Design of Technology-Enhanced Learning

Integrating Research and Practice

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By

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INVESTOR IN PEOPLE

Contents

To my wife, who cared not one iota about what I was writing, but generously and kindly made it possible for me to write it.

To my boys, Dan and Zac, who are the apple of my eye.

To educators and researchers everywhere who put their heart into what they do.

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Preface

Technology is changing everything in our world, including education. People have the ability to access information and communicate anytime and almost anyplace through a range of increasingly powerful and easy to use apps. In education, technology enables students and teachers to rapidly collect data, represent knowledge, share perspectives, digitally construct, and collaborate from almost any location. However, too often the use of technology for learning is presented as a panacea that will solve all educational ills. The reality is that simply using contemporary technologies in education does not guarantee a successful lesson, and in fact, using technology poorly can render a learning experience confusing and meaningless.

As technologies change, it is crucial that educators (school teachers, academics, pre-service teachers, and educational designers) respond in a principled fashion based upon a deep understanding of pedagogical issues, rather than haphazardly based on intuitive or superficial reasoning. Maintaining a focus on pedagogical issues means that educators can avoid being distracted by the novelty of new technologies and concentrate upon how each technology is influencing interaction and learning. Accordingly, in order to develop an accurate and confident command of technology-enhanced learning issues, educators need to understand the research of the field. Similarly, if learning technology researchers want to have far-reaching positive impact, their work needs to penetrate beyond the surface technological features through the underlying learning and teaching issues at stake. Understanding the key issues and research across technologies enables researchers to accurately position their work and demonstrate how it is making a contribution to the field overall.

As a teacher educator and educational researcher specializing in the technology area, I frequently lamented that the technology-enhanced learning literature was disorganized and disparate for educators who wanted to utilize it. This was a problem because most educators simply do not have time to find and distil

learning technology research relating to their area of focus. Why wasn't there a single resource that synthesized the key learning technology literature in a way that educators could immediately apply? At the same time, educational technology researchers are incredibly time-poor, and while they have immense expertise in their specific sub-areas, the breadth of the technology-enhanced learning literature means that it can be difficult to acquire an accurate sense of the empirical research as a whole. This is particularly true when it comes to understanding research relationships between different technological platforms from an educational design and practice perspective.

This book directly responds to these maladies by drawing technology-enhanced learning research and practice closer together. It does this by synthesizing the general and empirical learning technology literature to clearly identify the key educational potentials, issues, and design considerations relating to technology-enhanced learning. By examining this synthesis of research findings, educators can immediately adopt an evidence-based approach in their designs, and researchers can instantly position their work within the broad context of technology-enhanced learning field.

ABOUT THIS BOOK

This book has been designed to enable readers to construct an integrated understanding of the key issues surrounding technology-enhanced learning design. Chapter 1 considers the broader context of designing for learning using technology, including its key drivers at school and university levels. Without an understanding of the broader context, it is impossible for educators and researchers to reliably situate their work in a way that responds to social needs. An understanding of the broader socio-political context can also provide motivation for the use of technology in learning. However, the importance of adopting a critical approach to the design of technology-enhanced learning is emphasized.

Chapter 2 briefly introduces the Technology Pedagogy And Content Knowledge (TPACK) framework as a tool for structuring educator thinking. Technology, pedagogy, and content are indeed essential aspects of technology-enhanced learning design, and a focusing on these elements has undoubtedly led to the popularity of the TPACK model. However, the chapter also poses critical reflections on the TPACK framework in terms of its ability to support learning design practice.

In order to establish a solid conceptual foundation for analyzing technology-enhanced learning, Chapters 3–5 provide a general overview of pedagogy, technology, and content, respectively. Educators and researchers need to have an overarching understand how pedagogy operates on different levels, and the different types of pedagogies at each level, if they are to effectively analyze and utilize different types of technology in education (Chapter 3). Similarly, both educators and researchers need to have general frameworks for thinking about technology selection and utilization, which is why the concept of affordances and multimedia learning effects are interrogated in Chapter 4. The content that we teach and assess may be represented and shared in different ways using technology, and these issues are explored in Chapter 5.

Chapter 6 builds on previous chapters to unpack design thinking – what it involves and why it can be hard to learn. Importantly, teaching is positioned as a design science. Design is the nexus of scientific and artistic thinking, whereby novel and intrinsically valuable solutions emerge based on integrative knowledge. Seeing teaching as a design science helps educators and researchers to maintain a focus on understanding the elements that are most important to the design of effective learning tasks and the processes that help educators to optimize their designs. The field of Learning Design is also introduced, including the various ways it can support educators' design work.

Chapters 7–10 provide comprehensive overviews of educational research relating to Web 2.0, social networking, mobile learning and virtual worlds, respectively. These open, freely available, and relatively easy-to-use technologies have been deliberately chosen for analysis because they are contemporary, have been widely used in education, provide considerable design flexibilities, and have an extensive research base relating to their use. They are also quite different, which means they are interesting to compare and contrast from an educational and research perspective. The benefits, constraints, and design findings for each technology are distilled from the literature, and use cases ('vignettes') are also detailed to offer a clear understanding of issues surrounding learning technology utilization. Research relating to higher education and schools has been integrated on the basis that there is valuable knowledge that can be transferred between each area, though examples have been separated according to educational level so that readers can choose to focus on either university or school use cases if they wish.

It is important to note that the Web 2.0, social networking, mobile learning, and virtual worlds chapters were composed using a systematic methodology. First, search terms appropriate to each technology were used to scour educational research databases so as to source relevant literature. Papers were selected for inclusion based on the extent to which they constituted high-quality empirical research relating to the design and utilization of technology for learning purposes. A 'snowballing' approach was used, whereby relevant references from within selected papers were also considered for inclusion in the review. The benefits, issues, and design implications of all selected papers were then distilled and organized into themes for each technology. This systematic approach was adopted for each technology so that educators and researchers could have confidence that the emergent findings encapsulated the key issues surround technology-enhanced learning design.

Conducting a comprehensive and systematic analysis of Web 2.0, social networking, mobile learning, and virtual worlds also served as the basis for abstracting patterns and principles of technology-enhanced learning design in Chapter 11. By comparing and contrasting the benefits, limitations, and design implications of different technologies it is possible to detect patterns that hold across technologies, but also the nuanced differences of the technologies in application. Then in Chapter 12 future directions of the learning technology field are considered, in terms of the impact of technology trends, the critical role of the teacher, and the need for integrating technology-enhanced learning research and practice.

FOR WHOM IS THIS BOOK USEFUL?

By integrating technology-enhanced learning research and practice, this book is designed to be useful for practicing educators, pre-service teachers, postgraduate education students, and learning technology researchers.

Practicing Educators

Practicing educators (academics, school teachers, as well as educational designers) are often looking to extend beyond the anecdotal 'folk pedagogy' that pervades some institutions, and to understand how the research evidence can inform the approaches they would like to adopt. They also often want to know the

technological options available to them, and are looking for great design ideas. This book addresses these needs.

Pre-Service Teachers

If our teachers of the future are to be of the highest caliber, they need to adopt a scholarly approach to their study and practice. This book very definitely shifts the focus of pre-service teacher education from a 'how-to' operational emphasis on technological skills to a more research-driven approach. As well, instead of referring pre-service teachers to research papers that often contain methodological and theoretical discussions that are not directly relevant, and that provide no explicit connection to one another, this book presents an integrated narrative that is immediately applicable to teachers in training.

Postgraduate Education and Higher Degree Research Students

Students completing postgraduate studies and higher degree research in education often desire a concentrated overview of the literature relating to technology-enhanced learning design, which explains how principles from general educational theory have been applied within the learning technology field, and also the empirical findings as they relate to the use of different technological environments. This book satisfies these requirements for them.

Learning Technology Researchers

Learning technology researchers often want to quickly identify the benefits, issues, and design findings that relate to a particular technology or technologies, and this book provides them with an immediate reference. For instance, a researcher interested in motivation or community building or digital skills or peer feedback can quickly identify the key effects for Web 2.0, social networking, mobile learning, and virtual worlds, with links back to the underlying literature. Systematically abstracting themes across technologies in this book also constitutes new knowledge for the technology-enhanced learning field, enabling researchers to acquire a more accurate sense of the literature and better situate their work. The range of practice considerations outlined in the book may also assist researchers to better respond to the real issues confronting educators and hence optimize the impact of their technology-enhanced learning research.

FORWARD REMARKS

There is often a lamentable divide between academic research and coal-face teacher practice, as though either research alone or field-based expertise hold the crucible of pedagogical wisdom when it comes to educational technology utilization. The approach adopted by this book is that research and practice are mutually informing, inextricably valuable to each other, and need to be synergistically applied in order to achieve the best educational results. In order for the technology-enhanced learning field to make greatest progress researchers and practitioners need to be working more closely together, and indeed position themselves as both educators and researchers.

We are in an exciting time in history, challenged by both increasingly rapid changes in technology and mounting pressure to prepare students for an unknown future. By offering an evidence-based and integrated portrayal of how technologies affect learning, this book is designed to provide a common foundation for educators and researchers to confidentially respond to contemporary technological and pedagogical challenges together. I hope you enjoy the book and find it useful, and I welcome your comments and feedback.

Acknowledgments

There are several people and organizations that deserve thanks for their help in making this book a reality. Extensive thanks goes to Professor John Hedberg for his wise feedback on drafts of this book and his kind-hearted mentorship over many years. Dr Michael Stevenson also deserves immense thanks for his detailed and insightful advice on the manuscript – it is a privilege to work with such a talented educator and rising-star researcher. Thank you also to Karen Woo, who generously provided ideas and suggestions on early versions of this book.

Throughout my career, there have been several eminent learning technology experts who have serendipitously conspired to support me, without thought for personal recompense. These include, but are not limited to, Professor Diana Laurillard, Professor Peter Goodyear, Emeritus Professor Tom Reeves, Professor Peter Albion, Professor Barney Dalgarno, Professor Gregor Kennedy, Professor Lori Lockyer, Professor James Dalziel, and of course, Professor John Hedberg. Enormous thanks to each of you for your generous guidance over the years, and more broadly for the positive contribution that you have made to the field of technology-enhanced learning.

Thanks also to Macquarie University for kindly providing me with a six-month sabbatical to write this book. And finally, thank you to the team at Emerald Publishing, who have the open-mindedness to support the books that academics want to write, and the experience to bring them to fruition.

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Foreword

In this book, Matt has successfully coalesce the processes, design ideas, and recent research into a coherent framework that can provide guidance to teachers and academics who seek to maximize the impact of the wonderful technologies and tools we have in modern education. Matt explores the influencing theories and links their contributions to a range of research topics. He seeks not to fall into formulaic approaches or algorithms of the earlier learning sciences, but rather to clearly explore the nuances of design options. When exploring the range of technologies that can be interwoven in modern learning design, he investigates recent technologies that have had successful research studies around them to ensure that the discussion is well argued with evidence and exemplars of effective practice.

The discussion is carefully situated in contexts that employ interesting mixes of technology, pedagogy, and well-chosen theoretical ideas. The discussion links new ideas that underpin recent clever innovative exemplars. Great learning designers will use the ideas in this book to generate learning activities that are innovative and award winning. Activities that effectively employ the attributes of technologies, links to theories of their best design and how they support learning in different curriculum contexts.

John G Hedberg
Sydney, 2017

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CHAPTER

6 Design Thinking and Learning Design

ABSTRACT

This chapter unpacks 'design thinking' as it relates to educational design, and highlights how developments in the field of Learning Design may be of assistance to educators. Design is defined as a creative, scientific, and complex process, underpinned by several design thinking qualities. Teaching, it is argued, should be positioned as a design science, based on its nature, practice, and intentions. Learning to design is characterized as a challenging pursuit that is supported through practice, refection, examples, and expert guidance. Based on the literature, the pursuit of designing for learning is explained as a process involving the creation of accessible and aligned designs that cater to students in order to achieve desired learning outcomes. Educational design models by Laurillard, Siemens, and Conole are contrasted and evaluated in order to critically reflect on the general utility of such models. The field of Learning Design is introduced as a discipline area that aims to help educators develop and share great teaching ideas. Six approaches that support the description and sharing of learning designs are briefly described (technical standards, pattern descriptions, visualizations, visualization tools, pedagogical planners, and the Learning Activity Management System) so as to illustrate how the Learning Design field has evolved and how educators can capitalize upon it. Directions forward are recommended, which center around reflection, collaboration, and a design orientation.

Introduction to Design Thinking and Learning Design

The design phase is where educators draw together their technological, pedagogical, content, and contextual knowledge to create synergistic solutions to educational problems. But the million dollar questions are how should educators go about design, and what does it involve? In order to address these questions we will be taking a broad look at design both generally and with relation to education.

This chapter starts by examining what design actually is and what design thinking involves. This is useful because it enables us to draw from what is known about design across the disciplines and utilize it in education. We will also consider why design is particularly hard to learn and what is known about how design capabilities are most effectively developed. After having laid these general foundations, we will turn our attention to the field of education to scrutinize what designing for learning involves based on design models and conventional wisdom from the field. The field of Learning Design is then introduced, and techniques for representing learning designs critiqued. This allows us to learn from the developments and thinking approaches of the field and critically understand how it can be best utilized in practice.

A reflective rather than accepting approach is adopted and encouraged, based on the assumption that all design knowledge needs to be applied in context. That is, this book resists the temptation to provide a lock-step set of algorithms for design. Why? Because that's not how either good science or good art occurs. Good design is neither linear nor mechanistic – otherwise we would get robots to do it. Rather than adopting a paint-by-numbers approach to design, this book acknowledges the educator as the situated expert who, with a deep understanding of the design issues and context is perfectly positioned to create the right tasks for their students. But in order for this to occur educators need to have a deep understanding of design generally and as it relates to education.

So let's start by asking: what exactly is design all about?

What Is Design?

Design has been simply and seminally defined as devising "courses of actions aimed at changing existing situations into

preferred ones" (Simon, 1996, p. 111). Although concisely stated, this definition encapsulates key aspects of design, namely that design involves purposeful activity, it involves some form of creative transformation, and it is a value-laden pursuit. Alternately, Charles Burnette, a forefather of the Design-Based Education movement, defines design as:

> … a process of creative and critical thinking that allows information and ideas to be organized, decisions to be made, situations to be improved, and knowledge to be gained. (Burnette, 2005, para. 2)

In contrast to the more behaviorist definition of Simon, Burnette's definition places greater emphasis on the fundamental thinking processes that underpin design practice and its intrinsically constructive nature for the designer.

Design encompasses both art and science. Löwgren (2005) distinguishes between creative design and engineering design, stating that creative design is a more personal and unpredictable process resulting in the creation of many parallel ideas and concepts, whereas engineering design involves finding solutions to precisely defined problems. Importantly, in an attempt to dispel negative connotations associated with creative design processes and promote its intellectual rigor, Wolf, Rode, Sussman, and Kellogg (2006) point out that rather than being diametrically opposed, engineering design often involves elements of divergent and artistic production while creative design often contains structured practice and scientific reflection. That is to say, no matter the domain we should always expect design pursuits to involve both creative and scientific thinking.

Design tasks are ill-structured or even 'wicked' in nature. The aim of design is to find an optimal solution to satisfy multiple criteria within determined constraints, yet in reality goals and parameters of the design problem are rarely completely defined (Jonassen, Howland, Marra, & Crismond, 2008). The ill-structured nature of the problem means that the problem and the solution actually co-evolve, with the information designers need to know about a problem only revealing itself as they try to solve it (Cross, 2006; Dorst, 2006). Another challenge of design is that because design problems have multiple solutions rather than a single 'right' answer it is not possible to verify a design as being 'correct,' meaning that there is no inbuilt condition under which a designer knows they must stop (Jonassen et al., 2008).

Yet, design problems are among the most common problems that confront us every day, with literally millions of possible design tasks of many different levels of scale. In our daily lives we may need to design an invitation, or a room layout, or a way to stop a tap from leaking. In industries outside education people design products, systems, processes, models, or more tangibly items such as a software program, advertising campaign, or lunch order system (Jonassen et al., 2008). In education we may design a new lesson resource, or module of work, or curriculum, or school system. Design problems abound.

Design solutions typically attempt to please the recipients of the design, making design a highly interpersonal phenomenon (Jonassen et al., 2008). The designer's interpretation of the aims and context of a design task may not directly align with the value system of the reviewer of a design, and thus objective assessment of designs is often difficult. Yet, tantalizingly, there can be a large degree of alignment between judges of design (Greg Kress & Sadler, 2014). That is to say, even though good design is often hard to describe and quantify, we often know it when we see it.

Design can be characterized, conceptualized, experienced, and valued in many different ways. Design has been characterized as an exploratory, emergent, ambiguous, opportunistic, abductive, risky, reflective, and persuasive practice (Cross, 2006). Design processes can be conceptualized and experienced as evidence-based decision making, organized translation, personal synthesis, intentional progression, directed creative exploration, and creative freedom (Daly, 2008). Values that underpin design include ingenuity, practicality, empathy, and a concern for appropriateness (Cross, 2006). Thus, design is a complex phenomenon that may take on many different forms and functions depending on the context.

Designing and Design Thinking

'Design thinking' constitutes a focus on the fundamental thinking skills that underpin design. Recently, there has been considerable interest in developing the creative problem solving capabilities of people in ways that can be applied across disciplines. Research and inquiry in the area of design has shed light on the nature of design thinking, which can be summarized as follows:

1. *Design thinking is solution focused.* While attempting to solve 'ill-defined' problems designers use constructive

modes of thinking that focus more on the solution than the problem (Cross, 2006).

2. *Design thinking is user focused*. Designing inherently involves anticipating the tastes of the user in an attempt to provide them with an aesthetically pleasing and satisfying experience (Tonkinwise, 2011).
3. *Design thinking requires frequent reframing of the problem*. The frame of the problem, which can be thought of as the mental scaffolding around which designers build their solution (Greg Kress & Sadler, 2014), is frequently adjusted according to emergent criteria, priorities, foci, and constraints of the problem and solution space (Dorst, 2006; Dorst & Cross, 2001; Tonkinwise, 2011).
4. *Design thinking leverages previous design knowledge*. All design involves a degree of re-design insofar as it builds upon design knowledge from the past, meaning that in order to optimize design performance we should aim to understand previous design efforts (Meinel & Leifer, 2014).
5. *Design thinking necessitates prototyping*. Making tangible design artifacts, for instance prototypes, is crucial in order develop design ideas and to communicate our thinking (Meinel & Leifer, 2014).
6. *Design thinking involves exploring for creative bridges*. Design involves a creative search for mental bridges between previously unrelated elements of the problem space and solution space, often resulting in 'aha' moments of resolution (Cross, 2006; Dorst, 2006; Dorst & Cross, 2001).
7. *Design thinking requires flexibility*. Good designers are less likely to become fixated on a poor solution, are opportunistic, and are able to move fluently between design activities (Cross, 2004).
8. *Design thinking demands a tolerance for ambiguity*. Preserving a sense of ambiguity throughout the design process is important in order for new and potentially better ideas to emerge (Meinel & Leifer, 2014).
9. *Design thinking involves learning*. Because the problem is never entirely defined and the solution is not initially known design thinking necessarily involves learning (Dorst, 2006).
10. *Design thinking is ultimately social*. Even if design does not occur in teams it is ultimately social because design activities inevitably return to a human-centric point of view (Meinel & Leifer, 2014).

Researchers have noticed some other interesting phenomena surrounding design. One may suspect that good design involves the ability to manifest an almost endless array of design ideas, but actually too many solutions (as well as too few) appear to constrain the quality of creative design (Cross, 2004). Good designers will often arrive at an overall principal solution concept (but not solution) that drives the design process (Cross, 2004). Often designers, particularly expert designers, will base their solution concept upon apparent paradoxes within the design problem (Cross, 2004; Dorst, 2006). Thus, good design appears to involve striking the right balance, embracing challenge, and identifying promising lines of inquiry.

Why Conceptualize Teaching as Design?

Design fields such as engineering, computer science, and architecture can be distinguished from the natural or social sciences by virtue of their purposefulness – whereas natural sciences are concerned with how thing are, design sciences focus on how things should be (Laurillard, 2012; Simon, 1996). Noteable educational scholars provide articulate arguments for why teaching should be conceptualized as design. For instance, Laurillard explains:

> A design science uses and contributes to theoretical science, but it builds design principles rather than theories, and the heuristics of practice rather than explanations, although like both the sciences and the arts, it uses what has gone before as a platform or inspiration for what it creates. Teaching is more like a design science because it uses what is known about teaching to attain the goal of student learning, and uses the implementation of its designs to keep improving them. (2012, p. 1)

So for Laurillard (2012), teaching is a design science because its fundamental nature involves moving beyond what is known to purposefully and analytically reify what should be.

Kimber and Wyatt-Smith (2006) describe this role of teacher as designers more specifically through analogy with architecture:

> Through the metaphor of design … teachers are positioned as architects of classroom experiences, balancing the development of multiple literacies and designing a learning environment where appropriate computer-based

> cognitive tools are applied imaginatively to collaborative, student-focused, reflective, problem-based approaches to learning …. (Kimber & Wyatt-Smith, 2006, p. 28)

From Kimber and Wyatt-Smith (2006) we can see how the actual day-to-day practice of teaching constitutes design.

Taking a big picture view, Gunther Kress (2000) sees design as a means of engaging social transformation:

> Design shapes the future through deliberate deployment of representational resources in the designer's interest. Design is the essential textual principle and pedagogic/political goal for periods characterized by intense and far-reaching change. (Kress, 2000, p. 160)

According to Kress (2000), while educators are designing in the moment they are working toward preferred futures, potentially on a grand scale. Taken together these three perspectives highlight how teaching is a design science in nature, practice, and intentions.

The Challenge of Developing Design Thinking

Conceptualizing education as design is useful insofar as it can inform how we approach and think through our practice. However, if we are to consider teaching as design there are several conundrums we must confront when attempting to develop design capabilities, as originally outlined by Schon (1987) and more recently argued by Koehler and Mishra (2005):

1. Design is an holistic skill
2. Design depends on recognition of design qualities
3. Design is a creative process whereby the designer arrives at novel ways of seeing and doing, meaning that no prior description can take the place of learning by doing
4. Descriptions of designing may be initially perceived as confusing, vague, ambiguous, or incomplete
5. There are usually multiple gaps between the initial design conception and the process of achieving the final design.

Given these complexities, how should people go about developing their technology-enhanced learning design capabilities? The

perhaps obvious answer, which accords with themes raised in Chapter 2, is that the most direct way to learn about design is through design. Design tasks that require educators to develop an understanding of the complex interrelationships between artifacts, users, tools and practices help teachers to develop a more flexible understanding of how technology can be used for learning and teaching (Koehler & Mishra, 2005). Through design, educators learn about the affordances and constraints of technologies and their context sensitivity (Mishra & Koehler, 2006). When designing, educators learn about the eclectic and complex nature of design, in an experiential way that cannot be taught purely by lectures and demonstrations (Koehler & Mishra, 2005).

Exposure to examples can also support design by enhancing creativity. For example in one study, Kulkarni, Dow, and Klemmer (2014) found that early exposure to examples significantly increased the creativity of novice designers. Additional exposure to examples in-between prototyping activities further increased creativity. Though it should be noted that exposure to examples can increase conformity of thinking, so designers and design educators should apply this strategy judiciously (Kulkarni et al., 2014).

Reflection plays a key role in influencing how much can be learned through design processes. Schön (1987) famously analyzed and conceptualized design-based learning through observations upon an architectural design studio, and argued that design skills are best developed through 'reflection-in-action.' Whereas 'knowing-in-action' refers to the sorts of everyday know-how that we reveal in our intelligent action, and 'reflection-*on*-action' involves thinking about our actions (either past or present) without influencing them, 'reflection-*in*-action' is where in-situ events cause us to reflect upon our knowing-in-action and adjust our activity so as to explore, test, or affirm our evolving understanding (Schön, 1987). In order to learn to design, we need to reflect while we design, so as to take advantage of the intrinsic learning and optimization opportunities embedded within our moment-by-moment design practices.

Additionally, Schön (1987) points out that we also learn about design by observing and working with expert designers. Working with good designers allows us to move beyond superficial processing of design knowledge, to internalize design principles, and develop an embodied understanding of what it is to be a designer. This process often requires learners to assume an open-minded stance where they temporarily suspend disbelief

and explore the value of views express by others during design conversations (Schön, 1987). This social and constructive view of learning how to design is in contrast to the more rational and reductionist approach to design proposed by Simon (1996; see Cross, 2006, for an elaboration of this point). In practice, all the strategies above (undertaking authentic design tasks, drawing from design examples, adopting a reflective approach and consultation with experts) can be applied together in order to enhance design performance.

Designing for Learning

So if teaching is a design science, what does conventional wisdom say that designing for learning actually involves? First, let's clarify what we mean by 'designing for learning.' Beetham and Sharpe (2013a) define 'designing for learning' as:

> a process by which [educators] arrive at a plan or structure or designed artifact for a learning situation or setting. The situation may be as small as a single task, or as large as a degree course. In a learning situation, any of the following may be designed with a specific pedagogic intention: learning resources and materials; the learning environment; tools and equipment; learning activities; the learning program or curriculum. (Beetham & Sharpe, 2013a, p. 8)

The phrase 'designing for learning' is appropriate to use because it maintains the focus on the learner and our intentions to create designs that provide the optimal conditions for learning to occur (Dalziel et al., 2016; Laurillard, 2012).

Designing for learning is chiefly concerned with the design of good learning tasks – suggestions of what people should do in order to achieve intended learning outcomes (Goodyear & Carvalho, 2013). At this point it is important to make the distinction between a learning *task* and learning *activity*. A learning task is what educators design in advance for learners to do, whereas a learning activity is what actually takes place during the course of a lesson (Goodyear, 2005). It is critical to recognize that design works indirectly – although educators may design tasks in ways to promote certain sorts of activity, learners have scope to act in unintended ways during learning activities (Conole & Jones, 2010; Goodyear & Retalis, 2010). Thus,

learning can never be wholly designed, only designed *for* (Beetham & Sharpe, 2013a; Laurillard, 2012).

Good design is a complex, skillful, and time-consuming pursuit that requires synergistic consideration of people, tasks, and tools as inputs into activities (Goodyear & Retalis, 2010). Good design is crucial in education because much of the learning that students undertake is without direct supervision, meaning that learners only have designed instructions, artifacts, and scaffolding to guide their activity (Goodyear & Carvalho, 2013). The scope of educational design is quite broad, because it not only involves designing learning tasks but also supportive learning environments (Goodyear & Retalis, 2010). Good educational design incorporates all of the design thinking skills identified earlier in this chapter, but also builds upon and customizes that knowledge to directly relate to learning and teaching.

As well, deep consideration of the context is essential in order to design for high-quality learning (Boyle & Ravenscroft, 2012). This is problematic when generally discussing designing for learning because it is not possible to discuss every learning context (although the chapters to follow examine specific learning environments and example tasks). As a general grounding, four high-level concerns that relate to any educational design context are discussed below.

UNDERSTANDING AND CATERING TO STUDENTS

One of the challenges of designing for learning is that while there are general principles and theories from which educators can draw, the remit of the teacher is to create the conditions for learning that are specific to their students in their particular context (Laurillard, 2012). This involves imagining other people's learning and how they will respond to tasks (Goodyear & Retalis, 2010).

Learners have a range of attributes that warrant consideration. These include their subject-specific understanding, experience, motivations, expectations, preferences, interpersonal dispositions, access needs (including due to disabilities), familiarization with learning mode, and digital literacies (Beetham, 2013). These characteristics are intrinsically interlinked, for instance, learners of different dispositions and familiarities experience tasks quite differently when different technologies are involved (Beetham, 2013). The range of different learner attributes and their interconnected nature makes catering to learner variance a

considerable challenge (Beetham, 2013). In order to understand the characteristics of learners and the efficacy of previous designs, student learning data can become an important input into the design process (Sharpe & Oliver, 2013).

A core way that educators can cater to the multiplicity of different learner needs and interests in any class is by providing a variety of different tasks (i.e., 'differentiation'). The aim of differentiation is to provide appropriate levels of challenge and choice in order to optimize learning and motivation. Differentiation can be in terms of the content addressed (in terms of complexity and resources used), the processes applied (degree of interaction and student independence based on different pedagogies), and the products students produce (for instance using different media) (Fogarty & Pete, 2007). Technology can play a key role in facilitating the design and development of different learning pathways for students (Bower, 2012; Fogarty & Pete, 2007).

DESIGN OF TASKS ACCORDING TO INTENDED LEARNING OUTCOMES

Once the range of student needs have been identified and understood, educators can start to consider the sorts of tasks that they might design for learners. In formal learning contexts such as schools and universities, learning outcomes are often used as a starting point for design (Beetham, 2013). Based on the attributes of the students and the broader learning context, high-quality task designs promote learner engagement and challenge within a nurturing practice environment (Boud & Prosser, 2002). Effective designs foster both individual and social processes and outcomes (Laurillard et al., 2013).

Tasks may take many forms depending on the outcomes that need to be achieved. They may be *rule*-based (where students are required to learn a standard procedure), *incident*-based (where exposure to an authentic event helps to develop decision-making abilities), *strategy*-based (requiring courses of action to be planned), and *role*-based (where learning is achieved through assuming a role in a scenario-based activity) (Oliver, Harper, Wills, Agostinho, & Hedberg, 2013). Tasks can also vary according to their authenticity, formality, and structure, whether they require retention and reproduction versus reflection and internalization, the roles and significance of other people, and the locus of control regarding who makes decisions about learning activities and pathways (Beetham, 2013). Accordingly, there are many ways

that tasks may be actualized within different discipline areas depending on the learning requirements of the context.

ALIGNMENT WITHIN DESIGNS

Designing for learning operates at various levels of scale, from micro-level considerations of items such as specific technologies up to macro-level considerations such as institutional infrastructure (Conole & Jones, 2010; Goodyear & Retalis, 2010). Design is an iterative and multifaceted process whereby designers frequently switch between different levels and focus on different elements (Conole & Jones, 2010; Goodyear & Carvalho, 2013). While design may focus on different levels and elements at different stages of the design process, alignment between these levels and elements is critical for coherence and effectiveness (Conole & Jones, 2010; Goodyear & Retalis, 2010). For instance, it is important that the high-level pedagogy being applied aligns with the pedagogical strategies and tactics being used (Goodyear, 2005). Additionally, there needs to be an alignment between the learning outcomes, the learning tasks, and the approach to assessment (in accordance with Biggs & Tang, 2011, and as outlined in the previous chapter).

PROMOTING ACCESSIBILITY

Design needs to attend to the social and physical setting to ensure learners have effective access to resources (Goodyear & Carvalho, 2013). In accordance with the idea of differentiation, an important part of access involves considering students with disabilities or special needs. Building on the general concept of universal design (for instance, see Iwarsson & Ståhl, 2003), Universal Design for Learning (UDL) guidelines aim to provide all individuals including those with special needs equal opportunity to learn (Rose, Harbour, Johnston, Daley, & Abarbanell, 2006). Drawing upon findings from neuroscience, UDL is based on three principles:

1. *Providing multiple means of engagement* – through options for self-regulation, for sustaining effort and persistence, and for cultivating interest
2. *Providing multiple means of representation* – through options for comprehension, for language, mathematical expression and symbols, and for perception

3. *Providing multiple means of action and expression* – through options for executive function, expression and communication, and physical action.

There has been some initial work to integrate UDL and the TPACK model so that teachers understand how to synergistically integrate technology, pedagogy, and content in a way that caters to students with special needs (Benton-Borghi, 2013). For more information about UDL and designing accessible education generally, see the National Center on Universal Design for Learning website at http://udlcenter.org.

Understanding and catering to students, design of tasks according to outcomes, alignment within designs, and promoting accessibility constitute four foundational pillars of design thinking as it relates to education. Yet these pillars do not make any commitment about how an educational designer should go about the process of design. There are several design models that have been proposed in order to provide educators with guidance.

Educational Design Models

There are actually many models that have been created in order to support the design, development, and implementation of learning tasks and activities (we will refer to these as 'educational design models'). This section contrasts three of these by way of exemplification. While the summaries presented below are by necessity simplifications that do not attend to the detail contained within the models, they do serve to illustrate the range of possible considerations and approaches, as well as the variety of forms that guidance can take. Critical reflections on the models will be reserved until after all three have been presented.

THE CONVERSATIONAL FRAMEWORK

According to Laurillard's (2002) Conversational Framework, teaching involves facilitating an iterative dialogue with students that is discursive, adaptive, interactive, and reflective. Through iterative learning conversations, teachers describe theories and ideas that students describe back to them (discursive). Teachers also set goals for learning and students act upon those goals (interactive). Teachers will adapt the learning tasks in light of student ability, and students will adapt their actions in response to the ideas put

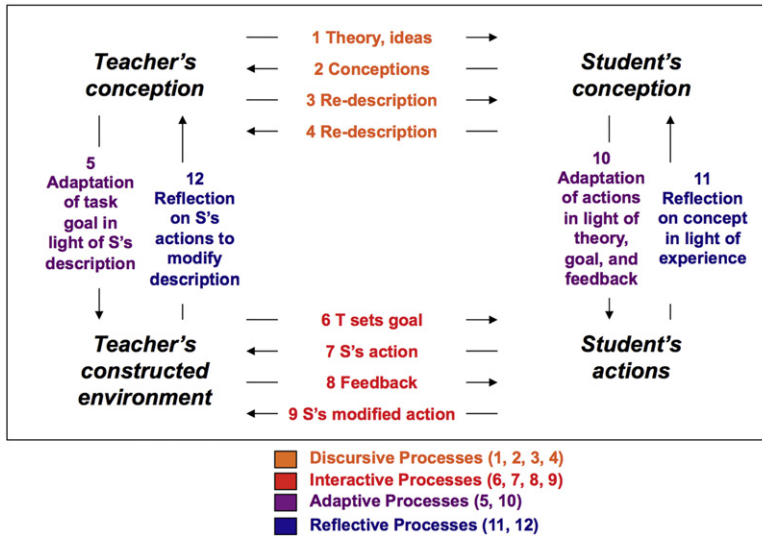

Figure 6.1. The Discursive, Adaptive, Interactive and Reflective Nature of Learning According to the Conversational Framework (Laurillard, 2002, p. 87).

forward by the teacher (adaptive). Students ideally reflect on their conceptions in light of their experiences, just as teachers preferably reflect on learner actions in order to modify the initial descriptions put forward (reflective). These transactions between students (S) and teachers (T) are shown in Figure 6.1, with numbering provided in order to help identify the nature of each process.

Laurillard (2002) proposes that different sorts of technologies can help to facilitate different types of activity. For instance, *narrative media* such as video broadcast and *communicative media* such as video conferencing can be used to support discursive processes, *interactive media* such as web and hypermedia resources can be used to support interactive processes, *adaptive media* such as simulations can be used to facilitate adaptive processes, and *productive media* such as modeling environments can be used to promote reflection. Note that according to the Conversational Framework multiple media types may support different types of learning processes, depending on the specific tools that are used.

THE LEARNING DEVELOPMENT CYCLE

Siemens (2005) suggests a Learning Development Cycle to cater for the more networked and ecological nature of contemporary

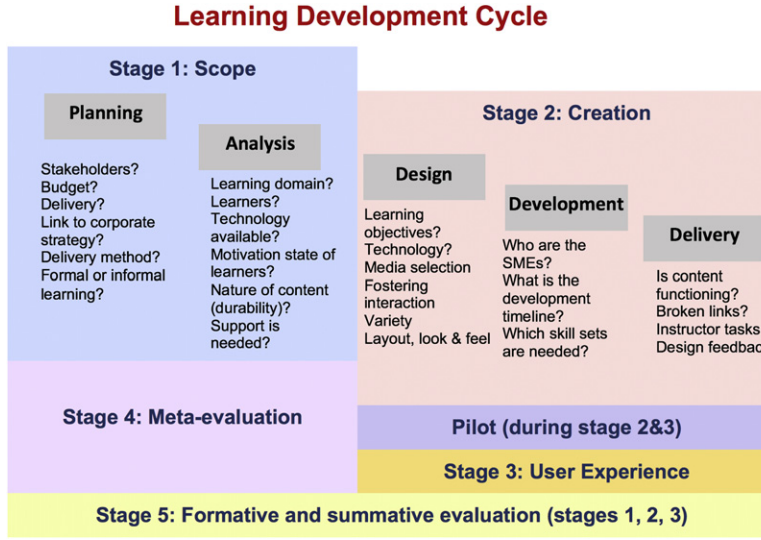

Figure 6.2. The Learning Development Cycle (Siemens, 2005).

learning. Learning is proposed to occur through teacher *transmission*, student-directed *acquisition*, reflective and reasoned *emergence*, and through situated and networked connectivist *accretion*. The Learning Development Cycle aims to provide a meta-model that accommodates the different approaches, intents, and desired aims of each of the ways of learning. It involves stages of Scoping (planning and analysis), Creation (design, development and delivery), User Experience (piloting and implementation), Meta-evaluation (reflecting on the effectiveness of the learning design process), and Evaluation of student learning and satisfaction (see Figure 6.2).

THE SEVEN CS MODEL

Conole (2015) proposes a 7Cs learning design framework that aims to shift the focus away from content provision to active and student-centered learning. It involves Conceptualizing the course in terms of forming a vision that is learner focused, thinking about how Communication will be facilitated, fostering mechanisms for group Collaboration, establishing ways for students to Consider and reflect upon their learning as well as enable teachers to assess student learning, Combining the different elements and perspectives cultivated throughout the design process, and

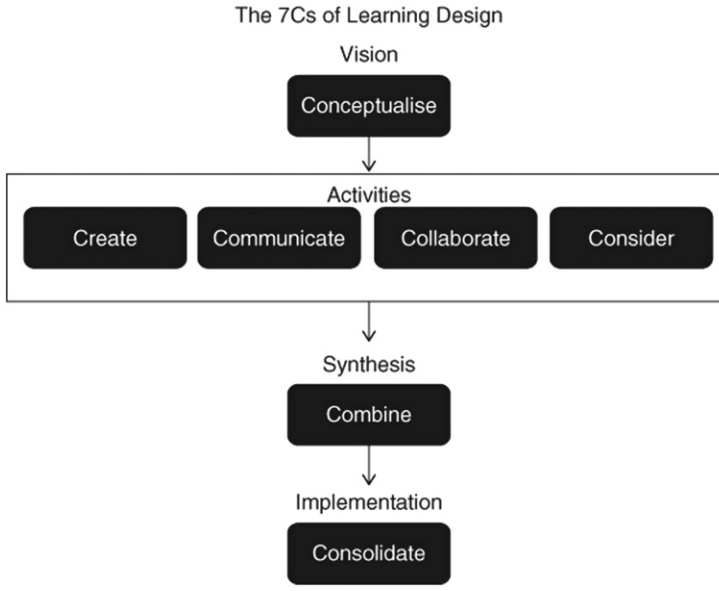

Figure 6.3. The Seven Cs Model (Conole, 2015, p. 119).

Consolidating the design in a real-life context and evaluate its effectiveness (Conole, 2015). The arrangement of these components is shown in Figure 6.3. A variety of established educational theories, principles, practices and examples are suggested in the detailed explanation of each 'C.' Reference to technology throughout the model stages occurs at the Create stage.

The models presented above are but three of numerous educational design models that have been proposed over the last two decades. Other model include the 4 Component Instructional Design Model (Van Merriënboer, Clark, & De Croock, 2002), Design Thinking for Educators (IDEO, 2012), The Practitioners Guide to Technology Pedagogy and Content Knowledge (Hofer et al., 2015), to name but a few and to illustrate the very different orientations that educational design models can assume (instructivist, design thinking, and TPACK, respectively).

Critical Reflections on Design Models

Firstly, let's reflect on the three educational design models summarized above. The Conversational Framework (Laurillard, 2002) distinguishes itself from other models by being based on a model of

how people learn and providing detailed guidance about how technologies might play a facilitative role. However, the convergence of information and communication media and the availability of multiple web services on a common platform means that it is difficult to maintain Laurillard's distinction between media (technology) types as they map to the processes in the Conversational Framework (Beetham, 2013). Also, the type of processes that technologies facilitate can depend more on the tasks that are set than the technologies themselves, as we saw in the previous chapter.

The Learning Development cycle (Siemens, 2005) flexibly caters to a range of different contemporary ways of learning, and is centered around the process that designers may undertake in order to develop learning tasks and modules. However, the model operates at quite an abstract level that means that it may be difficult for some designers to use in practice. Possible technologies that could be utilized in the creation phase are only briefly suggested and with no real mapping to any elements of the model.

The Seven Cs model (Conole, 2015) aims to support design activities as a process and does include numerous references to relevant theories and examples for designers to consider. However, to unpack all the elements of the model requires prolonged engagement, meaning that it perhaps lends itself more to professional learning than immediate application. The integration of learning technologies into the model could possibly be more comprehensive (at least in terms of the way the model is described).

This is not to be critical of these modeling attempts by three of the most eminent experts in our field – rather it is to point out that creating a comprehensive, generally applicable and useful educational design models is a fundamentally intractable problem. This is because educational design models can only ever struggle to account for all of the considerations along all of the numerous dimensions of variation that influence designing for learning. A model that strives to be too comprehensive or too generally applicable must inevitably compromise on usability. We have already established the wicked nature of design problems, and attempts to create an all-encompassing educational design model can only ever result in something that is too large, prescriptive, and unwieldy, or too general to be of any great assistance.

There are other notable issues with educational design models and design methodologies generally. Rational approaches to educational design that prescribe logical sequences of design steps are rarely used in practice because they do not account for the

social and political context, the degree of artistry that design involves, and the wide range of flexible ways that technologies can be applied (Sharpe & Oliver, 2013). Design methodologies have also been broadly criticized for providing little support for the realistic and actual processes that design practitioners undertake (Cross, 2001, 2006). Seeing educational design as a rational problem solving process is also problematic because of the complex and frequently changing educational and technological context (Holmberg, 2014).

Educational design models can be a useful point of reference against which educators can compare to their practice (Sharpe & Oliver, 2013). Some studies have also supported the idea that design methodologies can help novice designers adopt a more efficient design process that results in better quality and quantity of design outputs (Cross, 2006). However, a design methodology can have no effect or even a negative effect if it is too rigidly prescriptive (Cross, 2006). A key part of the organic nature of design is that good designers are willing to deviate from typical design methodologies based on emergent findings and ideas (Cross, 2004). For reasons such as these, the search for general design models has largely been overtaken by attempts to better share teacher practice (Beetham & Sharpe, 2013b). Fortunately, the new and growing field of Learning Design is dedicated to this very pursuit.

The Learning Design Field

LEARNING DESIGN DEFINITIONS

The term 'learning design' has been defined in a number of ways by different educational researchers over time (for discussions of this see Agostinho, 2008; Conole & Jones, 2010; Dalziel et al., 2016; Dobozy, 2013; Goodyear & Retalis, 2010; Mor, Craft, & Maina, 2015). According to a recent symposium of international learning design experts (see Dalziel et al., 2016) the field of Learning Design is principally concerned with how to help educators describe, design and share great teaching ideas. It constitutes the descriptive frameworks, learning and teaching concepts, and educator practices surrounding the creation of learning tasks that are increasingly technologically enhanced. Learning Design maintains a greater emphasis on the design of learning *tasks* rather than the enactment of learning *activities*. Whereas the older field of Instructional Design has traditionally emphasized the science of cognitively efficient information delivery, the relatively new field of

Learning Design encompasses more of a focus upon collaborative and student-centered learning (Mor et al., 2015). Learning Design is also more concerned with how designs are described and shared. For a timeline of key events, initiatives, tools and publications emerging from the Learning Design field see Dalziel et al. (2016).

You may have noticed that when referring to the field of Learning Design the 'L' and 'D' are capitalized. This is an important point of distinction because 'learning design' (lowercase) can denote the process of designing learning experiences (verb) as well as the product that is the outcome of the design process (noun) (Agostinho, 2008). The *process* of learning design can be defined as "the creative and deliberate act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given context" (Mor & Craft, 2012, p. 86). So, in a sentence, one might declare that 'learning design requires careful reflection.' Often the phrase 'designing for learning' is used to denote the process of learning design in order to avoid confusion between the noun and verb forms (Agostinho, 2008; Beetham & Sharpe, 2013a).

A learning design as a *product* can be defined as "a representation of the learning experience to which students are exposed" (Oliver et al., 2013, p. 103), or alternately "representations of the design process and its outcomes, allowing for aspects of design to be shared" (Beetham & Sharpe, 2013a, p. 9). In a sentence one might state 'I created a new learning design for my class.' Historically and strictly speaking, a 'learning design' has referred only to the intermediary design artifact (such as a diagram or blueprint that represents a plan for the lesson sequence) and not the final resources and learning environment that are developed. However, in practice, design work often takes place in the targeted virtual learning environment[2] such as a learning management system (Goodyear, 2005) and the term 'learning design' has become a common part of the language that teachers use to describe their approach to designing learning experiences for students (McAndrew & Goodyear, 2013). As such, it has become sufficiently common practice to refer to any sequence of teaching and learning tasks that have been constructed using the

[2]In line with Laurillard (2002), a Virtual Learning Environment can be described as an online technological platform that educators can use to provide students with resources and support facilities that they need in order to learn.

ideas of Learning Design as a 'learning design' (uncapitalized), or more simply a 'design' (Dalziel et al., 2016).

A LEARNING DESIGN CONCEPTUAL MAP

Dalziel et al. (2016) describe the key concepts of the Learning Design field and how they interrelate in a Learning Design conceptual map (see Figure 6.4). The core concepts of learning design center around guidance, representation and sharing. Designs may be aligned to any educational philosophies, may be informed by any theories and methodologies, and may occur within any type of learning environment. Within their context, teachers design and plan, engage with students, reflect and often undertake professional learning. These phases of the teaching cycle may occur at a number of levels of granularity, from specific learning activities, to sessions (lessons), modules of work or indeed entire programs. Teachers employ tools and resources to implement their designs, and draw upon a range of feedback, assessment, learner analytics and evaluation to refine their teaching approaches. Within this framework the challenge for educators is to create learning experiences that achieve the desired learning outcomes.

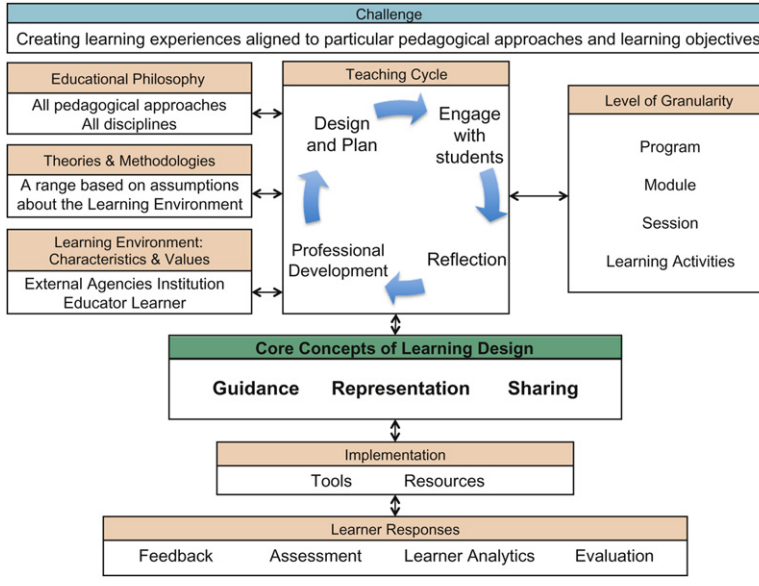

Figure 6.4. A Learning Design Conceptual Map (Dalziel et al., 2016, p. 17).

You may note that while the Learning Design conceptual map in Figure 6.4 explains the descriptive framework and concepts of Learning Design, it provides little direct guidance on *how* to design. The reason for this lack of direct guidance is that from a descriptive point of view the Learning Design field aims to provide a general framework to describe any design, and thus avoids any prescription, bias or values. Yet, as previously noted, the intention of the Learning Design field is to support the development and sharing of great teaching ideas. The tension between these two goals seems at first paradoxical, because Learning Design is attempting to be at the same time pedagogically neutral and selective. However, this tension can co-exist within the field by using pedagogically inclusive frameworks to describe learning designs, and allowing people to separately make judgments about the efficacy of the designs (Dalziel et al., 2016). So the Learning Design conceptual map in Figure 6.4 is not an educational design model insofar as it does not provide any direct guidance about how to design, makes no commitments about how people learn, and offers no recommendations about how technologies should be used. Nevertheless, the clear identification of learning design components does make it a useful referent for designers upon which they can apply their own value systems.

Describing Learning Designs

For educators to share learning designs they must be able to describe their designs. Learning designs, when represented well, are readily interpretable, can be used as a source of design ideas, and can even potentially support the integration of technology, pedagogy and content (Agostinho, Bennett, Lockyer, Jones, & Harper, 2013). Formally describing designs rather than immediately creating the actual learning resources and environments also has advantages, such as providing an initial representation that can be used as a basis for self or collaborative reflection, and providing the opportunity to share designs as abstractions for reuse with potentially different content (Conole & Jones, 2010). Because design is cognitively demanding, external tools are often used to offload and store parts of the problem as well as assist in creation of design solutions (Goodyear & Retalis, 2010).

There have been a number of initiatives within the Learning Design field to develop languages and tools to support the description and design of learning. Six approaches along with an

exemplar of each will be briefly described in order coarsely trace the evolution of learning design description in the Learning Design field. The six approaches are (i) the use of technical standards (IMS-LD), (ii) the use descriptive templates (pedagogical patterns), (iii) visualization approaches (AUTC LDVS), (iv) visualization tools (CompendiumLD), (v) pedagogical planner tools (the Learning Designer), and (vi) the Learning Activity Management Systems (LAMS). These examples also serve to illustrate the wide range of possible approaches that can be used to conceptualize, describe, create, and share learning designs.

TECHNICAL STANDARDS (IMS-LD)

Early efforts in the Learning Design field focused upon creating technical standards in order to support the description and sharing of learning designs. The logic behind these technical standards was that if learning designs could be described using a common technical framework then they could be more easily shared between people, platforms and contexts. There have been substantial initiatives to standardize the technical description of digital learning objects to make them more accessible, reusable and interoperable, for instance the Shareable Content Object Reference Model (SCORM). However, the most evolved and widespread set of technical standards for education is IMS Learning Design (IMS-LD).

IMS-LD is an open XML-based standard that can be used to specify a wide range of pedagogical strategies in the form of computer-interpretable models (Koper & Miao, 2008). This enables the models to be 'played' in any compatible execution environment (for instance, in learning management system such as Moodle). In comparison to other e-learning technical specifications like SCORM, IMS-LD provides strong support for the wide range of modern pedagogical approaches that are in use today, such as active learning, collaborative learning and competency-based learning (Koper & Miao, 2008). For IMS-LD guides and examples see https://www.imsglobal.org.

Despite the initial promise of the idea that technical standards could promote standardization, interoperation and sharing of learning designs across the education field, IMS-LD has not become as widely used as was initially hoped. One reason for the limited uptake of IMS-LD is that although there are freely available tools to support creation of IMS-LD designs, there is little incentive for coal-face educators and institutions to expend the

extra effort to adopt it in their designs (Goddard, Griffiths, & Mi, 2015). Another possible reason is that the specification doesn't necessarily cater for all sorts of learning designs, such as those involving run-time adaptation dependent on context (Burgos, 2015).

PATTERN DESCRIPTIONS (PEDAGOGICAL PATTERNS)

Based on the general concept of design patterns emanating from the field of architecture (Alexander, 1979), pedagogical patterns (or 'learning patterns') are proposed to provide a good way of capturing and sharing design knowledge in education because of the low technical threshold required to specify them (Goodyear, 2005; McAndrew & Goodyear, 2013). Patterns are specified in human readable form using the following format:

1. A picture showing an epitomic example of the pattern
2. An introductory paragraph explaining the context for the pattern
3. A problem headline to briefly describe the essence of the problem
4. The problem body that explains the empirical background and variants of the problem
5. The solution stated as an instruction to promote application
6. A diagrammatic representation of the solution
7. A paragraph linking the pattern to smaller patterns that can be used to complete it (McAndrew & Goodyear, 2013).

Sharing design knowledge using pattern descriptions is proposed to offer educators good design ideas in an easy to create and structured way that clarifies the context and emphasizes the relationship between patterns (Goodyear, 2005). The Pedagogical Patterns Project (http://www.pedagogicalpatterns.org) provides an example repository of pedagogical patterns. There has not been a wide proliferation in use of pedagogical patterns among educators, potentially because the approach is not closely integrated into the way they practice design.

VISUALIZATION APPROACHES (AUTC LD)

Based on funding from the former Australian Universities Teaching Committee (AUTC) the *ICTs and Their Role in Flexible Learning* project (known as the LD project) aimed to identify,

evaluate, document and disseminate high-quality learning designs that involved the use of technology (Agostinho et al., 2013). As part of the project a graphical representation called the Learning Design Visual Sequence (LDVS) was developed to facilitate descriptions of designs. LDVS describes learning designs in terms of the resources, tasks and supports that were required to implement them. A 'jigsaw' learning design (whereby teams of students research different topics and then individuals from teams share the findings with other groups) is shown in Figure 6.5. All visualizations were complemented by textual descriptions of the

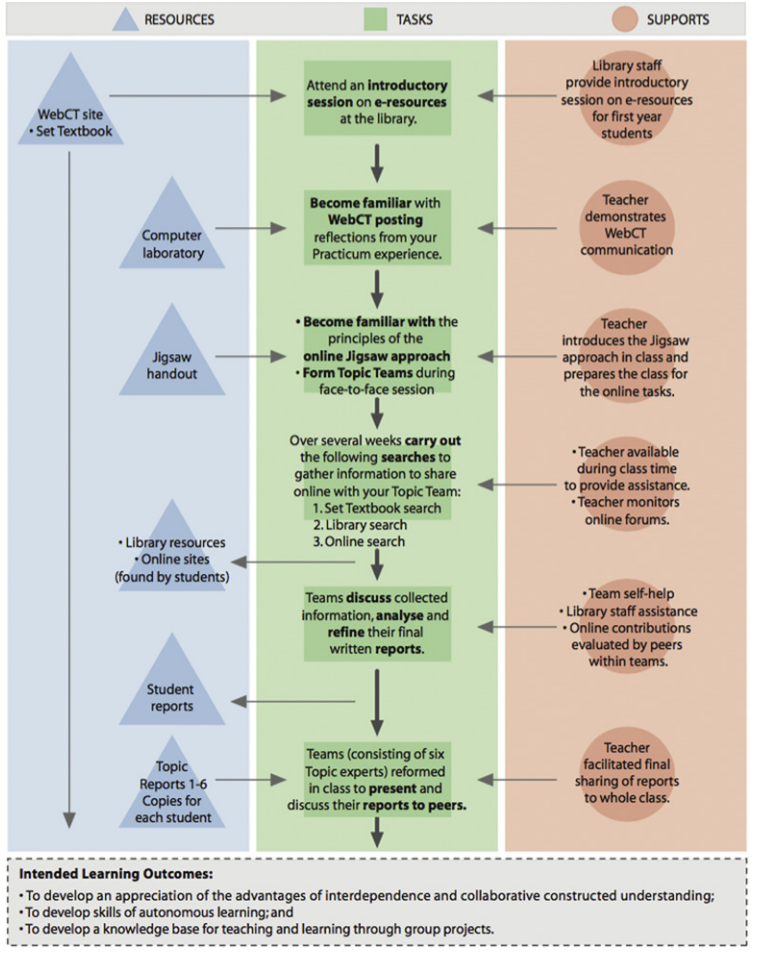

Figure 6.5. Representation of a 'Jigsaw' Learning Design Using an AUTC Learning Design Visualization Sequence.

implementation context (setting, outcomes, assessment and ICT contribution) and designers' reflections (pedagogical notes, history and evaluation).

Studies by Agostinho et al. (2013) report that educators found the designs to be particularly useful for sourcing design ideas and benchmarking good practice. The contextual descriptions that accompanied the LDVS visualizations were particularly important in supporting use and reuse of the designs. There was small-scale evidence that using the learning designs could improve TPACK understanding and that the system was used beyond the project. The repository of learning design descriptions and other supporting resources can be found at http://learningdesigns.uow.edu.au.

VISUALIZATION TOOLS (*COMPENDIUM LD*)

Compendium LD is a learning design visualization tool based on mindmapping paradigm (Brasher & Cross, 2015; Conole, 2013; Conole & Jones, 2010). It enables users to show connections between learner and teacher tasks and resources in a diagrammatic manner. Built using mindmapping software, custom icons enable representation of outcomes, tasks, resources, tools, roles, and learner. The designs can be exported in different formats including HTML and JPG. A visualization for a simple task is shown in Figure 6.6.

Conole (2013) reports that *Compendium LD* enabled those in the study to visualize design structure, as well as identify gaps and flaws in a way that textual descriptions could not. However some users found the tool frustrating and time consuming to learn and use, and also too rigid to represent all types of designs. The tool was considered by users as useful for articulating key steps and interdependencies within a learning design, planning logistics, and sharing practice. The *CompendiumLD* software along with associated documentation is freely available for download from http://compendiumld.open.ac.uk.

PEDAGOGICAL PLANNER TOOLS (THE *LEARNING DESIGNER*)

Whereas visualization tools provide a means for describing learning designs, pedagogical planners provide more structured guidance on the design process that accounts for the sorts of elements that need to be considered if a design is to be successful. The *Learning Design Support Environment* is an

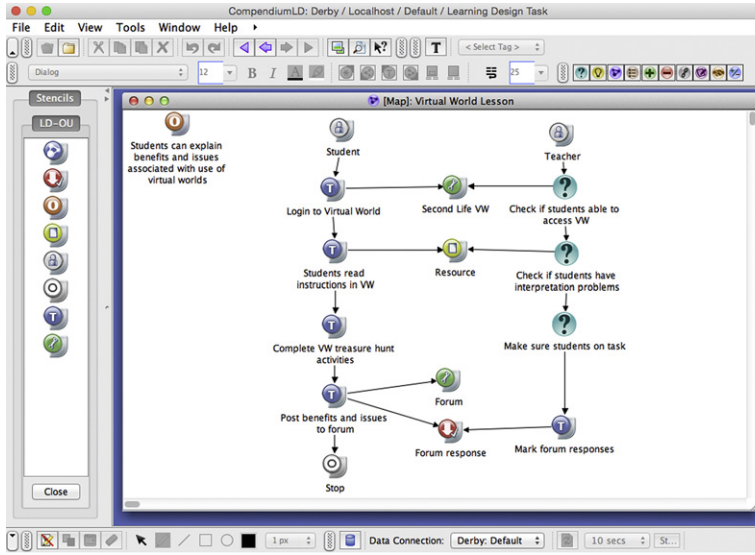

Figure 6.6. A simple Virtual World Task Represented Using CompendiumLD.

interactive tool and set of resources to scaffold teachers' technology-enhanced learning design thinking (Laurillard, Masterman, Magoulas, Boyle, & Manton, 2017). Using the main design tool (called the *Learning Designer*) educators can select from a range of teaching and learning activities and schedule them along a timeline. Activities have default levels of cognitive activity (acquisition, inquiry, discussion, practice, and production) and social nature (personalized, social, one-size-fits-all), which can be adjusted by the user. The design interface is shown in Figure 6.7.

Once learning modules and sessions have been drafted, the *Learning Designer* can provide an overarching analysis of the learning experience in terms of the different proportions of cognitive activities and social structure. The system is also integrated with an intelligent database feature that enables it to offer context sensitive scaffolding for the design process. This demonstrates how learning design descriptive frameworks can interweave with learning design concepts to assist learning design practice (Laurillard et al., 2013). The *Learning Designer* and associated systems are freely available for download and use from https://sites.google.com/a/lkl.ac.uk/ldse/.

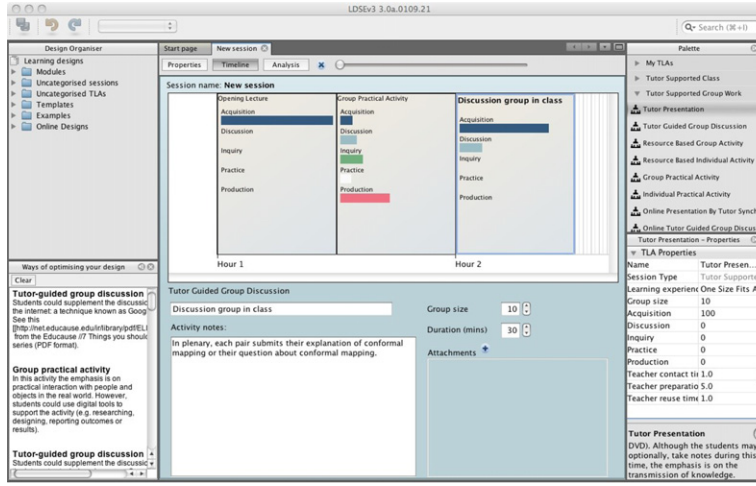

Figure 6.7. The Design View of the Learning Designer.

THE LEARNING ACTIVITY MANAGEMENT SYSTEMS (*LAMS*)

The Learning Activity Management System (*LAMS*) is an online platform that provides a drag-and-drop interface so that users can organize their lessons on a canvas (Dalziel, 2013). Users can choose from a range of 'activities' such as chat, forum, mindmap, Q&A, voting, wiki, and so on, and either linearly sequence them or use a range of more sophisticated control flow tools such as branching and conditional logic. A distinguishing feature of *LAMS* is that it allows each activity to be populated with actual content so that educators can actually run their designs with real classes. A screenshot of a basic *LAMS* sequence is shown in Figure 6.8.

LAMS first emerged in 2003 and over time has grown substantially in terms of its features and user-base. Sequences can be exported and uploaded to the *LAMS* Community (http://lamscommunity.org) so that educators can download, adapt, deploy and re-share designs. There are over three thousand freely available sequences available on the *LAMS* community that have been downloaded tens of thousands of times by several thousand users. The Lesson *LAMS* server enables educators to create a free account that they can use with their classes (see http://lessonlams.com). Alternately, the *LAMS* platform can be freely downloaded onto institutional servers from http://lamsfoundation.org.

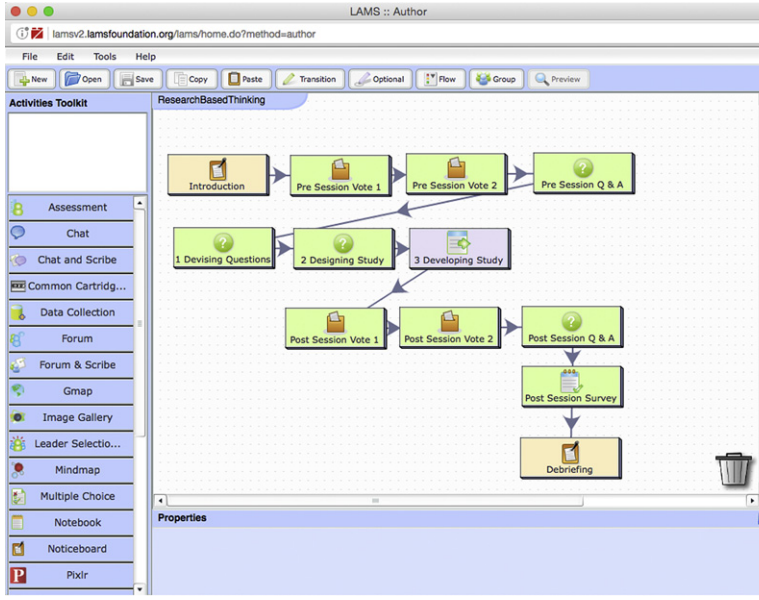

Figure 6.8. An LAMS Sequence in Author Mode.

REFLECTIONS ON REPRESENTATION AND SHARING OF LEARNING DESIGNS

As you can see, there are many ways that learning designs can be represented, constructed and shared. These learning design representations can vary according to the form of notation system, the formality of the language, the level of contextuality supported, whether the pedagogy is made explicit, what can be reused, how reuse is facilitated (Agostinho, 2008). Each approach addresses some of the needs of the field and practitioners, but also has limitations.

The IMS-LD technical standards constitute machine representations to facilitate standardized description for interoperability, but have not been utilized widely by practitioners because of the extra technical effort required to use them (Goddard et al., 2015). Pedagogical patterns overcome the technical barriers for use by offering human readable and easy to create learning design descriptions (McAndrew & Goodyear, 2013), but likewise have had limited uptake in part because they do not integrate tightly with how coal-face educators design. Manual visualization systems such as AUTC LDVS help to clarify the key components of a design and how they are sequenced, and there is some

evidence to suggest that it can help improve learning design thinking (Agostinho et al., 2013). While there are a few instances where LDVS has been used in practice beyond the scope of the project, such use is far from mainstream.

Moving beyond languages, the use of tools to represent learning designs has also had limited impact. Visualization tools such as *CompendiumLD* help educators to map out their designs in a flexible and somewhat portable way, but it can take users considerable time to learn the system and some are skeptical about the benefit as compared to the time commitment required (Conole, 2013). Pedagogical planner tools such as the *Learning Designer* do offer additional value add in terms of helping educators to analyze the efficacy of their designs, and the *Learning Designer* also integrates with an online repository and intelligent database to promote sharing. Yet as it stands, the *Learning Designer* has not yet infiltrated into general educational practice, perhaps because it is new but also again because teachers may not sufficiently value the return on investment for deviating from their current direct design approaches. *LAMS* is the learning design tool that has made the most impact on teaching practice, where people are able to plan their designs and then flesh-out the content so that they can run them with their classes. Yet, even the use of the LAMS Community is modest in comparison to the use of some learning object repositories (Dalziel, 2013).

Another important issue to consider is how much assistance design abstractions really offer. One of the key goals of learning design is to promote transfer of good teaching ideas (Dalziel et al., 2016). However, it is an open question whether general designs or patterns exist that make sense across a wide range of different learning contexts (Beetham & Sharpe, 2013a). Evidence suggests that educators prefer working with specific designs – even if they are from an unrelated context – rather than abstract designs (Agostinho et al., 2013; Masterman, 2013). Further, all intermediary design artifacts are once removed from actual artifacts and courses meaning that some of the detail is necessarily lost. What may be needed is for educators themselves to make abstractions about learning design, rather than being provided with them.

There is no doubt that each of the learning design representation approaches outlined above have made valuable conceptual contributions to the field of Learning Design, and can be used to advance practitioner thinking. When educators do take the time to use learning design tools and representations they often indicate it develops their design understanding (Agostinho et al., 2013;

Masterman & Manton, 2011). However, due to the general busyness of teaching work educators often struggle to find time for pedagogical reflection and to think explicitly about design (Laurillard et al., 2013). For the same reason they may be reluctant to use intermediary learning design representations and tools rather than directly creating their designs in the target virtual learning environment.

Summarizing the Current State of Design Thinking and Learning Design

What can we conclude from the various areas of research and development that have been drawn together in this chapter? We have seen that design is the deliberate and purposeful practice of trying to solve ill-structured problems in order to create preferred futures. Design thinking requires frequent reframing of the problem, involves a focus upon the solution, builds upon previous design knowledge, is centered around the user, necessitates prototyping, involves exploring for creative bridges, requires flexibility, demands a tolerance for ambiguity, and is an intrinsically educative practice.

Design is an excellent way to conceptualize teaching because how to educate is an ill-structured problem with practices and intentions that involve purposefully building upon prior knowledge to create preferred futures. Learning to design is challenging because design is an inherently ill-structured, synergistic, experiential, and ephemeral process. Adopting a reflective approach to design in combination with drawing upon expert guidance and examples is proposed as the most successful ways to develop design capabilities.

Quality designing for learning (or as we more recently agreed to call it, 'learning design') foundationally involves understanding and catering to students, designing tasks that accord in nature and focus with the desired learning outcomes, aligning the various levels of a design (from macro-level whole course concerns to micro-level strategies and tactics), and promoting accessibility. There are several educational design models (which we could just have easily called learning design models), including the Conversational Framework, the Learning Design Cycle, and the 7 Cs model, that aim to provide educators with guidance for the design of technology-enhanced learning. However, due to the

intractable and contextual nature of design problems, these models struggle to be at the same time comprehensive, generally applicable and easily used.

The field of Learning Design aims to support the design of learning by helping educators to describe, design and share great teaching ideas. Several different approaches to describing and sharing designs have been proposed, including technical standards such as IMSLD, formalized pattern descriptions, visualization languages such as AUTC LDVS, visualization tools such as *Compendium LD*, pedagogical planner tools such as the *Learning Designer*, and the runnable learning design tool *LAMS*. While these have each made a considerable contribution to conceptualization and thinking in the field, the challenge has been for these approaches to impact on the practices of everyday educators.

Directions Forward for Learning Designers

So, given what is known about design thinking and the developments in the field of Learning Design, what strategies are likely to be most useful for learning designers going forward? Firstly, based on the work of Schön (1987), it is imperative that learning designers adopt a reflective approach to their practice (Holmberg, 2014). Design of high-quality technology-enhanced learning involves a great deal of artistic and reflective input from the educator, particularly for highly adaptive or cutting edge applications (Harding & Ingraham, 2013). Without periods of informed reflection it is hard for design practices to improve (Goodyear & Retalis, 2010). Holmberg (2014, via Schön, 1987) describes how in-action this involves learning designers have a "reflective conversation with the situation" (p. 294). That is to say, good design involves continual and conscious reflection in response to emergent conditions and observations.

Secondly, learning designers should strive to collaborate. Design itself occurs in a socio-cultural context, in which the community practices can have a marked impact upon the design process and outcomes (Masterman, 2013). Designing in teams provides opportunity for dialogue, brings together different sources of expertise, and enables peer learning through sharing of ideas (Sharpe & Oliver, 2013). At a practical level designing in teams allows complementary skills and knowledge to help

solve the problem at hand (Goodyear & Retalis, 2010). Support from others, including administrators and personal learning networks plays a critical role in successful technology-enhanced learning design practices (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012), so these should be utilized wherever possible. For instance, online communities formed through social networking tools such as Facebook and LinkedIn can offer an important source of support (Conole, 2013). Another more recent and exciting possibility is including students as participants in the design process (Sharpe & Oliver, 2013), for example, as outlined in the Students as Producers project at the University of Lincoln (http://studentasproducer.lincoln.ac.uk).

Thirdly, educators need to adopt a design mindset in order to truly become empowered and capable learning designers. Teacher beliefs play a critical role in determining how they design for learning (Kim, Kim, Lee, Spector, & DeMeester, 2013; Voogt, Fisser, Tondeur, & van Braak, 2016). A strong belief in the utility of student-centered and technology-based learning, as well as a problem solving mentality and a passion for technology all underpin exemplary technology-enhanced learning design and practice (Ertmer et al., 2012). Teachers' design dispositions (such as openness to new experiences, exploring conflicting ideas, deviating from established practices, comfort with productive failure) also influence the sorts of design practices that teachers use (Koh, Chai, Hong, & Tsai, 2015). Outstanding design is fueled by a personal commitment to high standards (Cross, 2004). It appears that for experienced designers, "design becomes a part of one's being because it involves so much that is personal, like your creativity, way of approaching the world's problems, your own history, learning style and view of the world" (Lawson & Dorst, 2009, p. 270). Sharing of teachers' orientations and beliefs has been associated with deeper levels of inquiry into technology-enhanced learning issues (Boschman, McKenney, & Voogt, 2015).

Final Comments

While there has been small sample self-report qualitative evidence from educators that working with learning design visualizations and tools can enhance learning design thinking (Agostinho et al., 2013; Masterman & Manton, 2011), the evidence to suggest that visualizations and tools result in better designs, or better student learning outcomes, is far from conclusive. Nor is there any strong

evidence to suggest that educational design models result in better quality designs. Perhaps we do not have sufficient research data and they do in-fact lead to qualitatively better designs, or maybe difficulty objectively assessing designs makes improvements difficult to gauge. However, other reasons that descriptions, tools and models have not lead to convincing improvements in learning design could be that good design is an intrinsically complex, authentic and creative process, and that learning design tools and models do not fully capture and integrate the interconnected elements in a way that optimally supports design.

At the same time, the Learning Design Field is faced with a conundrum. It advocates the creation of generalized and transferable learning design patterns, while simultaneously recognizing that deep consideration of context is deemed essential for high-quality learning design. This means that no matter what sorts of abstractions that are provided to educators in the form of learning designs, it is up to individuals to make sense of designs and potentially significant adaptations depending on learner needs. Accordingly, out-of-context or generalized learning designs can only ever be sources of ideas, and significant responsibility and expertise necessarily needs to rest with the educator.

Thus, the best way to support technology-enhanced learning design may be to assist people to develop a deep understanding of the possibilities and issues so that they can make situated and empowered design decisions. Koh and Chai (2016) have shown that the design knowledge of teachers plays a large role in influencing their design processes. There is no doubt that learning design models, languages, tools and repositories can provide some support for educators. However, irrespective of the tools and resources provided, to create good technology-enhanced learning designs educators must move beyond surface processing of design to deeper and more analytical, yet still creative processes and production. Thus, instead of primarily aiming to provide educators with blueprints that are contextually void or inaccurate, or rational design prescriptions, the most realistic and promising approach to supporting design practices may be to help educators acquire contextually sensitive design principles (Holmberg, 2014; Sharpe & Oliver, 2013).

Empowering educators with contextually sensitive design principles and knowledge means that they can broach design as an in-context reflexive practice rather than naïvely, inaccurately or incompletely applying prescriptive approaches. It means that educators are more able to shift beyond what they are given and

develop more creative and customized learning designs. That is the premise of this book, and the focus of the chapters to follow. The next four chapters provide an in-depth and evidence-based examination of different technologies, as design environments, in order to explore issues and potentials associated with the design of technology-enhanced learning, and to derive context sensitive principles for their use.

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