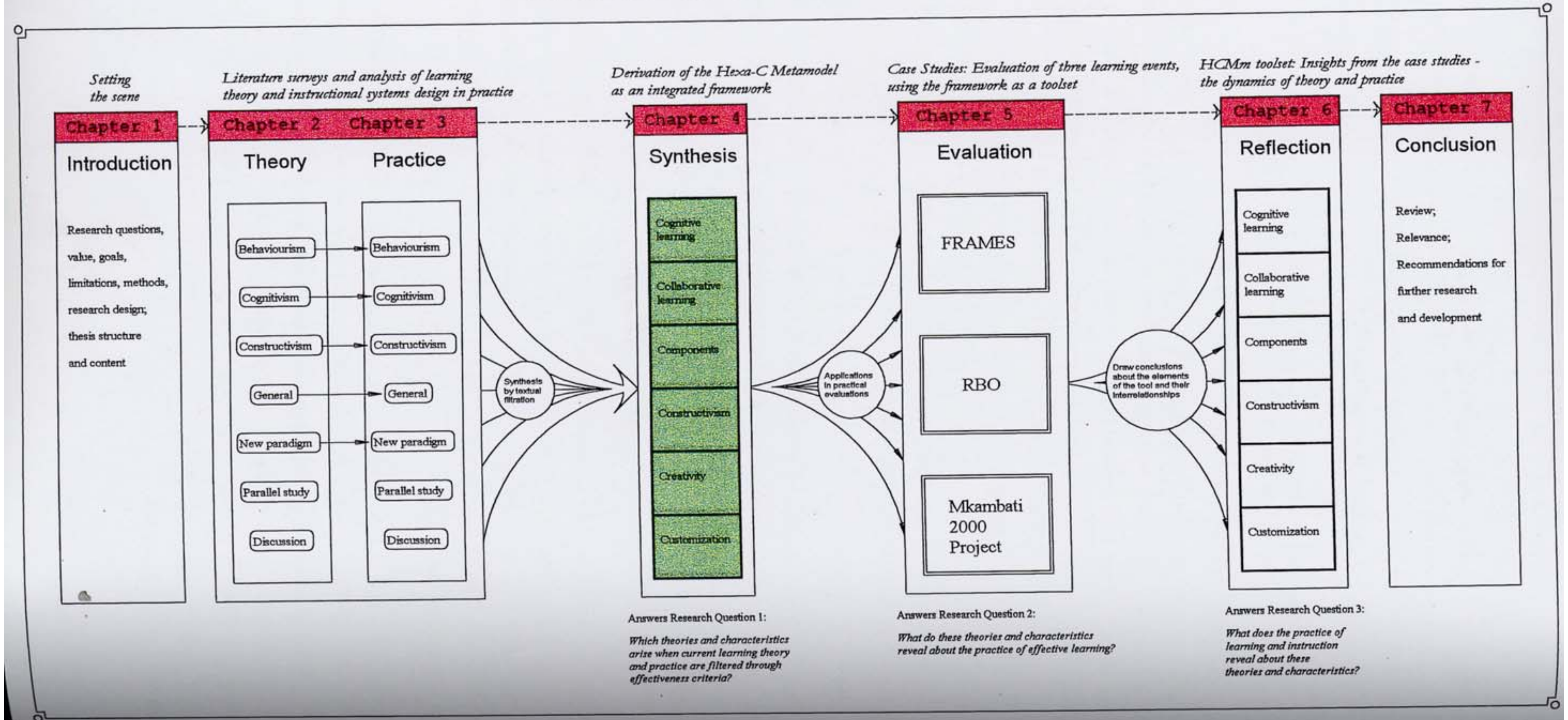
Structure of the thesis



Chapter Four

Synthesis

Towards a metamodel

4.1 Introduction

Chapter Two is a literature overview, which investigates various instructional and learning theories and stances, while Chapter Three similarly surveys practical aspects in the development of instructional systems and learning environments. Based on these studies, Chapter Four sets out to answer the first research question posed in Chapter One by investigating:

> *What theories and characteristics arise when current learning theory and practice are filtered through effectiveness criteria?*

The aim of the chapter is to use information from the literature to **develop a compact synthesis or framework of the current dynamics in learning and instructional design theories from the cognitive family, including characteristics of effective practice**, for the dual purpose of:

(i) Developing learning experiences and interactive learning environments, and

(ii) evaluating learning events and environments, from a learning theory perspective.

Practical implementation of the theories and characteristics that comprise the framework should both enhance the experience of the learner and support the task of the instructional designer / educator. However, not all elements of the framework would apply to every kind of learning experience. Second, the framework would also serve as an enquiry and evaluation tool, to be applied to existing learning experiences and events; educational materials and resources; and interactive learning environments, in order to investigate them from the viewpoint of contemporary learning theory.

Section 4.2 sets the scene for this chapter, with a parallel examination of the three main current theoretical stances and instructional paradigms discussed in Chapters Two and Three: behaviourism, cognitivism, and constructivism.

Section 4.3 re-introduces the selection criteria initially listed in Section 1.4.4. The researcher will use these effectiveness criteria to select and filter theories and characteristics, so as to extract key elements on which learning events and resources should be founded, i.e. theoretical foundations; and elements which should be incorporated within them, i.e. practical characteristics.

In Section 4.4, these nine selection criteria are applied to filter textual data, a process which leads to the derivation of a framework/synthesis, termed the Hexa-C Metamodel (HCMm).

Section 4.5 is a brief reversal of the process shown in Section 4.4. The six prime concepts emerging from the textual filtration are tabulated against the criteria to confirm their conformance.

Section 4.6 compares and contrasts aspects of the HCMm with Reigeluth's *new paradigm of ISD* and *learning-focused theory* (Reigeluth,1996a; 1996c; 1999; Reigeluth and Squire, 1998) and Duchastel's (1998) *prolegomena to a theory of instructional design*. With relation to Duchastel's challenge for a single, full theory of instructional design, the outcome of this study cannot be viewed as such. The proposed framework is not a single theory of instructional design, nor even a partial theory.

However, it does represent an attempt to identify a set of theoretical and practical features appropriate for effective learning and instructional environments and products, in line with the ethos of the so-called new paradigm.

4.2 Comparative analysis of the three major paradigms

This section summarises and discusses information extracted from the textual surveys of Chapters Two and Three, comparing and contrasting the three paradigms: behaviourism, cognitivism, and constructivism. As explained in Sections 1.2, 1.3, 1.6.2 and 4.1, it is a delimitation of this study to emphasize learning theories from the cognitive family. This comparative study, however, covers certain behaviourist aspects to set the context - in particular, the transition from behaviourism to cognitivism and the inclusion, under some circumstances, of objectivist methods within the latter approaches.

4.2.1 Comparison and contrast: a summary

The parallel examination of the three main current theoretical stances and instructional paradigms is carried out using four tables, which summarise the three approaches under different headers. Table 4.1 reflects the underlying philosophy of each approach, and Table 4.2 examines the impact of each on the ISD process, showing how the positions differ in producing instruction and in designing and developing instructional and learning resources, and in actual instruction. Tables 4.3 and 4.4 investigate the actual instructional and learning experience, as encountered under the three systems respectively - with Table 4.3 focusing on the learning process and Table 4.4 summarising the positions of the three stances on evaluation and assessment of learning.

The tables set out the purist positions, for example, behaviourism is presented in its original form rather than its later position, which was influenced by the strategies of the cognitive revolution and was characterised by more flexible ISD. In practice, there is a perceptual continuum - in every category, each of the three stances occupies an interval along the axis and overlaps with aspects of the others.

In setting out *the underlying philosophies*, Table 4.1 indicates how behaviourism aims for behavioural change, manifested by learners' responsive actions; whereas cognitivists stress cognitive response in the form of mental operations; and constructivism emphasizes the value of personal involvement in contextual and experiential learning.

<table>
<tr><th colspan="4">Table 4.1 The paradigms: Their underlying philosophy</th></tr>
<tr><th>Characteristic of the paradigm</th><th>Behaviourism</th><th>Cognitivism</th><th>Constructivism</th></tr>
<tr><td>Operates on</td><td>Overt behaviour</td><td>Covert mental operations</td><td>Performance of authentic tasks</td></tr>
<tr><td>Implemented by</td><td>Instructional intervention</td><td>Interaction with internal and external environment</td><td>Self-regulation</td></tr>
<tr><td>Goal</td><td>Behavioural change;
Performance</td><td>Reorganization of internal knowledge structures</td><td>Meaning interpreted from experience</td></tr>
<tr><td rowspan="3">Foundations of the theory and classic models</td><td>Skinner:
Stimulus-response;
Reinforcement-feedback</td><td>Newell and Simon:
Human information processing</td><td>Schön:
Reflection-in-action</td></tr>
<tr><td>Gagné:
Different conditions of learning for different learning outcomes</td><td>- Sensory perception (STM)
- Cognitive reception (WM)
- Encoding (LTM)
- Retrieval</td><td>Lebouw:
Intentional learning
Values
Bruner:
- Theoretical framework
- Own constructing</td></tr>
<tr><td colspan="2">Component display theory (CDT)</td><td>Problem-based learning (PBL)</td></tr>
<tr><td>Appropriate domain</td><td>Well-defined domains</td><td>Subject matter that explicitly incorporates higher-order thinking skills</td><td>Ill-defined, real-world situations</td></tr>
<tr><td>Recipients</td><td>Students</td><td>Learners</td><td>Learners</td></tr>
<tr><td>Affective locus</td><td>Extrinsic motivation</td><td>Fostered motivation
(eg. ARCS model)</td><td>Intrinsic motivation</td></tr>
<tr><td>World view</td><td>Objective, universal reality - to be imparted to learner</td><td>Common understanding - to be attained by learner</td><td>Personal, subjective interpretation of reality;
Social negotiation of meaning - collaborative environment</td></tr>
</table>

In examining the impact of each paradigm on the design of instructional systems, the analysis distinguishes between the processes and the products of ISD. Table 4.2 outlines characteristics of the *instructional design process*, and lists features of *ISD products*.

Table 4.2 Instructional and learning models: The ISD process

Characteristic	Behaviourism	Cognitivism	Constructivism
Objectives	Predefined learning objectives	Performance objectives; Integration of multiples objectives	Objectives & negotiated goals emerge across process - not same for each learner
Features of design and development process	Linear sequence of steps; Independent, discrete phases	Linear process, with feedback and revision; Iterated phases	Non-linear, recursive design and development; At times even chaotic
	Design of instruction separate from implementation	More integration; Some strategies selected during instruction	Roles of designers and actual educators converge
	Systematic labour-intensive development methodology	Creativity in design and development	Open system of design and development; Holistic and reflective
Features of ISD products	Reductionist: Component parts Decontextualised skills	Integrative: Parts-into-wholes; Transactions	Holistic: Construction, complexity, and contextual
	Identify objectives; Identify components of performances	Identify objectives; Identify procedures that enable performance	Identify case study Or problem
	Deterministic and replicable	Integrate affective and cognitive issues	Unpredictable and indeterministic
	Pre-planned learning experiences	Pre-planned options	Environments provided with resources and tools; Learners supported.
	Rigid models	Flexibility within the Given framework	Incorporated subversion
	Learning designed to achieve outcomes	Learning designed to result in mental processes	Designed to stress Learning gain
	Instructional strategies appropriate for the kind of learning	Cognitive strategies focusing on developing learners' knowledge structures	Principles, guidelines
Evaluation	Emphasis on summative evaluation	Emphasis on formative evaluation	Formative evaluation by learners and experts
Role players	Expert ID practitioners produce instruction	Professional designers	Participatory, negotiated design, including user-designers and teachers/trainers/instructors
Research approach	Proven strategies; Media comparisons; Empirical analysis; Research-based	Cognitive science Information processing theory	Qualitative, real-world effects; Subjective analysis

Table 4.2 sets the scene for Table 4.3, which describes the *learning processes* that occur using the various instructional/learning resources

Table 4.3 Actual instruction and learning: The learning process

Characteristic	Behaviourism	Cognitivism	Constructivism
Pre-requisite	Defined entry behaviour	Prior knowledge in mental models	Zone of proximal development; Cognitive readiness
Perception of learners	Standardisation and conformity	Individualisation within standard tuition	Customisation; Supports diversity of learners
	Passive recipients	Interactive participants	Active constructors
	Instructor-centric; Instructor and instructional materials mediate knowledge	Instructor as facilitator and materials as activators of knowledge	Learner-centric; Tasks and problems that are personally relevant.
	Direct instruction	Supported cognitive processes	Anchored instruction; Apprenticeship
Nature of Learning process	Simplification of complexity	Integrate new with prior knowledge	Cognitive conflict, complexity, and incongruities
	Linear learning of components; Sequence of events	Non-linear integration And association	Contextualized learning activities; Problem-solving
	Teaching and practice segments interspersed	Guided practice	Real-life tasks; Scaffolding to support learning activities
	Events of instruction: Gain attention, explain objectives, stimulate prior knowledge, present stimuli, guide learning, elicit performance, feedback, assess performance, enhance retention and transfer.	Relate to prior learning; Support decision-making; Foster self-monitoring and metacognitive skills; Activate learning strategies; Enable transfer; Motivational (ARCS) Application of learning	Learning experiences: Holistic approach,; Collaborative learning; Rich learning environments and tools; Refinement and evolution of beliefs; Multiple perspectives Problem-driven learning
Expected learning outcomes	Observable, measurable behaviour and skills; What learners *do*	Internal cognitive activity; Mental models; What learners *know* and *how* they know it	Reflection; Learners-ownership of both process and problem
	Information transferred and knowledge instilled	Information assimilated and re-assembled	Knowledge constructed from personal experience
Approach to domain	Cover domain comprehensively	Grasp interrelationships; Classify, organise , decode	Information access, extraction, exploration and organisation
Learner-content relationship	Automaticity; Mastery	Deep understanding; Discovery	Just-in-time, as needed; Exploration
	Bottom-up	Integrated	Top-down
	Predetermined solutions to problems	Fixed problems and solutions	Open-ended activities
Ethos	Individual achievement; Competitive ratings	Individual achievement; Cognition	Social context; Cooperative; Collaborative
Role of computer / technology	Technology controls learning (tutor)	Towards learner control	Technology as tool; Augmenting learning
	Drill and practice; tutorials; Scoring and record-keeping	Tutorials incorporating scoring and record-keeping	Internet and other navigable resources; Multimedia

Tables 4.3 and 4.4 investigate actual instruction and learning under the three paradigms. With regard to the behavioural products/resources/learning events and the instructional/learning experience that occurs from their use, behaviourist instruction is basically predefined, but in learner-centric constructivist learning, no two presentations of the same course will be identical. Following on Table 4.3, which outlines characteristics of the different learning processes, Table 4.4 summarises *evaluation and assessment of learning* within the three stances, showing major differences.

<table>
<tr><th colspan="4">Table 4.4 Actual instruction and learning: Evaluation of learning</th></tr>
<tr><th>Characteristic of the paradigm</th><th>Behaviourism</th><th>Cognitivism</th><th>Constructivism</th></tr>
<tr><td rowspan="2">Purpose of assessment</td><td>Assessment corresponds with objectives
(may be drawn up before instruction is developed)</td><td>Assessment according to objectives</td><td>Goal-free / socially-constructed goals / personal goals</td></tr>
<tr><td>Master sub-skills in prescribed sequence</td><td>Components and composite skills</td><td>Authentic tasks</td></tr>
<tr><td rowspan="6">Mechanism of assessment</td><td colspan="2">Criterion-referenced assessment;
Assessment instruments</td><td>Integrated assessment</td></tr>
<tr><td colspan="2">Correct solutions exist</td><td>Open-ended problems</td></tr>
<tr><td>Bring learners to prescribed level</td><td>Elicit reasoning</td><td>Learning gain</td></tr>
<tr><td>Formal testing;
Frequently multiple choice</td><td>Formal testing</td><td>Multi-modality,
i.e. portfolio assessment and project assessment</td></tr>
<tr><td colspan="2">Mark allocation (grading) by instructor</td><td>Peer evaluation;
Self evaluation;
Evaluation by facilitator</td></tr>
<tr><td colspan="2">Quantified measures</td><td>Qualitative measures;
Context-dependent</td></tr>
<tr><td>View of errors</td><td>Negative reinforcement after error;
Branching</td><td>Self-adjustment after error</td><td>Positive stimulants leading to Strategic exploration;
Tentative beliefs challenged by errors</td></tr>
</table>

As indicated in the preceding tables, there are major variations between the paradigms with respect to the sequence and the tasks of the ISD process and equally powerful variations in the resulting products. Traditional instructional systems development within the behavioural, and to an extent, in the cognitive school, is a highly structured process. Constructivist design, on the other hand, cannot be limited to process design models, but is a more open and free process - sometimes aimed at developing specific resources, but often entailing the inter-relating of existing resources and defining learner-activities in the environment so created. Similarly, learning and instructional experiences are predetermined under behaviorism, relatively constrained under cognitivism, and much more flexible within constructivist situations.

What do these differences between the paradigms suggest in the context of this chapter? Rather than mutual exclusivity, this study proposes that **the differences suggest complementarity and different realms of applicability -** points which are explored further in Section 4.2.2.

4.2.2 The different approaches - conflict, convergence or co-existence?

Differing paradigms are currently being used within ID, leading to quite different answers to the same questions, with concomitant implications for the theorist, the designer, and the instructional practitioner. The differences are major, with origins deep in the core of the paradigms (Willis, 1998). Willis suggests that designers of instruction usually take one of three positions:

1. Decide which paradigm he/she accepts, and practice solely within its principles in a partisan fashion, making no attempt to design within two differing stances;
2. Separate core paradigm issues from instructional strategy issues. This entails partial reconciliation of conflicting paradigms, as a practitioner is a proponent of one ID position, but supports the use of certain strategies from another persuasion under certain circumstances; or
3. Place themselves within a particular paradigm, but accept that none of the current ID models have such firm foundations that they can be considered infallible. In other words, open democratic pragmatism is a basis for design and development that accommodates open-mindedness to methods and results from other paradigms, and even permits a change of paradigm.

The last approach is the one Willis recommends, and is the persuasion of the current author, who believes in an open approach, which integrates where appropriate and uses different methods and models in tandem where appropriate. This chapter, therefore **aims to develop a compact synthesis of current thinking in**

- **Learning theories from the cognitive family,**
- **instructional design theory, and**
- **characteristics of effective practice**.

The framework so generated should serve as a tool to facilitate development of effective instructional systems/resources and learning events/environments. It should also support meaningful inquiry into such, as well as further inform theory as it investigates the dynamics between learning theory and instructional design/practice.

Although there will not be explicit application of the behaviourist paradigm as such, the researcher believes that some of its aspects/methods hold value for incorporation within particular kinds of instruction and certain subject-matter domains, hence its inclusion in Tables 4.1 to 4.4.

4.3 Selection criteria

The extensive and intensive survey of learning theories and instructional systems development in Chapter Two and Chapter Three, summarized in Tables 4.1 - 4.4, identifies a daunting plurality of theories and models. The effectiveness criteria mentioned in Chapter One, Section 1.4.4, are re-visited and used to select appropriate theories and characteristics for learning events and environments. Positions and stances are sought which as a whole, comprise a concise set of theories from the cognitive family and characteristics that capture the essence and strengths of current learning theory and practice, i.e. positions and stances which:

1. *Are consensus-builders - methods applicable to situations that transcend paradigms*, i.e. a synergistic combination or integration of concepts that were initially used separately. Such integration works against exclusivity and is variously described as open democratic pragmatism or multiple frameworks (Reigeluth, 1996c; 1999; Greeno, Collins & Resnick, 1996; Hannafin *et al*, 1997; Willis, 1998; Duchastel, 1998).

2. *Demonstrate functionality and utility in authentic situations of training or instruction,* i.e. they should work in practice according to the values used to judge the methods, *even if they do not necessarily possess traditional empirical research-proven effectiveness* (Reigeluth 1989; 1999). Theories and characteristics are sought which promote the attainment by learners of both basic and problem-solving skills (Gagné, 1985; Jonassen, 1994; Hannafin, 1994). Conversely, much of what is 'proven' under controlled conditions contrived for research, works very differently in natural learning contexts (Hannafin, 1996). Willis (2000) advocates the grounded theory perspective, whereby a researcher begins a study without predefined hypotheses and methodologies. ‘In grounded theory what was wrong in traditional research is … acceptable, even desired and required’ (Willis, 2000:11).

3. *Are learning-focused for democratic societies where the learners' role is predominant,* in keeping with Reigeluth's (1996a, 1996c; 1997) 'new paradigm' and Jonassen's (1994) call for environments that support learner-learner collaboration with the educator serving as a coach or facilitator.

4. *Comply with pragmatic, rather than idealistic, purist considerations* - pragmatic considerations are one of the foundations of a learning system (Hannafin *et al,* 1997) and may entail some compromise between theoretically ideal situations, available resources, and constraints. The aim should be to achieve a balanced and aligned foundation for a learning experience. Jonassen (1999), a protagonist of constructivism, advocates the use of both constructivist and objectivist methods in appropriate contexts within constructivist learning environments, and makes the point that 'to impose a single belief or perspective is decidedly non-constructivist' (Jonassen 1999: 217).

5. *Conform to the general requirement that formal instruction incorporates some form of external assessment / marking / grading of learners*, i.e. more than mere learning gain or self-assessment should be measured (Braden, 1996; Dick & Carey, 1996).
6. *Integrate affective and cognitive aspects* (Tennyson & Nielsen, 1998; Martin & Wager, 1998; Duchastel, 1998).
7. *Incorporate means of communicating complexity* in ways that either simplify it (Merrill, 1991) in a decontextualized manner (where appropriate), or support it (Perkins, 1991b) when it is encountered in context.
8. *Are platform-independent for means of presenting instruction;* i.e. not tightly coupled to a single technology/medium for delivery (Clark, 1994; Kozma, 1994; Russell; 1999).
9. *Prepare learners to apply skills in practice and use knowledge in real life*, so as to facilitate application, retention, and transfer in the real world (Estes & Clark, 1992).

The first and most important criterion aims, within the context of current philosophy and practice, to select theories and characteristics that can transcend exclusivity and that, explicitly or implicitly, can be incorporated in appropriate ways into instructional environments and events to foster effective learning. The criteria, which derive deductively from theory and inductively from practice, by a process of filtration of textual data should be used as general guidelines and be applied within realistic constraints. It is not the intention that every position or characteristic selected should comply with all nine criteria.

Certain concepts occur across the board, in many contexts and in different kinds of learning events. Some features transcend underlying philosophies; others are integrally associated with a particular paradigm. The search is on to define underlying theories and characteristics of learning environments which support and facilitate learning. It is a cross-paradigm search for contextually and currently relevant stances and features.

In the next section these nine selection criteria are used to set up a textual filtration process. In this process, textual data comprising philosophies and practices relating to learning/instructional theories (Chapters Two and Three) are tested against the criteria. Theories and stances that comply are then extracted, processed, and used as a basis for generating the metamodel.

4.4 Selection process - culminating in the Hexa-C Metamodel

Section 4.4 demonstrates and explains how the metamodel was generated. The findings of the textual filtration process are recorded in three series of tables, accompanied by discussion.

4.4.1 How the selection criteria were used to filter textual data

The nine criteria of Section 4.3 were applied to the information in Chapters Two and Three, examining the concepts studied to identify aspects in these two chapters that satisfy the criteria. Elements and features were selected from **the theoretical, informational and principle-type material** in the two chapters, and not from information regarding specific ISD or C-ID models.

The theories, concepts, and characteristics which conform to Criterion 1 to Criterion 9 are listed in Tables 4.5.1 through to 4.5.9 respectively. The next set of tables, Tables 4.6.1 - 4.6.9, are concise summaries of Tables 4.5.1 - 4.5.9 respectively, with 4.6.1 corresponding to 4.5.1, etc. The 4.6 series represents reduced, consolidated versions - grouping together characteristics that are repeated or related, and scoring them to record the incidence of repeating characteristics and theories. The scores are used to derive a compact and concise set of theories and characteristics that capture the essence and strengths of effective learning theory and instructional practice as required in Section 4.3. Finally, Tables 4.7.1, 4.7.2, and 4.7.3 integrate, consolidate, and total all the information from Tables 4.6.1 - 4.6.9, grouping each occurrence of related stances and characteristics under a single label.

For example, Table 4.5.1 and Table 4.6.1 were derived as follows: The material in Chapters Two and Three was filtered through Criterion 1 to identify and extract concepts that satisfy it. Where the requirements of the criterion were met by a feature/property of a theory/characteristic reviewed, the concept was entered in Table 4.5.1. Concepts selected by this text filtration process are listed in Table 4.5.1, along with their sections of origin, and are subsequently consolidated and totalled in the associated summary table, Table 4.6.1. Some of the composite concepts give rise to more than one corresponding entry in Table 4.6.1. The subsequent pairs of tables are derived in the same manner, using the successive criteria. The derivation of the 4.7 series of tables is explained in Section 4.4.3

Section 4.4.2 contains Tables 4.5.1 - 4.5.9 and their corresponding summaries, Tables 4.6.1 - 4.6.9. Section 4.4.3 follows with a review of the criteria and the results of their application. This section includes a major table, which consolidates all the findings. In Section 4.4.4 the textual data filtration process and its results are discussed, and the concise set of related concepts, namely the Hexa-C metamodel is introduced. The metamodel is not a formal model in and of itself - rather, it is an integrated framework comprising overlapping stances and models, whose utility in analysis and meta-analysis is demonstrated in Chapters Five and Six.

4.4.2 Results of the textual filtration process

Table 4.5.1 shows textual data that emerged when concepts and methods were sought, and situations mentioned, that transcend paradigms and decry exclusivity.

Table 4.5.1 Criterion 1: *Consensus-builder* (Methods/stances that transcend paradigms)
From Chapter Two: • Behaviourist learning viewed as construction of a set of S-R associations (2.2.1). • Humanist-cognitive viewpoint on human verbal behaviour (2.2.5) by which behaviourists and non-behaviourists agree on important role played by individual's cultural and social origins. • Cognitive learning: Construction by learners of knowledge (2.3.2). • CDT draws from various learning theories (2.3.3.3). • Cases arise, even in constructivist learning, where learners need to acquire objectivist understanding from an expert (2.4.4). • Many learning events incorporate aspects based on objective traditions as well as elements of constructivism (2.4.6). • Learner-centredness transcends paradigm boundaries (2.5.2). • Basic methods are used cross-paradigm (2.6.2). • The new paradigm should incorporate much of the knowledge of previous models, but re-structured into the new context (2.8). • Systematic ID, structured, direct instruction and objectivism have a place within all types of learning, with a transition to constructivist approaches at advanced stages (2.8).
From Chapter Three: • Grounded design can be applied to any learning theory, as well as cross-platform, provided that it is consistently rooted on an underlying theoretical stance, and that it achieves alignment between its underlying principles (3.1.2). • Instructionism straddles the divide between behaviourism and cognitivism – it uses direct instruction, but founded on cognitive psychology (3.3.4.2). • Five-star instructional design rating has hybrid requirements (3.3.4.3). • Customization is implemented in different ways across the spectrum of learning theories (3.5.2). • Researchers from different theoretical perspectives can collaborate around the authentic educational technology model (3.5.5). • All the instructional theories have means of implementing basic skills – but use varied terminology (3.6.4). • Cross-fertilization must occur / A theoretical base and meta-rules are required that can handle both conventional instruction and the content approach (3.7). • Learners can construct meaning from well-designed direct instruction (3.8).

Table 4.5.2 lists characteristics and approaches that satisfy the criterion which tests for functionality in authentic situations of teaching/learning, although they may not be explicitly research-proven.

Table 4.5.2 Criterion 2:

Demonstrates functionality in authentic situations of instruction/training

(Works in practice, even if not research-proven)

From Chapter Two:

- Observable behaviour/Stimulus-response-reinforcement (2.2.1).
- Practice on prerequisites and components helps learners boost performance (2.2.1).
- Objectives (2.2.2).
- Different conditions of learning for different learning outcomes (2.2.3.1).
- Cognitive learning: prior <--> new knowledge (2.3.2.1).
- Cognition: human information processing for problem-solving (2.3.3.1 and 2.3.3.2).
- Automaticity in subskills (2.3.3.6).
- Customization: learners determine own progress & learning activities (2.5.2)
- Kellers ARCS model enhances the learning experience (2.5.3.2).
- Traditional introductive theory is implemented by basic methods, which increase the problem of certain types of learning (2.6.2).
- Traditional ID process models relied on research and empirical data re different methods, but it is also possible to select what 'works best', depending on the values used to judge methods (2.6.5).
- Learning can occur from participation in the practices of communities and social practices (2.7.3).
- Instructional strategies should be selected from the context of theoretical frameworks, but they may originate from different families of instructional strategies (2.9).

From Chapter Three:

- Reinforcement and correction guide learners to achieve defined goals (3.2.1).
- Gagné's events of instruction (3.2.3.1).
- Cognitive learning: learning within problem-solving situations for the sake of correct performance (3.3.2.3).
- CDT: Each learner selects components he/she needs as an individual (3.3.3.1).
- Interaction between learners, and articulating knowledge to others consolidates learning (3.3.4.1).
- Instructional designers must support learners in individual knowledge construction (3.4.1).
- Multiple perspectives on the content (3.4.2.1).
- Encourage strategic exploration of errors (3.4.2.2).
- Social negotiation helps learners build mental models (3.4.2.3).
- Give learners ownership of the overall problem and of the problem-solving process (3.4.2.4).
- Constructivism, like reflective practice, is based on flexible guidelines rather than rules of inquiry (3.4.2.5).
- Client-centred designs: involve users at each stage of design of instruction (3.4.3.2).
- For ill-structured problems, embed learning in a holistic and realistic context (3.4.3.3).
- Users may creatively adapt learning materials for the best use in their own context (3.4.3.4).
- Cognitive apprenticeship: scaffolding and coaching extend the development of learners (3.4.4.1).
- Understanding is inextricably tied to the process and context of learning (3.4.4.3).
- Understanding is individually mediated (3.4.4.3).
- Cultivating cognitive processes can be more important than learning truths and solving problems (3.4.4.3).
- Students must take ownership of a problem in order to solve it, i.e. it must be personally relevant (3.4.4.4).
- Errors and behaviour that deviate from stated objectives must be used as forces for re-equilibrium (3.4.4.5).
- Students who learned cooperatively scored higher (3.5.1).
- Learners in learner-centred systems must have metacognitive skills to make effective judgements (3.5.2).
- Good education/ using what 'works' engages learners (3.5.3)
- Teachers select/adapt/create materials in novel ways <u>during</u> instruction (3.6.3).
- Constructivist learning, with its creativity/flexibility does not lend itself to research-based empiricism (3.8).

In Table 4.5.3 concepts are shown that contribute towards democratic, learning-focused instruction.

Table 4.5.3 Criterion 3: *Learning-focused* (Learners' interests are predominant)
From Chapter Two: • Student models and tutoring modules to support individual learners (2.3.1.1). • Cognitivism learning: Mental schemata (2.3.2.1). • Component display theory: different types of knowledge / different types of performance (2.3.3.3). • Cognitive networks : interaction of content & cognitive strategies for problem-solving (2.3.4.1). • Metacognition (2.3.4.3). • Cognitivism: Students viewed as true learners / independent thinkers (2.3.5). • Constructivism: Personal experience and relevance / collaborative learning (2.4.1). • Learning differs from learner to learner (2.4.1). • Learning is socially negotiated (2.4.1) (2.4.2). • Constructivism-collaborative learning connection (2.4.3). • Constructivism: more about facilitating learning than about pre-prepared instruction (2.4.3). • Constructivism: learner as prominent as facilitator (2.4.3). • Constructivism: learner in control – individuals make decisions and develop their own knowledge (2.4.5.3). • Collaborative learning: groups of learners working together, sharing responsibility, interacting and empowering learners (2.5.1). • Customization is the most important distinction between instruction in the Information Age and that in the Industrial Age (2.5.2). • Creativity engages learners and holds their attention (2.5.3.1); meets their needs (2.5.3.1). • Creativity in instructional strategies must enhance learning, not reduce its status (2.5.3.2). • Learning-focused approach entails: - individual learners taking control/responsibility, - working in teams and doing peer-teaching, - using technology as tools (2.6.3). • S-R associations entail connectionist learning, whereby information instilled strengthens certain connections (2.7.1). • Cognitive learning means constructing patterns of symbols and relationships to understand concepts (2.7.2). • Constructivism: concerned about boring, out of context learning (2.8). • Constructivism and cognitivism avoid producing inert knowledge (2.8).
From Chapter Three: • Behaviorist perception principles lead to practical learning principles (3.2.2.1). • Gagne's events of instruction (3.2.3.1). • Cognitive ISD: learners have a role in mediating learning with instructor as activator of learning (3.3.1). • Individuality of each learner (3.3.1). • Constructivism is concerned with each learner's unique perspective (3.4.1.2). • Instructional goals negotiated, not imposed (3.4.2.1). • Less concerned with instructional strategies and more with supporting learner-control of their own activities (3.4.2.1). • Learning in context (3.4.2.1). • Support construction of knowledge by learners (3.4.2.3). • Challenge learners' thinking; learners should become critical thinkers and self-regulators (3.4.2.4). • Test personal ideas against alternative views of other learners (3.4.2.4). • Involve learners in participatory design of learning systems (3.4.2.5). • Provide for social negotiation as part of designing learning materials (3.4.3.2). (continued ...)

- Learning emerges from activity: define internal and external contexts of a learning activity and its system dynamics such as how individuals communicate, rules/roles for each individual, relationships and dynamics of all these aspects (3.4.3.5).
- Situated cognition: learning should not be decontextualized by isolating elements (3.4.4.1).
- Learners must also be coached in metacognitive skills (3.4.4.1).
- Open-ended learning environments are student-centric, using the capabilities of technology (3.4.4.3).
- Tutor should become more of a facilitator than an instructor (3.4.4.4).
- Learner-control of instructional components customizes learning (3.5.2).
- A learning-focused paradigm should be characterized by customization, expectations of diverse learners, the teacher becoming a coach, and learners building their knowledge with support and acquiring skills (3.6.3).

Table 4.5.4 indicates the results of textual filtration through a pragmatism-seeking criterion.

Table 4.5.4 Criterion 4: *Pragmatic, not theoretically idealistic*

(A balanced approach)

From Chapter Two:

- Instructionism: need-to-know basis reconciles theoretically-ideal with available resources/content (2.2.4.2).
- Cognitive psychology, *how* as well as *what* learners learn (2.3 and 2.3.1).
- Cognitive learning: Construction of knowledge (2.3.2.1).
- Teach certain higher-level skills outside of relevant problem i.e. skills can be generalizable (2.4.4).
- Cognitive flexibility theory: Approaches which are cognitive, based on constructivist assumptions, yet with an objectivist grounding (2.4.5).
- Some constructivist learning environments combine objectivism and constructivist methods as complemenatry design tools (2.4.5.3).
- Exclusivity of focus should be avoided; it leads to limited scopes and restricted practices (2.8).
- Different approaches to support different stages of learning.
- Hybrid approach combining:
  - Objectivist approach for basic practice,
  - Constructivism for complex domains and ill-structured aspects (2.8).

From Chapter Three:

- For a learning option to be effective, it must be founded on (i) psychological (ii) pedagogical (iii) technological (iv) cultural and (v) pragmatic considerations, with these five foundations being aligned so as to maximize coincidence (3.3.4.2 and 3.4.3.3).
- No single theory is the panacea for all instructional problems, yet all are designed to make learning a more realistic and meaningful process. (3.4.1).
- Traditional design principles can be applied towards self-directed changes within learners (3.4.2.2).
- Behaviourism and constructivism are not incompatible, in that different methods can be used for different kinds of problems (3.4.2.5:1).
- Within an activity system, define the activity structure, its operations and its component actions (3.4.3.5).
- Qualitatively different learning processes require qualitatively different methods. User activities in an OELE range from highly mathemagenic to generative processes where learners identify, interpret and elaborate concepts (3.4.4.3).
- Mitigate against extreme tendencies by aiming pragmatically for learning environments with aligned, balanced foundations (3.4.4.3).
- Current instructional design theories and models are characterised by diversity (3.6.1).
- Some learning goals are accomplished by high control, others by flexible instruction. The issue is when to switch from a directive style (tractable problems) to constructivist style (ill-defined problems) (3.7).

Table 4.5.5 and Table 4.5.6 show the results of filtering the material in Chapters Two and Three through criteria that test respectively for the incorporation of external assessment and the integration of affective and cognitive aspects.

Table 4.5.5 Criterion 5: *Incorporates some form of external assessment* (Grading)
From Chapter Two: • Objectives (2.2.2). • Testing objective beliefs (2.2.4.1). • Constructivism: multi-modality i.e. portfolio assessment (2.4.2.2: 1). • Constructivism: assessment of group work (2.4.2.1) / assessment of collaborative efforts (2.4.2.2: 2).
From Chapter Three: • Content, methods, and assessment designed to promote competence in defined outcomes (3.2.3.2 & 3.2.3.3). • Typical instruction a range of sequences, & activities & assessment arranged around educational goals (3.2.1). • Gagne's events of instruction include assessing performance (3.2.3.1). • Criterion-referenced tests (3.2.3.3). • Mastery learning (3.2.4). • Learners should evaluate one another's performance & provide mutual feedback (3.3.4.1). • Constructivist evaluation: problem-solving in a domain / learners required to reflect on learning (3.4.1.2). • Constructivism: flexible evaluation to accommodate variety in learners (3.4.2.1). • Constructivism: assessment of portfolios (3.3.3.6 and 3.4.2.7). • Constructivism: assessment of projects (3.3.3.6 and 3.4.2.7). • Objective tests are inappropriate, since different students learn in different ways (3.4.3.4).

Table 4.5.6 Criterion 6: *Integrates affective and cognitive aspects*
From Chapter Two: • Cognitivism: active participation and critical thinking by learners within cognitive processes (2.3.2). • Complexity theory: affective elements support critical thinking/decision-making/creativity in learners (2.3.4.1) • Constructivists believe individuals are intrinsically motivated to seek information (2.4.1). • Creative instruction motivates learners (2.5.3.2) • Dual coding (2.5.3.2). • Positive reinforcement motivates learners to respond correctly (2.7.1).
From Chapter Three: • Avoid external control of learning situations (3.4.2.1). • To make instruction personally relevant, emphasize affective domain of learning (3.4.2.2). • Learning process cannot be separated from learners' attitudes, values, and interests (3.4.2.2). • Embed reasons for learning into the activity (3.4.2.2). • For learning to occur, learners must be dissatisfied with their existing knowledge (3.4.3.2 - theoretical part). • Learners should become engaged when using knowledge in problem-solving (3.4.4.1). • Ownership of the problem engenders motivation in learners (3.4.4.2). • Problem-based learning: learner-centric and highly effective in engaging and motivating learners (3.4.4.4). • Collaborative learning: impacts positively on attitudes and motivation (3.5.1). • Affective and cognitive domains are closely related (3.5.3). • The 'new paradigm': incorporates theories and models that foster attitudinal & social development (affective domain) as well as those geared towards understanding and strategies in the cognitive domain (3.6.1). • Authentic instruction: content motivates learners inherently (3.7).

In Table 4.5.7 theories and concepts are shown that emerge from textual filtration through a criterion that seeks aspects which aim to communicate domain complexity. Table 4.5.8 indicates the result of filtration through the criterion of platform-independence.

Table 4.5.7 Criterion 7: *Has means to communicate domain complexity*
From Chapter Two: • Objective reality specified and instilled in learners (2.2.4.1). • Bottom-up, basics-first, modular instructionism (2.2.4.2). • Reductionism: Study / simplify components independently (2.2.4.3). • Enterprise schemas: multiple integrated objectives : facts & concepts in context (2.3.2.3). • Component display theory : components of learning (2.3.3.3). • Cognitive learning simplifies complexity (2.3.4.4). • Constructivism: Cognitive complexity handled by conflict deferred (2.4.3). • Situated cognition: presents complex, ill-structured situations (2.4.5.1).
From Chapter Three: • CDT: different content dimensions (3.3.3.1). • Incorporate cognitive and metacognitive strategies in instruction but without distracting from task-essential learning (3.3.4.1). • Stress connections within and beyond the information, integration of old & new, and relationships (3.3.4.1). • Constructivism : Design the learning environment to reflect the complexity of the post-learning environment – rather than simplifying, support learner in situation of complexity (3.4.2.4). • Address complexity by providing multiple perspectives (3.4.4.2). • In an open-ended learning environment, it should be possible to alter the level of complexity (3.4.4.3). • Chaos theory: Learning is a complex process, but despite the complexity, learning does occur – even within random systems (3.4.4.5).

Table 4.5.8 Criterion 8: *Platform-independent* (Not restricted to a specific technology for presentation/performance of instruction)
From Chapter Two: • Component display theory (2.3.3.3). • Incorporated technology subversion: learners use environments in a way not originally intended (2.4.5.3). • Technology's role is to augment learning (2.4.5.3). • Media debates distract from the main purpose of media, which is to support individual learners (2.5.2). • Technology can be used in a flexible way to motivate learners (2.5.3.1). • Technology can support 'flow' (2.5.3.1). • Basic methods are implemented by means of variable methods of delivery (2.6.2).
From Chapter Three: • Predictive theory of ID – developing new rules during instruction (3.3.2.3). • Use technology as a tool (3.4.3.3). • Due to chaotic influences, a result often obtained in between-media experiments is 'no significant difference' (3.4.4.5). • Multi-media can better be used as environments or tools for learners to create their own products (3.4.4.5). • Learning environments (whether or not they use technology) comprise Perkins' five facets (3.5.4)

The results of the final textual filtration process - using Criterion Nine to find theories and stances that help learners apply knowledge and skills in the real world – are given in Table 4.5.9.

Table 4.5.9 Criterion 9: ***Helps learners apply knowledge and skills in practice*** (Real-world value)
From Chapter Two: • Transfer (2.3.4.2). • Constructivism: exposure to the real environment (2.4.2.1). • Constructivism: authentic tasks (2.4.2.1). • Constructivism: context-driven (2.4.2.1). • Anchored instruction – within realistic problem-solving environments (2.4.5.1). • Cognitive apprenticeship – instructor acts as a guide (2.4.5.2). • Problem-based learning & project based learning (2.4.5.4). • Chaos theory: real world phenomena are unpredictable, but there's order within chaos (2.4.5.7). • Learner centredness is accomplished best in problem-based approaches (2.5.2). • A well chosen theme is, of itself, a creative motivating force (2.5.3.2).
From Chapter Three: • Facts are not isolated, but are knowledge to be applied in real life (3.4.1.2). • Anchor learning activities to an authentic task or case-based problem (3.4.2.3). • Constructivism : Design the learning environment to reflect the complexity of the post-learning environment and support the learner in such situations of complexity (3.4.2.3). • Through social integration learners make sense of the world and find new ideas (3.4.3.2 - theoretical part). • For ill-structured problems, embed learning in a holistic and realistic context (3.4.3.3). • Activity theory: Conscious learning occurs when doing an activity, rather than preceding the activity; therefore the context of learning and performance is vital (3.4.3.5). • The problems presented should be real rather than realistic (3.4.4.4). • Learner-centred CPS entails real-life role shifts and power relationships in a rich social context (3.5.1). • Team-based learning and problem-based learning - using real problems - are learner-centric (3.6.2).

The purpose of the 4.5 series of tables is to show theories and characteristics that were extracted when the textual filtration process was applied to Chapters Two and Three to identify stances that conform to the nine selection criteria. As explained at the beginning of Section 4.4.1, the next series of tables, Tables 4.6.1 - 4.6.9, have a one-one relationship with Tables 4.5.1 - 4.5.9, in that they summarize them - with Table 4.6.1 corresponding to Table 4.5.1, etc. The 4.6 series shows summaries and scores of the results obtained from applying the nine criteria. They represent condensed, consolidated versions of the 4.5 series - grouping together concepts that are repeated or related, totalling them to record the incidence of repeating characteristics and theories, then listing them in decreasing sequence. The findings indicate which concepts and perspectives appear most frequently as a result of filtration through the effectiveness criteria.

Table 4.6.1 Summary and scores of results from Criterion 1: *Consensus-builder* (Can be used in situations that transcend paradigms)			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Cross-paradigm / cross-platform / cross-theory	2	5	7
Combinations: Constructivism within objectivism / constructivism in direct instruction / cognitivism in behaviourism / constructivism in cognitivism	4	1	5
CDT / components / basic skills	3	1	4
Learner-centric systems / customization within different paradigms	1	1	2

Tables 4.5.1 and 4.6.1 show the results of textual filtration in seeking positions that *build consensus by transcending paradigms*. When applied to the literature of Chapters Two and Three, Criterion 1 extracted a total of twelve references to cross-platform applications and paradigm combinations.

Table 4.6.2 Summary and scores of results from Criterion 2: *Demonstrates functionality in authentic instructional/ training situations* (Works in practice)			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Cognitive learning / apprenticeship / mental models / human information processing / metacognition	3	4	7
Motivation / creativity / novel ways	2	4	6
Constructivism: knowledge construction / multiple perspectives / exploration of errors		5	5
Customization / learner-centric / learner-ownership / client-centered / individually-mediated	1	4	5
Collaborative learning / shared responsibility / social negotiation	2	3	5
Objectives / outcomes / S-R / observable behaviour / Events of instruction	3	2	5
Basic methods / CDT /skills components / subskills	3	1	4
Context of learning		2	2
Cross-paradigm strategies	1		1

Criterion 2 (Tables 4.5.2 and 4.6.2) relates to aspects *that show functionality and foster learning in practical situations of instruction*. The highest score (seven) went to learning approaches that emphasize the role of the mind in comprehension and cognitive processing. This was followed closely by customized learning and collaborative learning (five mentions), with an equal count for objectivist traditions, demonstrating that in appropriate contexts and domains, aspects of behaviourism can, and do, foster learning. Component instruction and constructivism, far removed from one another, as well as engagement and creative aspects, each had a score of four mentions.

Table 4.6.3 Summary and scores of results from Criterion 3: *Learning-focused*
(Learners' interests predominant)

Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Learner-control / customisation / learner-centric / individuality of learners / negotiated goals	7	5	12
Collaborative learning / social negotiation / community of learners / participatory design	4	6	10
Cognitive learning / self-regulators / HIP / metacognition / critical thinkers / activators	5	4	9
Constructivism: active learning / facilitate learning / knowledge construction / technology as tool	4	3	7
Engage learners / creative strategies	3	1	4
Connectionist / Gagné / behaviourist principles	1	2	3
Contextual learning		3	3
Components	1	1	2

Using Reigeluths term, '*learning-focused*', Criterion 3 (Tables 4.5.3 and 4.6.3) - seeking predominance of learners' interests - extracted its highest mention (twelve occurrences) from literature on matters such as learner-control, customization, individualization, etc, with collaborative / participatory aspects close behind at ten occurrences. Cognitive and constructivist aspects scored nine and seven respectively.

Table 4.6.4 Summary and scores of results from Criterion 4: ***Pragmatic, not theoretically idealistic*** (A balanced approach)			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Cross-paradigm / cross-theory / hybrid approach / different methods for different times or diverse problems / avoid exclusive focus	5	7	12
Instructionism / need-to-know / pragmatic ISD	2		2
Cognitive psychology / cognitive learning /	1	1	2
Decontextualized skills / component actions	1	1	2
Customizing learning in varied ways		1	1
Team approach		1	1
Knowledge construction	1		1

Tables 4.5.4 and 4.6.4 indicate that, over and above the references to cross-paradigm applications revealed by Criterion 1, Criterion 4 - relating to a *balanced, rather than theoretically ideal approach* - extracted a further twelve references to the value of a cross-theory, hybrid approach, using different methods at different times and avoiding exclusivity.

Table 4.6.5 Summary and scores of results from Criterion 5: ***Incorporates some form of external assessment*** (Grading)			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Constructivism: portfolio assessment / projects / journal / reflection /objective tests unsuitable	2	6	8
Objectives / outcomes / goals as basis for testing / events of instruction	2	3	5
Assess collaborative efforts	2	1	3
Criterion-referenced / mastery		2	2
Peer evaluation		1	1

Criterion 5 (Tables 4.5.5 and 4.6.5) acknowledges the requirement that *formal instruction incorporates learner-assessment*. The greatest number of references to conventional assessment/testing (five) was found in material on objectives and goals, but the overall highest score (eight) went to the newer constructivist-style assessment.

Table 4.6.6 Summary and scores of results from Criterion 6:
Integrates affective and cognitive aspects

Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Intrinsic motivation / creativity as motivator / personal relevance / foster emotional aspects / affective-cognitive link / ownership motivates / content motivates	3	9	12
Cognitive processes / active participation / ID for deep understanding / cognitive strategies / complexity theory	2	1	3
Learner-control / learner-centric		2	2
Constructivism: problem-based learning motivates		2	2
Collaborative learning		1	1
Extrinsic motivation	1		1

Filtration through the criterion, *Integration of cognitive and affective aspects* (Criterion 6 - Tables 4.5.6 and 4.6.6) extracted twelve mentions under aspects such as intrinsic motivation, creativity, and relevance; as well as three and two respectively under cognitive strategies/complexity theory and constructivist problem-solving.

Table 4.6.7 Summary and scores of results from Criterion 7: *Communicates domain complexity*			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Constructivism: support in managing complexity / cognitive complexity / situated cognition / scaffolding / alternative levels of complexity chaos theory	3	4	7
Components / basics first / CDT	3	1	4
Cognitive learning simplifies / cognitive and metacognitive strategies / integrate information	2	2	4
Objectives / specify objective reality	1		1
Concepts in context	1		1

Criterion 7 (Tables 4.5.7 and 4.6.7) stresses the need to *communicate complexity to learners,* either by working with inherent complexity or by simplifying it prior to transfer to learners. Seven references on management of intrinsic complexity were extracted from the various aspects of constructivism, and a total of eight emerged from sections on the use of cognitive methods (four) and component-based strategies (four).

Table 4.6.8 Summary and scores of results from Criterion 8: *Platform-independent* (Not restricted to a single or specific technology)			
Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Technology: as a tool / to enhance / to support	4	3	7
CDT / components / basic skills	2		2
Constructivism: technological subversion / flexible process of instruction	1	1	2
Innovative use of technology motivates learners	1		1
Different media - no significant difference		1	1

Theories and characteristics to be integrated into the proposed framework *should not be limited to a specific technology as means of delivery* (Criterion 8). Tables 4.5.8 and 4.6.8 stress the integral role of technology as a tool for current learning, and distribute various scores across the spectrum of the literature. It would appear that restriction to tightly-coupled forms of technology is not a valid threat.

Table 4.6.9 Summary and scores of results from Criterion 9:
Helps learners apply knowledge and skills in practice
(Real-world value)

Theory or characteristic	Number of occurrences		
	Chapter Two	Chapter Three	Total
Constructivism: authentic tasks / order within chaos / complexity / multiple perspectives / activity theory: learning-by-doing / anchored instruction /	4	4	8
Realistic context	2	1	3
PBL / realistic problem-solving / ill-structured	2		2
Cognitivism: transfer / instructor as guide	2		2
Learner-centered PBL / customization by problem-based learning	1	1	2
Team-approach / social negotiation		2	2
PBL motivates and engages learners	1		1
Components / facts		1	1

Criterion 9 (Tables 4.5.9 and 4.6.9) states that learning theories and characteristics should be sought that *help learners to apply knowledge and skills in the real world*. Constructivism (scoring eight) is undoubtedly the major force for supporting learners in real-world performance.

4.4.3 Consolidated results of the textual filtration process

Tables 4.7.1 and 4.7.2 integrate, consolidate, and total information from Tables 4.6.1 - 4.6.9, grouping each occurrence of related concepts under a single appropriate label. The scores are then used to derive a compact and concise set of theories and characteristics that capture the essence and strengths of learning- and instructional design theory/practice, as was required at the beginning of Section 4.3. Table 4.7.1 lists aspects that can be classified as instructional paradigms, philosophies of learning, or characteristics of instructional systems / learning environments – all part of or related to the cognitive family. Table 4.7.2 sets out other notable issues that emerged strongly from the textual filtration, yet which cannot be categorized as particular theories/characteristics of learning events. The findings in the tables are discussed in Section 4.4.4. Section 4.4.4 also includes Table 4.7.3, which presents concepts from the behavioural family that emerged from the textual filtration.

Table 4.7.1 Consolidated occurrences of learning theories and characteristics (from cognitive family)										
Theory or characteristic	**Criterion and its associated table in the 4.6 series**									
	1 4.6.1	**2** 4.6.2	**3** 4.6.3	**4** 4.6.4	**5** 4.6.5	**6** 4.6.6	**7** 4.6.7	**8** 4.6.8	**9** 4.6.9	**Total**
Knowledge construction, active learning, problem/project-based, authenticity, support in complexity, chaos theory, flexible instruction, anchored, ill-structured domains **(Constructivism)**		5	7	1	8	2	7	2	10	**42**
Cognition, cognitive learning, mental models, HIP, metacognition, self-regulation, integration **(Cognitivism)**		7	9	2		3	4		2	**27**
Affective aspects, intrinsic motivation, engage learners, creative/innovative strategies, affective-cognitive, ownership **(Creativity)**		6	4			12		1	1	**24**
Learner-centricity, learner-control, individuality, negotiated goals **(Customisation)**	2	5	12	1		2			2	**24**
Joint responsibility, social negotiation, team approach, peer evaluation **(Collaborative learning)**		5	10	1	4	1			2	**23**
CDT, basic skills/methods, decontextualized skills **(Components)**	4	4	2	4			4	2	1	**21**

Table 4.7.1 shows aspects from the cognitive family that are instructional/learning paradigms or characteristics of instructional systems. Table 4.7.2 indicates the high incidence of references to hybrid paradigms and cross-paradigm approaches extracted by the effectiveness criteria, as well as two other issues that feature strongly, namely, context and technology itself.

Table 4.7.2 Consolidated references to other issues										
Category	**Criterion and its associated table in the 4.6 series**									
	1 4.6.1	**2** 4.6.2	**3** 4.6.3	**4** 4.6.4	**5** 4.6.5	**6** 4.6.6	**7** 4.6.7	**8** 4.6.8	**9** 4.6.9	**Total**
Cross-theory/discipline, different methods at different times **(Cross-paradigm / hybrid paradigm)**	12	1		12						**25**
Contextual learning (**Context)**		2	3				1		3	**9**
Technology as a tool, to support, no-significant-difference (**Technology)**								8		**8**

4.4.4 Discussions of results of textual filtration

As already stated, the textual data in the 4.5 series of tables and their respective summaries in the 4.6 series, emerged as the result of filtration through effectiveness criteria. Tables 4.7.1 and 4.7.2 were then generated by taking the groups of characteristics and theories listed in the left columns of each of Tables 4.6.1 - 4.6.9, analysing them, and synthesizing them into categories. Each category was given an appropriate, succinct umbrella-type label. This section discusses the naming process and the tables, addressing Table 4.7.1 in Section 4.4.4.1 and Table 4.7.2 in Section 4.4.4.2 respectively. Section 4.4.4.3 briefly shows aspects from the behavioural family that also resulted from textual filtration.

4.4.4.1 Learning theories and characteristics of instructional design/practice

Table 4.7.1 was generated by combining related sub-totals from tables in the 4.6 series. It was found that most of the elements in the 4.6 series fall into six major categories of aspects of learning theory and instructional design, each of which has been allocated a label, indicated in bold print underneath the aspects that comprise the category. The labelling process was indisputable in three of the categories, namely: **constructivism**, **cognitivism** (or cognitive learning), and **collaborative learning** - all coincidentally commencing with the letter 'C'. The other three categories suggested alternative valid labels, but in each case, one of the possibilities was a C-word, and these were selected in order to be consistent. The first of these other categories addresses affective and motivational aspects, as well as the issue of creative instruction, which relates strongly to motivating learners, hence the decision to term the category **creativity**. Another involves concepts such as learner-control, learner-centricity, customization and individualization, suggesting the candidate labels *customization* and *learner-centricity*, of which **customization** was chosen. Customization is a stronger term than learner-centric, since it is possible for an instructional system/event to be centred on learners, yet not easily customizable to the individual. The final category relating to CDT and the basic knowledge, skills and methods inherent in every domain was more complex to name. However, due to the role of Merrill's component display theory and Reigeluth's promotion of the use of components within the 'new paradigm', the term **components** was chosen.

The researcher compositely terms this compact and concise set of six stances the **Hexa-C Metamodel**. It is not a model as such, since it does not propose nor represent any rigid process or system. Rather it is a set of strongly inter-related stances, most of which are associated with the cognitive paradigm, in line with the requirement in Chapter One that the theories and characteristics come from the cognitive family (although the methods of teaching basic skills originally emerged from behaviourist instruction). It is called a metamodel – a model of models, since it is a **synthesized framework comprising six inter-related, overlapping, and composite elements**, each of which was generated by the selection criteria.

The elements of the metamodel are therefore:

1. *Cognitive learning theory*: A fairly self-evident class - relating to cognition, cognitive psychology, and cognitive learning; as well as the fruit of cognitive processes such as mental models, HIP, metacognition, self-regulation, and integration, etc;
2. *Constructivism*: The major category - which relates to tenets such as knowledge construction, active learning, anchored instruction; also to constructivist implementations of learning such as problem/project-based learning, open-ended learning environments, authentic tasks, and complexity; as well as associated fields like chaos theory, flexible instruction, and learning within ill-structured domains;
3. *Components*: A category that incorporates aspects of component display theory, also all mention of basic skills and methods - entailing unitary components and composite components, as well as decontextualized skills;
4. *Collaborative learning*: Incorporates references to cooperative learning, joint responsibility, social negotiation, team approach, and peer evaluation;
5. *Customization*: A broad category - including all reference to learner-centric instruction, learner-control, and negotiated goals; in addition to the more obvious connotations of individuality and personalisation and customized learning; and
6. *Creativity*: Another wide group - combining assertions regarding motivational and affective aspects, intrinsic motivation, the engagement of learners, creative and innovative strategies, and the affective-cognitive bond.

The Hexa-C Metamodel (HCMm) is thus a framework that suggests sound characteristics of and underlying foundations for learning events and environments. The consolidated totals in Table 4.7.1 show constructivism (total 42) as the dominant paradigm resulting from the selection process, followed by the other five Cs within close range of each other (scores of 27, 24, 24, 23 and 21). The framework of the HCMm can be used as a design aid and can also be applied within evaluations of existing learning resources, courses and interactive learning environments, to investigate them from the perspective of instructional and learning theory.

4.4.4.2 Further aspects of learning, including context and technology

Some of the groups of characteristics generated by the 4.6 series of tables do not relate directly to a specific learning theory/philosophy or characteristic of instructional systems design. These groups were similarly combined under umbrella-labels, and the figures in the columns of Table 4.7.2 were determined by adding together related sub-totals from the associated rows in the 4.6 series of tables. They were categorized under issues of **hybrid paradigms**, **context**, and **technology** respectively.

- *Hybrid paradigms*: The aspect of transcending paradigms emerged strongly from the textual filtration process in three of the categories, including twelve mentions under Criterion 4, the learning-focused category . 'Hybrid paradigm', in and of itself, is not a theory or a characteristic to be incorporated in the metamodel. However, the fact that so many sources advocate cross-paradigm fertilisation or combinations is a confirmation of the intention of this study, and underscores the integrated nature of the elements of the framework.
- *Context*: Contextualized learning is shown to be of great value. The concept of 'context' is thus used in the HCMm as a meta-context, in that the environment in which the framework is to operate is that of contextualized learning - the context dynamically being each domain within which the HCMm is applied.
- *Technology*: The HCMm can be used independent of technology and can be applied to investigate any learning product or -experience. However, most current learning occurs in environments that use technology and multimedia, and technology-based learning is an innate assumption of this study. Technology is thus the hub of the framework, since it relates to each of the six C-elements.

4.4.4.3 Aspects of learning theory from the behavioural family

One of the groups generated from the 4.6 series of tables relates to aspects of explicit objectivist behaviourism. The concepts in this group, shown as a single row in Table 4.7.3, are mostly excluded from the metamodel, since the integrated stances, as required in Chapter One, Section 1.2 are to be current theories and practices of learning/instruction and from the cognitive family. The researcher's approach, shown in Table 4.7.1, however, does incorporate certain cross-paradigm aspects that originate from behaviourist instruction, for example, the role of basic knowledge and skills.

Table 4.7.3
Consolidated occurrences of concepts from the behavioural family

Characteristic	**Criterion and its associated table in the 4.6 series**									
	1 **4.6.1**	**2** **4.6.2**	**3** **4.6.3**	**4** **4.6.4**	**5** **4.6.5**	**6** **4.6.6**	**7** **4.6.7**	**8** **4.6.8**	**9** **4.6.9**	**Total**
Objectives, stimulus-response, Gagné's events of instruction, observable behaviour, objectives used for testing, criterion-referenced tests (**Behaviourism**)		5	3		7	1	1			**17**

4.5 Elements of the Hexa-C Metamodel

The criterion-based textual filtration process of Section 4.4 delivered six categories of learning and instructional concepts, each of which was consolidated into a single term/ label that aptly represents the category. The six labels became the elements of the framework of the Hexa-C Metamodel, representing aspects that are shaping current dynamics in learning and instructional design. As well as theoretical perspectives, the framework includes practical factors relating to design and delivery of instruction.

Before proceeding to apply the metamodel in Chapter Five and amplify its elements in Chapter Six, the researcher set out to determine whether the single labels selected to represent the various categories, in and of themselves (along with their connotations/denotations), **generally comply with the selection criteria**. In Section 4.4 the criteria delivered the categories and in this section, conversely, the category labels - in their pure, rather than representative forms - are examined against the criteria. Section 4.5.1 briefly defines each element, culminating in a graphic representation of the integrated framework. In Section 4.5.2 each element is examined against the nine selection criteria; this is set out in Table 4.8.

4.5.1 The six elements: singly and compositely

1. Cognitive learning theory

Cognitive science views learning as a process that supports cognition, formation of internal knowledge structures within the learner, and retention. Cultivating cognitive processes is seen as more important than generating learning products. Critical thinking skills are fostered in learners in the context of authentic problem solving or by explicit teaching of cognitive strategies alongside content knowledge.

2. Constructivism

Constructivism is not direct instruction; rather, it entails setting up learner-centric environments and activities. The aim is to instil personal goals and secure active involvement in knowledge construction within real-world situated learning, resulting in the type of knowledge attainment that results in applicatory skills, and effective transfer. It emphasizes collaborative activities and learner-research using a wide variety of multi-media resources.

3. Components

Component display theory (CDT) (Merrill, 1983) examines whether the instructional strategies used in a learning event can effectively achieve its instructional goals. However, the choice of 'components' as an element of the framework goes beyond CDT, in that it relates to the basic knowledge/skills of a domain.

4. Collaborative learning

Collaborative learning involves joint work, sharing responsibility within a group. It optimizes on complementarity and instills collaborative skills in learners.

5. Customization

Customized learning aims for instruction that adapts to individual learners' profiles, supporting personal processes and products, and allowing learners to take initiative with regard to (some or all of) the methods, time, place, and content of their learning. It supports the ethos of matching learners' needs and interests within the context of instruction/learning.

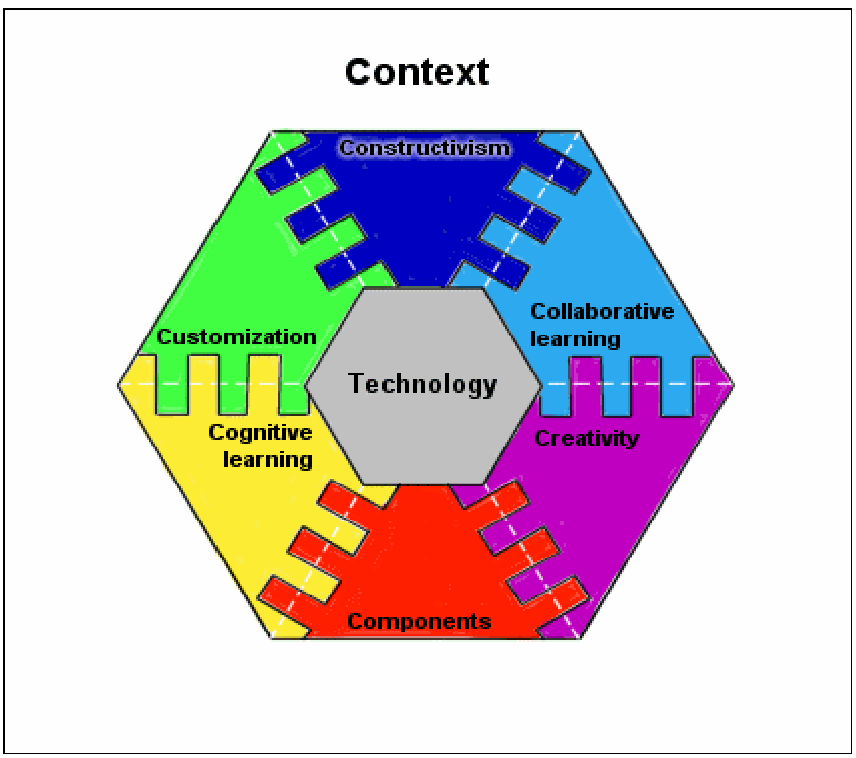
5. Creativity

Creativity supports the affective aspects of instruction, aiming for novelty within functionality, in ways that motivate learners intrinsically.

Graphic representation of the Hexa-C Metamodel framework

Figure 4.1 depicts the framework of the Hexa-C Metamodel, giving an indication of how the six elements merge and integrate. The dynamics of the theory-practice situation differ from one domain to another, hence the situation of the framework embedded within each *context*. The hub of the framework is *technology*, and concealed beneath 'technology' in the diagram are further central points of convergence and areas of overlap. If Figure 4.1 was a 3-D representation, further rich interrelationships could be portrayed - interrelationships which are discussed further in Chapter Six.

Figure 4.1 The framework of the Hexa-C Metamodel



4.5.2 The elements of the HCMm: examined against the effectiveness criteria

In the pull-out section following, Table 4.8 examines each element against the selection criteria.

Table
The six elements of the Hexa-C Metamodel

Selection criterion	Cognitive learning theory	Collaborative learning	Components
1. Consensus-builder: can be used in situations that transcend paradigms	Arose due to weaknesses in Skinner-behaviourism - leading to cognitive revolution. Later, contributed towards the emerhgence of constructivism, as the emphasis moved from knowledge assimilation to knowledge construction.	Intrinsic part of constructivism, but collaboration and particularly, cooperation can be used with all approaches.	Used in behaviourist and cognitive instruction. Not part of the constructivist paradigm, but may be appropriate for use in direct instruction of well-formed topics that precede constructivist learning.
2. Demonstrates utility: in authentic teaching situations, even if not research-proven	The various Merrill models have had a broad general impact.	Preparation for the real world	Not usually – components are often taught in a decontextualized setting.
3. Learning-focused: with learners' interests predominant	Intrinsic purpose is to enhance learning.	Working in teams is an integral part of Reigeluth's learning-focused theory.	Allows learners to chooses both the content components and type of performance
4. Pragmatic: complies with pragmatic, rather than theoretically idealistic considerations	Aims to guide and support cognition and for cultivation of cognitive processes within learners.	Yes	Yes, communication of components is done using a wide variety of instructional strategies.
5. Assessment: conforms to the general requirement that formal instruction incorporates grading / external assessment	Usually	Group assessment is a recognised form of assessment - usually entailing a group mark; may be supplemented with peer- and/or self assessment.	An integral part of the system; Objectives and assessment are frequently designed together.
6. Cognitice-affective: integrates affective and cognitive aspects	This is inherent in the more recent works on cognition.	Learners gain self-confidence by stating viewpoints and sharing knowledge. Less-able learners learn from peers.	Often aims to achieve the four aspects of the ARCS model
7. Complexity: has means of communicating complexity	By integrating new knowledge into existing cognitive structures.	Social negotiation helps to unravel complexity.	By breaking into various types of content information and types of performance/ activity.
8. Technology-wise: platform-independent	Yes	Yes	Yes
9. Prepares learners for real-world use	Supports contextual learning.	Preparation for real-life	Not directly

4.8 **examined against the nine selection criteria**		
Constructivism	**Creativity**	**Customization**
Extreme constructivism is intolerant of other paradigms, but moderate constructivism incorporates aspects and strategies that co-exist with other approaches; in particular it is in harmony with cognitive learning. Constructivism is founded on the tenet of personal experiential learning.	There is scope for creative product and environment design across the spectrum of learning theories.	Customization transcends boundaries and is practiced across the spectrum: it occurs in behaviourism by branching and adaptivity (program-controlled); it is inherent in ITSs (AI) which address individualisation by student models; CDT individualises by learner-control in selecting content and performance type; cognitive learning systems include branching, often student-controlled
Moderate constructivism is impacting increasingly on education in the form of project-based learning and -assessment.	Yes, provided that 'bells and whistles' special effects do not distract from the primary instructional purposes.	Very common
By definition - in particular by providing multiple perspectives on the topic.		Its basic purpose is to produce learning directed toward the individual
Not always	Usually	Depends on the application domain
Constructivism subscribes to assessment which differs from the conventional forms.	N/A	N/A
Recognises intrinsic motivation.	The main purpose of creative instruction is to motivate, engage and engross learners	Learner-control increases the affective and motivational utility of a learning experience
Learners are explicitly exposed to complexity; however, educators should ensure that support is provided in managing complexity.	The process of communicating complexity can well give rise to creativity.	Learners frequently find their own way through complexity.
Yes	Yes	Yes
Real-world value is an explicit goal.	Depends on the application	Depends on the application

The examination in Table 4.8 preceding indicates how the different elements of the metamodel fulfil different roles in meeting the nine selection criteria. All these may not necessarily be present at the same time, and a researcher would do well to make a selection of appropriate requirements for a particular instructional system / learning event, which, in turn, would be reflected by greater emphasis of certain C-elements within that system/event/environment, according to its requirements, subject domain, and context.

Various ways of implementing the six different elements of the framework are addressed in Chapter Six.

4.6 The Hexa-C Metamodel compared to Duchastel's challenge for a single theory of ID and Reigeluth's new paradigm of ISD

In Chapter One, Section 1.4.3, it was stated that *Reigeluth's new paradigm of ISD* (Sections 2.6 and 3.6) and *Duchastel's call for a full theory of instructional design* (Section 3.7) were catalysts for this study.

This study cannot be viewed as proposing a single, full theory of instructional design in response to Duchastel's (1998) challenge. The proposed framework, though useful for instructional designers and instructor-designers, is not a single theory of instructional design - it is not even a partial theory, since it does not attempt to propose any systematic model for the preparation of instruction and training.

However, it does represent an attempt to identify a set of theoretical and practical features as characteristics desirable and appropriate for effective learning and instructional environments and products, in line with the ethos of Reigeluth's new paradigm (1996a; 1996c; 1999). In view of this, Table 4.9 compares and contrasts aspects of the HCMm with Reigeluth's new learning-focused paradigm and Duchastel's prolegomena.

Table 4.9 Comparison and contrast: Hexa-C Metamodel, Reigeluth's new paradigm, and Duchastel's prolegomena			
Aspect	**Reigeluth's new paradigm**	**Duchastel's prolemena**	**Hexa-C Metamodel**
Goal	Learning-focused instructional theory, as well as broad variety of instructional-design theories and models in Reigeluth's Volume II (1999)	Calls for a full and comprehensive theory of instructional design to cover all domains and encompass all processes.	Integration of theories and practices from cognitive family to support effective learning. To be generally applicable to learning environments and materials/resources.
Defines instructional design theory as	Instructional design theory is concerned with characteristics of the instruction and its methods, not with processs used to develop instruction	A theory of instructional design is an organized set of prescriptions to help with preparation of instruction, i.e. a procedural model for planning execution of instruction.	Supports the Reigeluth view; Hexa-C is not an organized set of principles for the preparation of instruction - rather it comprises a set of inter-related stances and characteristics for effective learning.
Theory-method relationship	All the theories implement the basic methods, but by variable strategies and methods, cross-paradigm, using different terms. New theories should not replace predominant paradigms but should incorporate their strengths.	Rejects pluralism & calls for single theory. In particular, behavioural, cognitive, and constructivist learning should be integrated into a compre-instructional design theory.	Uses techniques and skills so as to transcend paradigms
Stance on learning	Learning is accomplished in environments that provide: Challenge under guidance; Empowerment with support; Self-direction within structure.	Learning theory is a descriptive science for learning processes, with scope for potential unification, which could facilitate associated consolidation in ID theories.	Moderate constructivist persuasion; tempered by the guidance stance of cognitivism.
Key features and methods	Customization, individualization, autonomy, and learner-as-king; Cooperative relationships, shared decision-making, and networking; Diversity and learner-initiative; Holistic approach; Process-oriented	Motivation achieved inherently, by means of authentic instruction that capitalises on natural curiosity.	Customization, learner-centric; Collaborative learning; Creativity and novelty; Uses components to teach basic knowledge and skills

Table 4.9 Comparison and contrast: Hexa-C Metamodel, Reigeluth's new paradigm, and Duchastel's prolegomena
(continued ...)

Practice of learning	Learning-focused theory should use the wide variety of current methods (PBL and project-based) as well as earlier (tutorials, simulations, etc.) Decisions taken during instruction	Certain goals are best accomplished by strong sequencing and high control; others require flexible, less rigid instruction. Key decision: when to switch?	Uses basic methods and components to achieve automaticity in subskills and knowledge units. Strong constructivism in appropriate situations
Roles	Roles of designer and teacher converge. User-designers (learners and facilitators) play decision-making role in designing and creating learning environments and materials.	Instructional designer to remain clear of content decisions. Subject-matter expert and instructional designer are different persons; there is no mention of user-designers.	Optimally, designer and facilitator are same person, i.e. an instructor-designer, rather than an instructional designer.. Users are designers in selecting content and strategies from options
Beliefs and values	Philosophies and values influence learning goals and methods used. Diversity of values results in different instructional approaches. Different kinds of learning should be addressed - such as character education, attitudes, HOTS and cognitive strategies	Differences between paradigms are due to the underlying values of theorists. This influences what is taught, beliefs about learning, and views on instruction.	Proposes cross-paradigm use of stances: - Integrating where appropriate; and - Using in tandem for different kinds of learning, where appropriate.
Ideal theoretical approach	The variety of learning-focused theories in Reigeluth Volume II (1999) allows practitioners to select theory or model that best fits the situation.	Principles to determine a single theory of ID: Determine and explain nature of learning. Characterise process and products that shape learning experience. Subjugate content to instructional function without artificial motivation. Form general rules of instruction. Situate and confront - as an integral part of scientific progress.	Accepts the separate existence of various theories but defines a model (or abbreviated theory) to integrate the strengths of learning-focused theories.

4.7 Conclusion

This chapter has discussed underlying theories and characteristics of learning experiences that support effective learning and facilitate the task of the educator. The study is aimed at the context of educational practice with its contemporary pervading themes of social learning; authentic problem-solving; and interactive technology, both as a tutor and as a tool. Based on studies of the literature and textual filtration techniques, Chapter Four proposed an answer to the first research question in Chapter One, by putting forward a compact synthesis in the form of a framework of theories and characteristics that emerged when current learning/instructional theory and characteristics of practice and learning experience were filtered through effectiveness criteria. The resulting framework, called the HexaC Metamodel, comprises six interrelated and synergistic theories and stances, namely: cognitive learning, collaborative learning, components, constructivism, creativity, and customization.

The prime focus of the HCMm is interactive learning, frequently via online, technologically-enabled learning experiences and resources. It is also applicable to learning events not necessarily delivered via, or mediated by, computer or the Internet, but where learners use technology as tools and facets of general learning. With this in mind, Chapter Five presents case studies in which the Hexa-C Metamodel, with its constituent elements, is applied to three learning events to evaluate them from the perspective of learning theory.