysis. Based on this, New Zealand and Ontario (Canada) were chosen as the focus for this study.

Before moving on to the literature review, we set out our understanding of the terms and definitions which we were working with through the study.

Definitions of curriculum

The OECD (2020b) acknowledged that there is no consensus definition of curriculum. They identified various complicating aspects such as the formal/hidden curriculum, and mandatory/non-mandatory. Kelly (1999) also drew attention to the many interpretations of the term 'curriculum', including the fact that curriculum for some is equated with syllabus. He argued that a curriculum is broader than a subject syllabus and should incorporate all subjects and include high-level aims and objectives like the purposes of education and the effects the curriculum is likely to have. Accordingly, we understand curriculum to mean the overall rationale for education put forward, in this case, by national education ministries. There are, however, further observations that can be made about a curriculum including a distinction between theory and practice. This can be characterised as the difference between the planned curriculum (that set out in official documents) and the received curriculum (how learners experience it) (Kelly, 1999) or the three-part model developed by Schmidt et al. (1996), where the three aspects of curriculum are the intended curriculum (aims of curriculum as outlined in official documentation, standards, etc.), the implemented curriculum (what happens in the classroom) and the attained curriculum (outcomes for

students). OECD further developed these categories to include the perceived, expected, negotiated, experienced and evaluated curriculum (2020b, p.17).

Eraut et al. proposed a curriculum model in which the curriculum strategy (objectives and outcomes, subject matter, assessment pattern, and teaching, learning and communication methods) could be related back to the curriculum aims. In addition, these aspects are all interrelated (Eraut et al., 1975, p.93). They did point out that curriculum design decisions “are often undocumented, and even when they are documented, there may be divergences between the curriculum as planned and the curriculum as taught” (1975, p.11).

The distinction between curriculum materials and the enacted curriculum was also noted by Eraut et al. (1975), whereby classroom practice may not reflect the published materials such as curriculum documents or textbooks.

Bearing these complexities in mind, this report has focused on the intended curriculum. The scope needed to be limited in some way in order to make the research manageable and the official curriculum documentation is a well-defined area in which to focus our analysis. The intended curriculum was also a logical place to start when looking at whether learning theories have informed the curriculum design. Unpicking how learning theories have informed the enacted curriculum is likely to be a much more demanding process, which is not within scope for this work.

Definitions of learning theory

UNESCO (2017) stated that, when developing a curriculum framework, one of the critical considerations should be the learning theory and philosophy that forms the foundation of the curriculum.

There are numerous learning theories, some better known than others. For example, one website lists 62 articles in its section on learning theories and models¹. We have not attempted to describe all the learning theories in detail and have provided links to further information where relevant. UNESCO (2017) condensed the various theories into the following categories and identified the thinkers behind them:

- Behaviourism
- Cognitivism
- Constructivism
- Design-based research
- Humanism
- Miscellaneous

Similarly, noting the lack of information relating learning theory to curriculum design, Cunningham et al. (2007) set out to address this and described the main learning models as:

- Behaviourist
- Humanist

¹ <https://learning-theories.com> (Accessed: 11 October 2024).

- Information processing
- Activity
- Situated

Learning theories, however, cannot be tidily arranged into discrete categories. For example, situated learning is considered to rest under the constructivist umbrella because it uses collaborative learning, but it also diverges from traditional constructivism by regarding the learner as part of a wider complex system. Figure 1 shows how the main learning theories of behaviourism, cognitivism, constructivism, connectivism and humanism have distinct as well as shared features. The Appendix contains a more detailed table which attempts to map the learning activities generally associated with different learning theories.

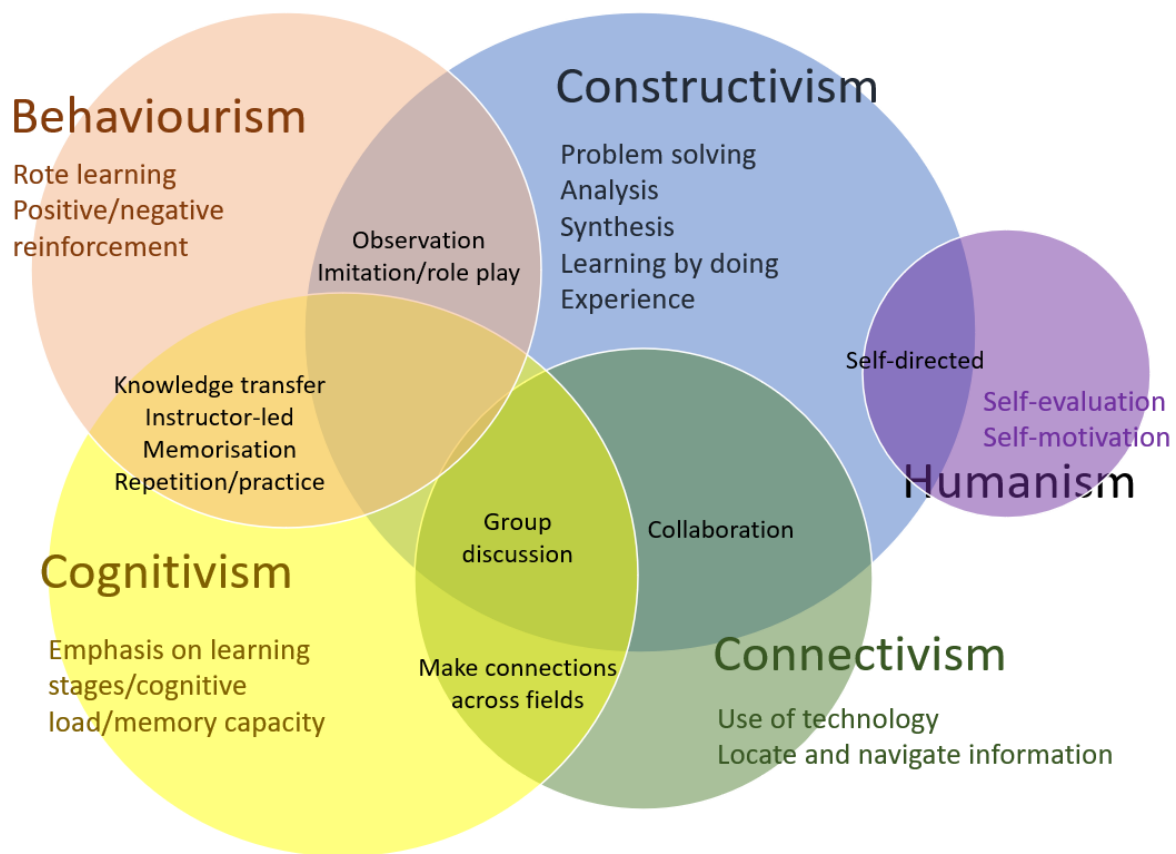


Figure 1: Diagram showing differences and commonalities between main learning theories

Current thinking seems to endorse some learning theories but dismiss others. For example, constructivism has been hugely influential for many years (Fox, 2001; Taber, 2023), but more recently has been criticised by Larison (2021) for being based on damaging assumptions about learners' backgrounds and motivations. Larison (2021) argued for an intersubjective approach to learning, whereby the collaborative relationship between teacher and student facilitates learning. This intersubjective approach does not completely reject constructivism but incorporates elements of constructivist and situated learning based on our growing knowledge of brain development. Similarly, Dehaene (2020) criticised the concept

of discovery learning² (found in constructivism and humanism) and argued that guidance from teachers is essential in order to structure learning for students. He argued that developments in neuroscience will allow us to better understand how learning occurs and consequently which learning theories are likely to align with what neuroscience tells us.

Schunk (2013) described how teaching and learning theory have historically been somewhat disconnected and gave several possible reasons for this:

- The fields of teaching and learning have developed separately – educators vs psychologists
- The concept of teaching as an art not a science means that some have assumed it to be difficult or impossible to understand what makes a good teacher and that teaching has therefore escaped scientific scrutiny
- Difficulties with the instructional theory necessary to link theories of cognition and the practicalities of classroom teaching, for example the need for theory to apply simultaneously to individuals and groups, as described by Sternberg (1986)
- Difficulties with researching teaching and learning simultaneously.

Schunk also noted that there are common principles to most learning theories including the concept of progression through stages; learning materials organised in small steps; and the importance of practice, feedback and review. These are the kinds of principles frequently observed in curriculum documents and they tell us little about which specific learning theories support the curriculum design.

The move towards competencies-based and progressions-based curricula reflects education policies which aim to develop learners' ability to integrate knowledge and skills from across subjects, moving away from curriculum as a list of content to be covered in the classroom. Competencies- and progressions-based curricula are student-centred in that they measure what a learner can do before they are deemed to have achieved mastery and progress to the next stage. However, it has been argued that learning progressions can oversimplify how learners develop by relying on a 'ladder' concept of progression rather than a network (Gallacher & Johnson, 2019).

Method and analysis

Given the complexity in the number of learning theories and the overlap in concepts, it is difficult to identify which specific theories should be focused on when conducting a literature review. As there is a wide range of possible learning theories in use, the literature review searched for sources where clear reference to any learning theory was made, usually identified by use of the phrase 'learning theory' or similar.

We identified relevant material from a range of sources, including academic databases and governmental websites. We also narrowed the focus to documents about the intended

² Schunk describes the discovery learning approach as one where 'students search, manipulate, explore, and investigate' for themselves rather than through teacher presentations (2013, p.268).

(written) curriculum, although the enacted curriculum was still mentioned in the literature we encountered.

After removing duplicates, we analysed the remaining relevant documents in MAXQDA – a qualitative analysis software (Verbi Software, 2021).

The findings from the review refer to sources from across the years, therefore caution must be maintained when interpreting how current the sources and curriculum-related information is. As we did not inspect actual curriculum documents (programmes of study), the literature used may not be completely up to date.

Findings

New Zealand

The New Zealand Curriculum and Te Marautanga o Aotearoa

The New Zealand Ministry of Education states at the top of its curriculum website that “The National Curriculum is composed of The New Zealand Curriculum and Te Marautanga o Aotearoa which set the direction for student learning and provide guidance for schools as they design and review their curriculum” (Ministry of Education, 2023d). This statement immediately alerts us to the fact that we are not in fact dealing with one single curriculum in the New Zealand system, but several. Te Marautanga o Aotearoa is the national curriculum for Māori-medium schools, which is currently being redesigned, while the New Zealand Curriculum (for English-medium schools) is being ‘refreshed’. In addition, schools have the freedom to develop their own curricula: “Curriculum is designed and interpreted in a three-stage process: as the national curriculum, the school curriculum, and the classroom curriculum” (Ministry of Education, 2007a, p.37). For the purposes of this literature review, the national curriculum is the only one of these three which it is possible to address, given that there are likely to be as many school curricula as there are schools. The 2007 version of the New Zealand Curriculum is still the one in use in 2023, albeit with changes being rolled out gradually resulting from the programme to refresh the curriculum over six years from 2021. The new Te Marautanga o Aotearoa will be fully implemented in 2027 (Ministry of Education, 2023c).

Learning theories in the curriculum

Overall, specific learning theories did not appear to form the basis of any New Zealand national curriculum from the 1990s onwards. There was some evidence that learning theories had been considered during curriculum development work, either implicitly or explicitly.

There is a series of statements in the current New Zealand Curriculum (Ministry of Education, 2007a) which appear to relate to learning theories. These mention the social and cultural context of learning and the ways in which students “learn most effectively”, for example, “when they develop the ability to stand back from the information or ideas that they

have engaged with and think about them objectively” (p.34). Some of these statements could be associated with particular learning theories, as with the statement “Students learn best when they are able to integrate new learning with what they already understand” (p.34) which may represent a constructivist view of learning. However, this document does not cite any references, so it is unknown whether specific learning theories have informed these statements. Additionally, different learning models can overlap and so without explicit knowledge of the source of a statement, it is difficult to be certain about which learning theories statements might refer to. For instance, the statement about students integrating new learning with what they already understand could relate to a number of models identified by Cunningham et al. (2007) including behaviourist, information processing, and constructivist models such as activity and situated learning³. The curriculum document itself does not therefore tell us whether learning theories have been used in its development.

It is clear that the New Zealand Ministry of Education commissions research and literature reviews to inform development work, for example see the lists of references for developing National Standards (Ministry of Education, 2010); for implementing an inclusive curriculum (Ministry of Education, 2015) and for the development and consultation phases of the New Zealand Curriculum Project 2004-2007 (Ministry of Education, 2007b). It is this last list which we would expect to provide the evidence for the statements from the 2007 curriculum. Here, however, it becomes clear that it is necessary to engage with historical education policies in New Zealand and the fact that elements of previous curricula are often retained through redevelopment. Curriculum (re)development programmes are often undertaken because the existing curriculum has been found to be inadequate or outdated, and the 2007 curriculum was no different, having been developed in response to recommendations from the New Zealand Curriculum Stocktake Report (Ministry of Education, 2002), which addressed the previous curriculum from the 1990s.

Cubitt (2006) outlined the history of the New Zealand curriculum from the 1990s up to the revision of the curriculum in the early 2000s. According to Cubitt (2006), the curriculum stocktake of 2002 recommended the redevelopment of the New Zealand Curriculum Framework and Te Anga Marautanga o Aotearoa, and the use of language such as ‘clarified, revised, reviewed’ in the stocktake recommendations shows that elements of the 1992 curriculum would be carried through to the new one. Clark (2004) was critical of the fact that the 2002 stocktake did not “undertake a review of the curriculum from first principles”. Cubitt also noted that “each learning area development group had taken a different approach” (2006, p.206) which suggests that consideration of learning theories could have been different for different curriculum development groups. Given this history of redevelopment, it is possible that parts of the 1990s curriculum have been retained in the 2007 curriculum and will be retained after the current ‘refresh’, given that neither of the redevelopment projects went back to first principles.

Giving an insight into curriculum work from those involved, Bell et al. (1995) described New Zealand curriculum developments in science from the 1950s to the 1990s and focused, in

³ Situated learning is based on the idea that learning should take place in the context in which it is situated, e.g. learning map skills is more effective when conducted in the physical location on the map (Griffin, 1995).

particular, on the revision of the secondary science curriculum between 1985 and 1989. They stated that “the main underlying theoretical perspective was a personal constructivist view of learning” (p.78) and described widespread support for the curriculum focus on learning, rather than content alone. However, this particular piece of curriculum development work was abandoned when a new government was elected and a new curriculum review began.

The new science curriculum that was eventually produced in 1993 was discussed by Bell et al. (1995), who found that it was not “based on an explicit view of learning” (p. 91) although they described some aspects of the document being based on constructivist views of learning (sample learning contexts, possible learning experiences and assessment examples). The six strands of learning were expected to be integrated with one another, which suggests similarities to a network model, where there is less emphasis on linear progression and more emphasis on making meaning through connecting ideas across contexts (Ireland & Mouthaan, 2020). Bell et al. (1995) described the achievement objectives and progression model of the new science curriculum as having ‘a mixed behaviourist, hierarchical and Piagetian flavour’ (p. 91). In addition, they regarded some of the language used for achievement objectives to be aligned with neo-behaviourism⁴. Overall, they reported that criticism of the curriculum in terms of its view of learning focused on its hierarchical model of learning, based on the levels of attainment and progression, which they saw as emphasising teaching outputs rather than learning outputs. Given the authors’ first-hand knowledge of the 1989 curriculum development work (Bell et al., 1995) which was eventually abandoned, it appears that learning theory was considered during the design and development stage. Their discussion of learning theories related to the 1993 curriculum is based on an evaluation of the final document and not the development work they undertook, so it is unknown whether the learning theories they identified intentionally informed the 1993 science curriculum.

Further evidence for different subject groups taking different approaches can be seen in Hipkins et al. (2002), who produced a literature review on effective pedagogy in science education in New Zealand. They explained how the Learning in Science projects (LISP) frequently questioned the accepted theories of learning and pedagogy and contributed to changes in the curriculum and changed during the course of the projects from a personal constructivist framework towards socio-cultural and discursive ones. The use of “terms relating to constructivist views of learning” (Hipkins et al., 2002, p.103) in the 1993 Science curriculum document reflected the LISP findings. However, while some of the recommendations from the LISP projects could be identified in the 1993 New Zealand Science curriculum, “other aspects of the curriculum format, especially the notion of the ‘levels of achievement’ do not reflect the research nor the associated theories of learning which developed during the LISP projects” (Hipkins et al., 2002, p.103).

⁴ Lefebvre et al. (2006) described neo-behaviourism as the belief that a learner’s behaviour is determined by environment and social interactions. Learning strategies include “modelling, imitation, and drill-and-practice” with the teacher acting as the expert holder of the knowledge to be transmitted (p.8).

The report 'Quality teaching for diverse students in schooling' (Alton-Lee, 2003) does not explicitly state its purpose beyond responding to a request from the New Zealand Ministry of Education for a review of future-focused research on teaching and learning. It concentrates mainly on teaching and recommends that different learning outcomes require different teaching strategies (for example, between different subjects). The timing of the report suggests that it may have been a response to the recommendation from the Curriculum Stocktake report (Clark, 2004) that a section on effective pedagogy should be included and subsequently informed decisions about the 2007 New Zealand Curriculum, although there is no clear link between this document and the statements published in the 2007 curriculum. Additionally, this and other publications in the BES series tend to focus on teaching and teacher development, e.g. *Effective Pedagogy in Mathematics*; *Teacher Professional Learning and Development*.

Fernandez et al. (2008) discussed the implementation of a new physics curriculum in New Zealand in the context of communities of practice. Although the design process itself was not the focus of the article interesting insights emerged, for instance, one curriculum writer stated: "I see the three of us [curriculum writers] as constructivists in the sense that we are interested in how the kids are learning" (p.192). The new curriculum was then described by the authors as offering suggestions for constructivist and student-centred approaches, listed under the label of pedagogy. Having interviewed curriculum writers and teachers, Fernandez et al. developed a theory based on work by Étienne Wenger on communities of practice that a final curriculum document can be pictured as the tip of an iceberg, with the main part of the iceberg hidden underwater. The curriculum writers have been through a long and complex process to produce the final document, but the final document does not convey much of that process, which remains hidden. In trying to make sense of the new curriculum they are required to implement, teachers use their own experiences to 'fill in' that part of the iceberg that is invisible to them. Teachers' experiences and conclusions about the hidden part may or may not align with the experiences and processes that went into the curriculum design. This illustrates how learning theories may inform a curriculum, but not be evident in the final document(s).

Looking to the future, commentators (Chamberlain et al., 2021; McPhail et al., 2023) have discussed how the refreshed New Zealand curriculum might shift towards a learning progressions-focused model, given that this has been observed in the newly developed Aotearoa New Zealand's histories curriculum (Ministry of Education, 2023a). Chamberlain et al. (2021) noted that research evidence informs the progressions model: "Researchers use a variety of methods to generate this evidence, including cross-sectional and longitudinal studies looking at how concepts and practices develop over time and in different instructional settings" (2021, p. 9). Yet if research of this kind was undertaken to redevelop the history curriculum, it has not been published by the Ministry of Education. There is again no available information on how learning theory has informed the final curriculum for Aotearoa New Zealand's histories. Unusually, there is no list of references related to this part of the curriculum development either.

Research Question 1: Is there evidence of learning theory being used in national curriculum development?

There is some evidence that learning theories have been considered when designing the New Zealand national curriculum:

- Authors involved in curriculum writing have talked about learning theories they considered when developing the curriculum and how their recommendations relating to learning theory appeared (or not) in the final document.
- References cited by the Ministry of Education include those which specifically mention learning theory and appear to have informed curriculum (re)development.

Research Question 2: How is learning theory used in national curriculum development?

There are multiple reasons why it was not possible to ascertain the extent to which learning theory has informed final curriculum documents. These reasons are outlined below.

Curriculum principles

McPhail et al. (2023) argued that the 2007 curriculum had drawn on a variety of learning theories which meant that there was no central learning philosophy on which it was based and that this caused contradictions and tensions (p.6). They also noted that the evidence sources for the most recent curriculum refresh were not provided and that the underlying curriculum principles continued to draw from differing learning theories.

Missing links

As stated, there are lists of references and research articles available on the New Zealand curriculum website but there is nothing in the available materials which explains how the collated evidence informs the final document(s). There is also a convoluted path from the evidence to the final curriculum, for instance several studies might be synthesised by a literature review, which is referenced in a list related to curriculum reform, the outcome of which is later 'refreshed'. This can make it difficult to trace the source of curriculum statements. Furthermore, reducing evidence-informed decisions to concise curriculum statements risks a loss of meaning, as described by Fernandez et al. (2008) whereby those using the curriculum supply their own beliefs about the source or foundation of such statements. The iceberg analogy used by Fernandez et al. (2008) to demonstrate that the vast majority of curriculum development remains hidden from teachers' view also reflects the position of researchers trying to access the information that was used in that development. The availability of sources, process documents, etc. depends on the willingness of the jurisdiction to be transparent about its redevelopment processes.

Dispersed curriculum groups

The sources consulted suggested that different subject groups may take different approaches to curriculum development.

Learning and pedagogy

In the documents consulted, there was a tendency for learning and pedagogy to be treated as one concept. For instance, the 2007 New Zealand curriculum has a section called

Effective Pedagogy, which is where the statements about learning appear (e.g. “Learning is inseparable from its social and cultural context”). It is certainly the case that the relationship between learning and pedagogy is intertwined, but care is needed when interpreting information in this area, as teaching is not the same as learning.

Curriculum structure

Part of the difficulty in pinpointing learning theory in the curriculum is locating where it might be situated. The introduction to the Common Practice Model (Ministry of Education, 2023b) states that “the New Zealand Curriculum for schooling identifies ‘what’ to teach, and the Common Practice Model identifies ‘how’ to teach it” (p.1). Learning theory relates to both what and how to teach, and so we might expect learning theories to inform one or both of the curriculum and the Common Practice Model. Similarly, the structure of the curriculum into three levels (national, school, and classroom) suggests that responsibility for decisions about learning sits within each school’s own curriculum. The New Zealand curriculum website makes reference to the OECD publication ‘The Nature of Learning’ (Dumont et al., 2010), but that reference is located in the school curriculum design and review section, which further emphasises that it is for schools to engage with learning theory. There is however, a somewhat vague statement that the OECD seven principles of learning “serve as guides to inform everyday experiences in current classrooms, as well as future educational programmes and systems” (Ministry of Education, 2016), which suggests a wider application of the principles could be planned. Locating learning and learning theories outside the official national curriculum could afford schools the flexibility to keep up with new learning theories as they emerge. Fernandez et al. (2008) explained how teachers, when trying to get to grips with the new 2007 curriculum documents, struggled to assimilate new ideas into their existing practice. Instead of locating such changes in large-scale, sweeping national curriculum redevelopments, a school curriculum could arguably be more responsive to developments in learning theory and introduce corresponding changes gradually.

Curriculum design

As outlined above, the national curriculum redevelopments of the last 30 years have not been from first principles and given the lack of information around the design process, it is difficult to know what the starting points for redevelopment have been and consequently if, and where, learning theories have informed the process.

Curriculum development and supporting materials do not always appear to be aligned. For instance, the draft Phase 1 Common Practice Model document outlines principles and evidence-informed pedagogical approaches to Literacy & Communication and Mathematics (along with citations of the evidence for each approach). The model does not appear to explicitly link to the New Zealand Curriculum and has been released *during* the curriculum refresh.

Having moved over decades from content-focused, to outcomes-focused, to progressions-focused, curriculum reforms reflect the concerns of the stakeholders of the time. It is difficult to juggle the competing demands and purposes that a curriculum is required to serve. It appears to be the case that an overall direction is set and the curriculum content is shuffled, cut or inserted in order to fit that direction, as noted by McPhail et al. (2023). Learning theory

is just one aspect that may be considered and given the lack of transparency about the activity of curriculum design, it is unknown to what extent it informs the final curriculum. We have reported views of curriculum writers, e.g. Bell et al. (1995) but that tells us that those involved in curriculum development may have a knowledge of learning theory that tacitly informs their decision making, but there is little in the way of formal recording/mapping of learning theory and curriculum.

Research Question 3: How should learning theory be used in national curriculum development?

We found that this research question was not answered by our analysis. This is addressed further in the Discussion section.

Ontario

Education and curriculum in Ontario

Canada as a whole does not have a national curriculum. Instead, provincial governments (e.g. Ontario, Alberta) establish the curricula for schools and each province has a ministry-established common curriculum (NCEE, n.d.). The Ontario Ministry of Education oversees the education provision at school-level and administers publicly funded education, whereas the Ministry of Training, Colleges and Universities oversees higher and vocational education (Clausen & Drake, 2010; OECD, 2011).

The literature mentioned 'The Common Curriculum', which was developed in 1993 and released in 1995 (Masemann, 1996; Wien & Dudley-Marling, 1998) as a result of the shift to an intentions-based curriculum, where it became important to list what was expected of students at specific grades and at graduation (Ontario Ministry of Education and Training, 1993a as cited in Masemann, 1996). At the same time as the development of 'The Common Curriculum', a document called 'A resource guide for anti-racist and ethno-cultural equity education' was published (Masemann, 1996). According to the Office of the Auditor General of Ontario (2020), school boards had a lot of freedom in what they taught, but in 1996, the Ministry of Education undertook the development of a province-wide curriculum. The new curriculum was introduced in 1997 and was finalised in 2002 with the introduction of the grade 12 curriculum (NCEE, n.d.). It appears that the newer curriculum was called 'The Ontario Curriculum, Grades 1-8' and replaced the 'Common Curriculum, Grades 1-9' (Ontario Ministry of Education, 1995; Ontario Ministry of Education and Training, 1997; as cited in Wien & Dudley-Marling, 1998). The newer curriculum tended to emphasise learner outcomes.

The government of Ontario's website states that the Ontario curriculum includes one programme for kindergarten (in English and in French), eight subjects for English-language school boards and eleven subjects for French-language school boards for elementary schools (grades 1-8), as well as nineteen English disciplines and twenty one French disciplines at secondary school level (grades 9-12) (Government of Ontario, n.d.-a). The Ontario curriculum is organised into three sections: 1) programme planning (general information), 2) curriculum context (information for specific curricula), 3) curriculum expectations (what students must learn) and teacher supports (how students might learn; information and examples to guide teachers such as clarification of key terms and concepts or example dialogues between teachers and students). It also includes information on policies from the Ministry of Education in areas such as assessment, reporting, special education and inclusive education (Government of Ontario, n.d.-b).

Curriculum development

The Ontario curriculum is developed by the Ministry of Education, whilst school boards oversee the implementation of the curriculum. The Ministry consults with educators, students, parents, subject experts, education stakeholders and Indigenous partners when developing the curriculum. The curriculum is designed to be current, balanced and relevant to students, and to set them up for future learning (Government of Ontario, n.d.-a; OECD, 2011).

According to the Office of the Auditor General of Ontario (2020), the Ministry of Education initiated a curriculum review process in 2003. A typical review usually takes between 3-5 years from initiation to release and implementation of the new curriculum. The steps involved include *research, engagement with stakeholders, writing, editing, fact checking, finalising* and *implementing* (see p. 9 for more information).

The Office of the Auditor General of Ontario (2020) states that in most cases, the Ministry of Education follows such steps when reviewing and revising curricula, and develops curricula based on research and input received. However, in some cases, certain steps might be skipped or fast-tracked. For instance, stakeholders or other bodies may not be offered enough time to fact-check the curriculum correctly. For instance, according to the Office of the Auditor General of Ontario (2020), the Ministry did not get comprehensive stakeholder input or allow for enough time to fact-check the Health and Physical Education Elementary curriculum which was revised in 2019.

The literature review mentioned some influences on the curriculum across time. According to Cavanagh (2001), in the early 20th century, the Ontarian social science curriculum and pedagogy were influenced by Christianity. For instance, authors of materials for teachers referred to teachers as “pastoral guides” and “models of good national living” (p. 10). Another example which comes from the Department for Education (2011) mentions that in 2011, the Ontario Government was intending to introduce financial literacy to the curriculum for those in Years 4 to 12 (ages 9-18) due to the global economic crisis, which showed the need to improve financial literacy.

Clausen and Drake (2010) suggested that over time, decisions around Ontario’s curriculum have been influenced by two contrasting schools of thought: traditional and holistic. Traditional education favours accountability to the public, sorting students by ability, centralisation, top down control, standardisation of curriculum and assessment, subject disciplines, the teacher as lecturer, rote learning and other elements. In contrast, the holistic viewpoint highlights the importance of the student, success for all, de-centralisation, local “standards” for individualised learning, interdisciplinary design, learning through making connections and many other aspects (p. 70). Clausen and Drake (2010) said that the history of curricular integration in Ontario is a constant pendulum swinging back and forth between these two contrasting mindsets. For a visual demonstrating how these two schools of thought have influenced the Ontario curriculum see Table 2 in Clausen and Drake (2010) on page 72. They also wrote that when test-based accountability started, a chief research officer was appointed and research teams in the Ministry were created to ensure that elements of education were evidence and research informed.

Christou (2012) wrote that the curriculum of schools in Ontario went through considerable change in 1937-1938, as the curriculum was revised to be more progressive⁵ and include more progressive principles, beginning the move away from the traditional education identified by Clausen and Drake (2010), catering for individual students, encouraging active learning and having relevance to society. In 1937, social studies were included in the Ontario curriculum. Content for social studies was taken from contemporary issues in the world and were contextualised in terms of geography and history. According to Lemisko and Clausen (2006), Great Britain was a key contributor to the changes in the Ontario curriculum around the 1930s (Ontario Programme of Studies, 1937, as cited in Lemisko & Clausen, 2006).

Clausen and Drake (2010) stated that during 1960-1966, a newly created Ontario Curriculum Institute showed great dissatisfaction with previous revisions of the curriculum. As a result of this, educators, scholars and educational critics created new courses for science, technology and vocational education. Between 1975-1983, cross-subject integration started to pick up and could be seen in examples such as the Language-Across-the-Curriculum policy, which was influenced by academic research. During the early 1990s (1992-1996), the newly appointed government commissioned a review of the education system, resulting in the Radwanski report, which criticised the Ontario's government's management of the curriculum. The Common Curriculum, Grades 1-9 (drafted in 1993) was sent out for feedback to schools, parents and the public. This curriculum emphasised accountability, excellence, equity and partnership. It also explained that although the past curricula were based on disciplines, this was not useful to learners as the real world is not split into disciplines. The government decided to try a new "outcomes-based learning" approach, which was also prominent in North America at that time. In outcomes-based learning, the curriculum is about the experiences that students should have in order to meet a set of defined outcomes. Students would be expected to meet these outcomes over several grades and a wide range of experiences, not through one course. There is a link between an outcomes-based curriculum and an integrated curriculum (Ontario Ministry of Education, 1995 as cited in Clausen & Drake, 2010). According to Lemisko and Clausen (2006), eventually, Ontario returned to a subject/discipline-based curriculum.

According to the Ministry of Education's (2003) Annual Report of the Office of the Provincial Auditor of Ontario, when the Ministry was establishing the new curriculum standards in the 1990s, it investigated other jurisdictions' curricula and consulted Ontario school boards, subject associations and specialists in subject areas, such as the Ontario Association for Mathematics Education. Furthermore, for the secondary curriculum, the Ministry set up a validation process, through which various bodies provided their input (e.g., universities, colleges, business groups, trades etc.) to approve how appropriate the learning expectations were for students' post-graduation destinations.

⁵ Progressive education is an educational movement which grew in the 20th century. Various definitions of progressive education exist, so it is difficult to accurately conceptualise it in a single definition (McNear, 1978; Norris, 2004). McNear (1978) refers to progressive theory as going beyond the academic and addressing wider needs of children. Norris (2004) talks about progressive education as rejecting anything related to the traditional notion of school or instructional delivery. In contrast, (Oelkers, 1998) talks about progressive education as encouraging "free" or "natural" learning in children; without parental influences.

Clausen and Drake wrote that the current story (therefore back in 2010) was one of many curriculum refinements and reviews, with focus still staying on accountability. According to the authors, the newer curriculum iterations have “fewer expectations, are more explicitly concept-based, and include the new literacies such as media, critical, and technological literacies across the curriculum. Big ideas or concepts are explicitly identified in some of the most recent guidelines” (pp. 95-96). Lastly, they implied that research and evidence-based practice are aiding a move towards innovative and meaningful curriculum.

Mendaglio (2014) stated that “equity has been named as a core principle of mathematics education in the Ontario curriculum” (p. 5) and talked about employing a variety of teaching strategies and learning methods (OME, 2007 as cited in Mendaglio, 2014). Furthermore, the author wrote that the curriculum is displayed “as a continuous program (rather than a sequence of modules) to allow students to link ideas together and to “see the ‘big pictures’, or underlying principles, of mathematics” (OME, 2007 as cited in Mendaglio, 2014, p. 9).

Laidlaw et al. (2001 as cited in Zhu & Xie, 2020) stated that the elementary mathematics curriculum takes quite an ecological approach as it emphasises relationships between society, the environment and people, as it asks students to engage with their surrounding environment by observing and working with data (Zhu & Xie, 2020).

The Office of the Auditor General of Ontario (2020) states that the current process for deciding if a curriculum needs to be revised includes input from education stakeholders, research partners, academics and other experts. Additionally, the Ministry claims to consider how current the curriculum is (what the new trends in the subject are, pedagogical approaches, development and innovations in technology etc.), and checks for coherence from kindergarten to grade 12. Although curricula that can quickly become out of date (such as computer science) should be reviewed more often, Ontario’s science and technology curricula have not been reviewed more than once in the last 17 years.

Learning theories

The Government of Ontario website interestingly states that the “curriculum is based on research into teaching methods and learning approaches in other parts of Canada and the world” (Government of Ontario, n.d.-a, paragraph 2). This implies that the Ministry of Education considers research into the pedagogy and learning approaches when designing the curriculum. In this report, we focused mostly on evidence of learning theories being used to inform the development of the intended (written) curriculum rather than the enacted curriculum (e.g., teaching methods and what happens in classrooms).

This section will present information found in the literature review with an attempt to answer the three research questions.

Research Question 1: Is there evidence of learning theory being used in national curriculum development?

The literature has revealed some evidence of learning theory being used in the development of curricula in Ontario. Some sources explicitly stated which learning theories concepts in curricula refer to, whilst others mentioned assumptions or characteristics that can be associated with learning theories, therefore are more implicit. Where such

assumptions/characteristics are implicit, it cannot be assumed that the learning theory with these assumptions was used to develop the curriculum.

Cavanagh (2001) wrote that the Department of Education developed the curriculum to reflect the child-centred school of thought that was prominent in the inter-war years, and a liberal-humanist, progressive viewpoint of education, which was prevalent in the first half of the 20th century. According to this theory, the child is an active agent during learning rather than just a passive recipient who receives information.

According to Laidlaw et al. (2001) as cited in Zhu and Xie (2020) the Ontario curriculum was initially “rooted in the colonial perspectives of Great Britain and France” (p. 38). However, the Ontarian curriculum has also been influenced by American educationalists such as John Dewey and Howard Gardner, whose ideas are found in the mathematics curricula. For instance, mathematics teaching and education is seen as an active process, which comes from constructivism. Constructivism sees schooling as being student-centred and needing to allow the learner to build their own knowledge (Marlowe & Page, 1998 as cited in Zhu & Xie, 2020). Apparently, the latest elementary mathematics curriculum for grades 1-8 was released in 2005 and highlights constructivist views that “all students can learn mathematics and deserve the opportunity to do so through active learning that allows them to experiment and compare the predictions to the results” (Ontario Ministry of Education as cited in (Zhu & Xie, 2020, p. 39). Additionally, according to Zhu and Xie (2020), one of the key features of the recent curricula is a focus on inquiry⁶ and problem-solving-based education. The curriculum contains sections, such as “Literacy and Inquiry/Research Skills” and “application”, which are based on experiential learning (learning by doing, which helps students to develop knowledge and skills needed (Bhatia & Bhatia, 2019) and dialectical constructivism, which highlights the role of interactions between students, peers and their teachers (Dalgarno, 2001) (Dewey, 1966; Moshman, 1982; Ontario Ministry of Education, 2005; Vygotsky, 1978 as cited in Zhu & Xie, 2020, p. 39). Furthermore, Zhu and Xie (2020) wrote that the five strands in the mathematics curriculum (Number Sense and Numeration, Measurements, Geometry and Spatial Sense, Patterning and Algebra and Data Management and Probability) are taught according to a set of expectations that build on the previous years. This may imply some kind of spiral curriculum, although this is not explicitly stated. The concept of the spiral curriculum is based on Jerome Bruner’s cognitive theory, which suggests that topics should be built on each time they are re-visited, their complexity should be increased each time, and that new learning is linked with old learning (Johnston, 2012).

Lemisko and Clausen (2006) wrote that the progressive ideas taken from Dewey were part of discourse in schools in Ontario since 1907, but such ideas were not used in practice. Although this indicates some influence of constructivist theories, it applies more to practice rather than the written curriculum, which is the key focus of this report.

According to Wien and Dudley-Marling (1998), the aforementioned 1995 Common Curriculum appeared to arise from a progressive philosophy of education, which influenced

⁶ Inquiry learning focuses on the curiosity of the learner and encourages students to build their own understanding of concepts (Centre for Teaching and Learning, n.d.)

the Ministry of Education and schools in Ontario for 30 years. The Common Curriculum favoured integration of curriculum and holism whilst leaving schools and boards free to decide how the “ten essential outcomes” were met. The authors further suggested that the Common Curriculum highlighted student ownership of learning and a “shift in curriculum emphasis to more integrated programming and active, inquiry-oriented learning” (Wien & Dudley-Marling, 1998, p. 406).

Ruddock and Sainsbury (2008) compared the core primary curriculum in England to the curricula in other high performing systems. The authors wrote that the 1998 Ontario science curriculum contains both science and technology, and that it “is based on a constructivist framework where pupils are expected to build up their knowledge and understanding through first hand experience including investigation” (p. 160). According to the authors, the rationale in the science curriculum highlights a constructivist view of learning in science:

science is not only a body of knowledge but a ‘way of knowing’. Scientific investigation involves exploration, experimentation, observation and measurement, and analysis and dissemination of data. These activities require specific skills and habits of mind.... The science and technology curriculum is designed to develop these skills and habits of mind. (The Ontario Curriculum, 1998 as cited in Ruddock & Sainsbury, 2008, p. 161)

Furthermore, the authors of the report stated that there is no mention of a spiral curriculum in the rationale, but analysis of the curriculum showed that themes are repeated in following years, although the content of the topics within each theme is rarely closely related over the years. Furthermore, the authors also stated that there is emphasis on hands-on-activities, where inquiry and design are encouraged through activities that enable students to discover and learn concepts through investigating, experimenting and by placing concepts in the wider world, giving further evidence that the recommended pedagogical methods follow the constructivist theory. Finally, Ruddock and Sainsbury (2008) stated that “the rationale for the 2007 (science) curriculum is based on the same theoretical constructivist framework as the 1998 curriculum” (p. 168).

Golafshani (2020) argued that since 1997, mathematics curriculum and education in Ontario has been influenced by two philosophies: an absolutist philosophy, followed by a constructivist philosophy. Golafshani (2020) stated that before the 2003 reform, mathematics in Ontario was heavily absolutist – a view dominant in the school curricula. Absolutism assumes that mathematics is abstract and a collection of fixed concepts and skills (Romberg, 1992 as cited in Golafshani, 2020). Students would often carry out unrelated, routine tasks, review previous topics and try to find the correct answer. The curriculum was heavily focused on facts and rules to find the correct answers, which encouraged a teacher-focused style of instruction. Contrastingly, Ruddock and Sainsbury (2008) claimed that there was heavy emphasis on problem solving and on developing students’ meta-cognitive awareness of their thinking in the ‘Ontario Curriculum, Grades 1-8: Mathematics’, 1997. Ruddock and Sainsbury (2008) also mentioned evidence of a spiral structure in the mathematics curriculum. Furthermore, the curriculum was replaced in 2005 with a new ‘Ontario Curriculum, Grades 1-8, Mathematics, Revised’, which emphasises problem solving and meta-cognition even more. Concerning the literacy curriculum, the comparison showed that each grade builds upon previous grades in spiral-like fashion. Byers (2004) confirmed

that the mathematics reform for elementary and secondary curricula in the 2000s was revised with key social-constructivist principles in mind.

Research Question 2: How is learning theory used in national curriculum development?

Very little evidence was found in respect to how learning theory has been used in the development of the Ontario curriculum. One example comes from Wien and Dudley-Marling (1998), who stated that the lists of outcomes/expectations in the Ontario curriculum suggested that the skills involved in reading are part of one integrated process, which is “best applied in a context that students see as meaningful” and which “encourages them to think creatively and critically about what they are reading” (1997 as cited in Wien & Dudley-Marling 1998, p. 408) . The authors went on to say that “this suggests an active learner who participates in negotiating what is learned and how this is learned, and who has both some ownership of the learning undertaken... and some agency as a learner” (p. 408), further adding that this is supported by constructivist theories. However, the newer Ontario curriculum, which states what “students will” do at various stages of their education shifts from active to passive participation, moving away from constructivist views.

Ruddock and Sainsbury (2008) stated that the Ontario science curriculum is based on constructivism and students are expected to build up knowledge and understanding through hands on experience and investigations.

These examples suggest that learning theories might guide educators by giving some examples of what teachers can do (e.g., guide students by offering them methods for linking existing knowledge to new knowledge; Zhu & Xie, 2020) or what students might do (e.g., engage in hands on experiences; Ruddock & Sainsbury, 2008). However, these are very limited examples of how the principles of learning theories *might* be used in curricula to support teachers.

The sources examined did not explicitly state how curriculum developers have used principles of learning theories or why they used certain learning theories to inform curricula (e.g., constructivism in the mathematics curriculum).

Research Question 3: How should learning theory be used in national curriculum development?

We found that this research question was not answered by our analysis. This is addressed further in the Discussion section.

Discussion

With regards to the influence of learning theories, we found some evidence of learning theories being used in curriculum development in both Ontario and New Zealand (addressing RQ1). For instance, constructivism was probably the most commonly mentioned theory in the examined literature on Ontario (see Byers, 2004; Golafshani, 2020; Ruddock & Sainsbury, 2008; Zhu & Xie, 2020).

However, we did not find out how learning theories are used in the development of curricula (therefore not answering RQ2), particularly as we found that often, learning theories or their

influence on the curriculum were mentioned implicitly. This supports Fernandez et al. (2008) who talked about the issue that those working with curricula only see the top part of the iceberg – the curriculum document – but they do not see the hidden part, that is the whole process of getting to that curriculum. Furthermore, those who work with curriculum statements are at risk of losing meaning that curriculum developers intended for the statements to have. It is important for curriculum developers to state explicitly which learning theories influenced the curriculum and why. Those working with curriculum documents may find it helpful to understand why a certain learning theory was used to (re)develop a curriculum, as this could aid interpreting the curriculum, its aims and objectives, and guide the pedagogy that an educator may choose to adopt to teach a specific topic. This is further supported by Oates (2018), who wrote that designers/developers should be ready to state what evidence and model(s) they used “to determine the construct base, to determine the domain, to sequence or order the content, to determine the ‘language set’ used throughout the material, and to determine key elements such as practice activities, formative assessment etc.” (p. 13).

We did not find adequate evidence to address RQ3. Due to the complexity and magnitude of this question, we suggest that a separate project is needed to explore how learning theories should be used in the development of curricula and what best guidance for this is.

Although we did not find evidence that can answer this question well, Golafshani (2020) made suggestions that could be used as a starting point:

the evidence shows that going extreme one way or another will not produce the desired learning outcomes for students.... Teaching only mathematical procedures to students will limit students' performance in applying their knowledge to real life situations. Mathematics is cumulative in nature and linked within its strands. It demands a wide variety of skills, such as memorizing recalling the rules, and multi-step problem-solving (p. 32).

The author further stated that in order to meet the demand of mathematics, both the absolutist and constructivist views need to be included in the development of the mathematics curriculum. This should enable students to acquire the skills needed in mathematics, including computational fluency⁷ and problem-solving skills, understanding how numbers works and how to perform calculations (e.g., Ontario Ministry of Education, 2018 as cited in Golafshani, 2020). This suggests that when developing curricula, various learning theories should be considered carefully to see how they can aid the development of the various skills that students will need.

According to the Office of the Auditor General of Ontario (2020), a significant proportion of the current curricula was developed a long time ago. For instance, 15% of the curricula subjects taught in Ontario were developed and implemented at least 15 years before (2005 and prior), with an additional 51% of curricula released between 10-14 years before (2006-2010), including Computer Studies and Technological Education at secondary school level. In comparison to other provinces, Ontario's curricula in science and technology, language (elementary), English (secondary) as well as in elementary arts and mathematics at

⁷ Computational fluency refers to the ability to perform computations quickly and accurately (Tolar, 2007).

secondary level, were amongst the oldest curricula. Apparently, only 31% of elementary and secondary curriculum documents that were released a decade ago or more have a planned update and release date for a new curriculum. Similarly, while New Zealand has implemented curriculum reforms over the years, we found that the nature of these redevelopments means that elements of previous curricula may be carried over from the old to the new. Sources and therefore information used in this report may not be completely current, especially if they refer to older curricula.

Another important consideration is what definition of 'curriculum' one adopts and its implications. In this review, we focused mostly on the written/intended curriculum. However, this is a very narrow interpretation of what a curriculum is, which ignores other elements, such as the teaching, pedagogy, assessment and resources, all of which are important in understanding learning (e.g., Eraut et al., 1975).

Although this report focused on the intended curriculum, many examples of learning theories in the examined literature referred to the enacted curriculum (e.g., pedagogy). For instance, Planche (2012) talked in detail about inquiry-based learning/approaches, which are based on cognitive theories of how we learn and process information deeply so we can understand in (Bransford et al., 1999 in Barron & Darling Hammond, 2008, as cited in Planche, 2012). However, inquiry-based learning could also be said to share characteristics of constructivism. Inquiry-based learning sees the learning as a result of curiosity and thus places the emphasis on the learner, who should understand concepts by arriving at understanding primarily on their own (Centre for Teaching and Learning, n.d.). This is similar to some of the assumptions of constructivism, such as that learners learn by creating their own point of view of the world and that the key to learning is learning by doing (discovery learning) (Ouyang & Stanley, 2014).

We recommend that future projects investigate if there is evidence of learning theories being used to inform recommendations regarding the enacted curricula rather than the written curriculum. Due to the overlap of assumptions amongst learning theories, distinctions between learning theories and approaches should be made explicit, and curriculum developers should state clearly which learning approach they are basing their curricula on and why.

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Appendix

Table 1: Selected learning theories with examples of learning activities, organised under the five main theories

BEHAVIOURISM	COGNITIVISM	CONSTRUCTIVISM	CONNECTIVISM	HUMANISM
<p>External influences on learner behaviour / transferring knowledge</p> <p>Behaviourism Memorising Rote learning Repetition/practice Observation Positive/negative reinforcement</p> <p>Neo-behaviourism Modelling Imitation Repetition/practice</p>	<p>How learners think / transferring knowledge</p> <p>Cognitivism Instructional explanation Teacher demonstration Repetition/practice Journalling Group discussion Make connections across fields</p> <p>Cognitive load theory Instructor-led Learning designed for cognitive load limits</p> <p>Cognitive flexibility theory Make connections across fields</p>	<p>Students create their own learning</p> <p>Constructivism Problem solving Analysis Synthesis</p> <p>Social constructivism Group discussion Collaboration Problem solving Analysis Synthesis</p>	<p>Learners integrate thoughts, theories, etc. usually assisted by technology and in collaboration with others</p> <p>Connectivism Collaboration Use of technology Locate and navigate information to make meaning Make connections across fields Group discussion</p>	<p>Students have freedom and autonomy in learning</p> <p>Humanism Self-directed Self-evaluation Promotes engagement and self-motivation</p>

	COGNITIVISM	CONSTRUCTIVISM		
	<p>Information processing theory Instructor-led Memorising Repetition/practice</p> <p>Cognitive tools theory (Egan) Learning organised in developmental stages</p>	<p>Social learning/social cognitive theory Observation Role play</p> <p>Discovery learning/inquiry-based learning Self-directed Collaboration Problem solving Analysis</p> <p>Activity theory Collaboration Use of tools</p> <p>Situated learning Field trip Work experience</p> <p>Experiential learning theory Learning through doing/experience Reflection</p> <p>Intersubjective learning Relationship between teacher and learner is central</p>		