Preface

Designing high quality, technology-supported learning experiences is a significant challenge for educators. While there is a wide range of expert advice available, translating theories and good practice principles into learning settings can be a daunting task. The concepts of "learning designs" and "learning objects," on their own and through their integration, have emerged as potential strategies to help educators address this challenge.

Although educators have always shared ideas and resources, the formalisation of these activities using learning designs and learning objects is new. The idea of describing and presenting teaching and learning environments in a systematic way, and then potentially reusing them is now the focus of a broad international research agenda.

The editors of this handbook, through a call to experts, have assembled a collection of work from key research centres and influential individuals worldwide to showcase the latest research emerging to supporting high quality teaching and learning.

The handbook has been divided into three sections. Section I addresses the evolving concept of learning design, Section II presents current research on learning objects, and Section III examines the integration of learning designs and learning objects.

SECTION I LEARNING DESIGN

Learning design is a relatively new field in which research has predominantly occurred only in the last decade. Its "language of discourse" is evolving, with various conceptualisations being developed. The following 18 chapters present an international perspective on the latest research in learning design.

Explanation of Chapters and their Order

The first two chapters set the scene by introducing the concept of learning design and explaining the key issues that dominate the current discourse. In *Learning Design Representations to Document, Model, and Share Teaching Practice,* Agostinho presents a synthesis of the learning design literature by firstly exploring the definition of the term "learning design" and then explaining six learning design representations. The chapter compares and contrasts these learning design representations and proposes a pathway for future research. Falconer and Littlejohn, in *Representing Models of Practice,* further the discussion by examining ways in which learning designs can be used to share and also change teaching practice. The chapter discusses the findings from a UK research project that explored how practice models (generic learning designs) can be represented and used by teachers to improve their practice. Falconer and Littejohn conclude that while practice models may be useful to represent teaching practice,

contextualised learning designs coupled with community building activities may be more effective in changing teaching practice.

The next three chapters provide a detailed analysis of two learning design representations—IMS LD and patterns. In *Using the IMS LD Standard to Describe Learning Designs*, Koper and Maio present a comprehensive explanation of IMS LD, perhaps one of the most detailed discussions written to date. The chapter summarises the research conducted in developing the IMS LD specification to explain the underlying principles of IMS LD, its main concepts, what it can offer, and how it can be used. Griffiths and Liber, in *Opportunities, Achievements, and Prospects for Use of IMS LD,* extend this discussion by presenting an analysis of the current uses of IMS LD, and explaining the opportunities and achievements generated for four derived modes of use. Griffiths and Liber explain the research work conducted for each mode of use and conclude by proposing a research direction for the future. In *A Critical Perspective on Design Patterns for E-Learning*, Garzotto and Retalis provide an extensive examination of patterns and how they could be used in field of e-learning. The chapter presents an historical discussion about the origins of patterns, an explanation of how they have been used in multiple disciplines, and a summary of the research and development projects conducted about patterns in e-learning. Garzotto and Retalis conclude that a systematic classification system is needed and present a taxonomy of e-learning design patterns. The chapter discusses the potential benefits and limitations of patterns and proposes a future research pathway.

The following set of six chapters focuses on the concept of learning design as a support tool to facilitate reuse and examines its potential to change and improve teaching practice. The first two chapters focus on how design patterns can be used as a support tool in the educational design process. The next two chapters explore learning design more broadly by explaining research work conducted towards the development of pedagogic planning tools. The final two chapters in this set take a different tack by discussing how learning designs can be categorised and how categorisation could facilitate reuse and help teachers to reflect on their teaching practice.

In *Design Patterns to Support E-Learning Design*, Frizell and Hübscher report on their research in developing design patterns to support novices in effective e-learning design. The chapter reviews the research on design patterns in education and other disciplines, and proposes a future research direction that focuses on three areas: the standardisation of the design pattern representation, the integration of design patterns with other research efforts in learning designs, and the development of software tools to facilitate the creation and use of design patterns.

In *Patterns and Pattern Languages in Educational Design*, Goodyear and Yang explain their work on the development and evaluation of educational design patterns and pattern languages for networked learning. Their research is considered within the wider context of educational design as the authors discuss the ramifications of adopting a patterns-based approach in supporting educational design. In *The Role of Mediating Artefacts in Learning Design*, Conole explains how learning activities can be described and documented using different forms of representations and how these "mediating artefacts" can inform the process of designing a new learning activity. Conole reports on the research and development of a tool that utilises mediating artefacts to support the learning design process. Masterman, in *Activity Theory and the Design of Pedagogic Planning Tools,* explores the potential for the use of pedagogic planning tools more broadly by proposing a framework for analysing the planning process, that is, "design for learning," to inform how pedagogic planning tools can be effectively deployed to support the learning design process.

Harper and Oliver, in *Developing a Taxonomy for Learning Designs*, present a categorisation framework for learning designs developed from a project that surveyed over fifty learning designs implemented in higher education that utilise information and communication technologies. The framework is proposed as

a mechanism to help academics access high quality learning designs to encourage reuse. In *Using Expert Reviews to Enhance Learning Designs*, McNaught, Lam, and Cheng report on how an evaluation study used the framework presented by Harper and Oliver to provide expert reviews on e-learning strategies at The Chinese University of Hong Kong. The findings of the evaluation are reported and the authors conclude that the evaluation instrument serves as a reflection tool that can help teachers better understand the teaching and learning potential of their implemented learning designs.

The next two chapters report on the application of learning designs in educational contexts. *Investigating Prospective Teachers as Learning Design Authors*, by Kearney, Prescott, and Young reports on a research project that explored how learning designs could be used to help prospective school teachers develop online learning tasks. The preservice teachers adapted generic learning designs to inform the development of their own contextualised learning designs. The study acknowledges that the use of generic learning designs and a learning design authoring tool can serve as effective support tools to help teachers design effective learning activities. In *Using IMS Learning Design in Educational Situations*, Hazlewood, Oddie, and Barrett-Baxendale explain how IMS LD has been used in a number of projects at Liverpool Hope University. The chapter reports the experiences of teaching practitioners in using IMS LD and is one of the few research studies that report learners' perceptions when experiencing IMS LD units of learning (UoL).

The next three chapters focus on the development of specific learning designs and their representation as generic learning designs. McLaughlan and Kirkpatrick, in *Online Role-Based Learning Designs for Teaching Complex Decision-Making*, explain how an online role-play learning design has been created to develop students' decision-making skills. The chapter explains the rationale for the learning design, describes in detail what the learning design entails in terms of tasks, content resources, and teacher supports, and reports on how it has been used. In *Facilitating Learner-Generated Animations with Slowmation*, Hoban describes the development of a learning design that incorporates slow motion animation to facilitate a deep understanding of science concepts. The rationale for this teaching approach is explained and the learning design is described in a similar way to that presented by McLaughlan and Kirkpatrick. That is, the "slowmation" learning design is described in terms of the tasks students perform, the content resources provided and how students are supported in the learning environment. Examples of how this learning design has been used are provided and a visual representation illustrates the generic learning design. In *Representation of Coordination Mechanisms in IMS Learning Design to Support Group-Based Learning*, Miao, Burgos, Griffiths, and Koper explain how IMS LD can be used to implement group based learning strategies. The chapter details a particular group-based learning strategy and illustrates how it can be represented generically in IMS LD.

The next chapter explores implementation issues when using IMS LD. Strobel, Lowerison, Abrami, Bethel, and Cote, in *Modelling Learning Units by Capturing Context with IMS-LD*, report on a research project that explored the process of representing and modelling learning activities in IMS LD. Five generic learning activities were modelled in IMS LD using the IMS LD editor MOT Plus.™ The chapter discusses the design decisions made when translating these learning activities into IMS LD and concludes by proposing a four-layer model to ensure the quality of the modelling process.

The final chapter in this section presents a potential strategy for fostering future collaboration to establish an international learning design community. Burgos, Hummel, Tattersall, Brouns, and Koper, in *Design Guidelines for Collaboration and Participation with Examples from the LN4LD (Learning Network for Learning Design)*, present the lessons learned from the collaboration model implemented in an online community formed to investigate the potential of IMS LD.

SECTION II LEARNING OBJECTS

This section of the handbook brings together diverse perspectives on the design of learning objects and the outcomes of their use. Understanding of learning object design has progressed through our increasing and collective experiences with the process. The following 13 chapters report on the latest research in learning object design and implementation.

Explanation of Chapters and their Order

In *The Design of Learning Objects for Pedagogical Impact*, Boyle draws together the range of experiences of *The Centre for Excellence in Teaching and Learning in Reusable Learning Objects* to put forward a set of design principles, and considers the reusability of the learning objects and the designs, or pedagogical patterns, underpinning the learning objects.

In *Visual Meaning Management for Networked Learning*, Turner begins with the premise that university teachers experienced in developing print-based learning materials may not necessarily be able to easily make the conceptual shift needed when designing learning objects for a networked multimedia environment. Based on an analysis of the debate about visual meaning making, this chapter presents strategies and tools for learning object development.

Gitsaki considers design issues for learning objects in terms of students from non-English speaking backgrounds in *Modification of Learning Objects for NESB Students*. This chapter presents a linguistic analysis of learning objects designed for the K-12 environment. The analysis provides a basis on which recommendations are presented for modifications to cater for NESB learners.

Churchill and Hedberg, in *Learning Objects, Learning Tasks and Handhelds*, argue for the importance of the learning task when considering the design and use of learning objects. They provide suggestions for use of different types of learning objects. Also, given the growing interest in m-learning, they review the research and implications for learning objects and learning tasks for delivery through handheld devices.

A number of chapters focus on the evaluation of large scale learning object projects around the world such as *The Le@rning Federation* (TLF) K-12 curriculum content initiative in Australia and New Zealand and the *CELEBRATE* project in Europe.

The two chapters that report on evaluations in the Australian context both utilised a range of sources to understand both the actual use of and perspectives about learning objects by teachers and students. Freebody, Muspratt and McRae, in T*echnology, Curriculum, and Pedagogy in the Evaluation of an Online Content Program in Australia*, shed light on how learning objects are being used in various discipline areas, particularly in mathematics. This chapter contributes to the debate about the extent to which the 'learning' should be in the learning object. Lake, Lowe, Phillips, Cummings, and Schibeci, in *Effective use of Learning Objects in Class Environments,* analyse their evaluation findings through use of an educational environment model. The outcomes of the evaluation considered within this framework provide key evidence-based principles for design and implementation of learning objects.

In *A European Evaluation of the Promises of LOs*, McCormick, Jaakkola, and Nurmi present the outcomes of an evaluation of the *CELEBRATE* project in terms of production, distribution, and reusability. This chapter provides critical insights to the way learning objects are used, particularly with respect to different teaching approaches, and helps to address the question of what supports teachers and students may need to make best use of learning objects. In *Instructional Effectiveness of Learning Objects*, Jaakkola and Nurmi draw on the *CELEBRATE* project to present findings of an empirical study that compared the

learning outcomes achieved through the use of drill-and-practice and simulation-type learning objects to more traditional teaching methods. The authors' use their findings to argue that learning object based teaching should not be seen as a rival to more traditional approaches, but should instead be viewed as complementary.

Two chapters in this section examine approaches to evaluation with learning objects. In *Evaluating Large-Scale European LO Production, Distribution, and Use*, McCormick identifies the possibilities and limitations of evaluation identified through experience within the *CELEBRATE* project. Nesbit and Leacock, in *Collaborative Argumentation in Learning Resource Evaluation*, describe a collaborative approach to the evaluation of learning objects whereby multiple reviewers individually evaluate a learning object according to a common set of criteria, and then collectively negotiate to arrive at a final review. The authors propose a range of applications for this process to assist design and selection of learning objects.

Beyond design, use, and reusability is the issue of accessibility. The final three chapters in this section focus on accessibility and learning object repositories. In *For the Ultimate Accessibility and Re-Usability*, Martin and Eboueya challenge the current approaches to sharing and retrieving both learning objects and information objects in terms of limitations of scalability. The idea of a global, collaboratively updated system is suggested in order to overcome the identified problems. Bennett, Parrish, Lefoe, O'Reilly, Keppell, and Philip, in *A Needs Analysis Framework for the Design of Digital Repositories in Higher Education*, detail the considerations that underpin the design of a repository that is intended to house an archive of educational resources in addition to supporting a community of participants through networking facilities. Additionally, they detail their analysis framework and offer it as a tool for others engaged in repository design projects. In *Costs and Sustainability of Learning Object Repositories*, Bramble and Pachman analyse the range of funding models used by currently available repositories and suggest possible ways forward. In doing so they contribute an economic perspective often missing from the body of learning object literature that emphasises the technical and pedagogical.

SECTION III INTEGRATION

This section presents current research investigating the integration of learning objects and learning designs. Much of the work reported illustrates the use and impact of learning objects in support of learning designs implemented in educational settings.

Explanation of Chapters and their Order

This section opens with two chapters that present case studies of the integration of learning objects and learning designs. These chapters demonstrate how these concepts can be used in concert to examine and analyse key aspects of the teaching and learning process. *A Learning Design to Teach Scientific Inquiry* (Elliott, Sweeney, and Irving) describes a learning design informed by problem-based and inquiry learning developed for medical education into which learning objects are integrated for customisation on a particular topic. The authors explore the prospect of learning object reusability by comparing the cost of reusing an existing learning object and the estimated cost of preparing it from scratch. In *Adapting Problem Based Learning to an Online Learning Environment*, Lobry de Bruyn describes the integration of learning objects into a problem based learning design created to cater for the needs of on- and off-campus learners. The author explores two variations of the learning design, each presented as a case study conducted over a 3-year period, and compares the patterns of communication undertaken by students.

Learning Objects and Generative Learning for Higher Order Thinking (Chuen, Aris and Abu) offer a different perspective in describing the design and evaluation of a Web-based learning environment that allows learners to select and organise learning objects from a library of resources. Based on the principles of generative learning, this design allows learners to choose the learning objects they consider relevant for a task and then to structure, and restructure, the items as they wish.

The next two chapters describe initiatives in which learning objects and learning designs (in the form of lesson plans or templates) have been collected into repositories for particular groups of educators. Both highlight the challenges in creating a repository that meets the needs of users, and ponder means of supporting effective integration of learning objects into effective learning experiences. In his chapter, *Applying Learning Object Libraries in K12 Settings*, Foti examines a series of projects begun more than 20 years ago that have collected and organised thousands of resources into databases for school education. Foti describes the process of categorisation and the dilemmas raised by this process. He goes on to consider the role of the teacher as organiser and designer and the challenges of integrating learning objects into meaningful learning experiences. Curda and Kelly, in *Guidelines for Developing Learning Object Repositories*, describe the development of a learning object repository to meet the needs of faculty in a university department. In the repository the designers have included templates that capture particular learning designs that can be combined with learning objects, an illustration of one approach to supporting teaching staff.

Next follow four chapters that offer more general discussion of learning objects and learning designs, and their integration. In *Reusability of Online Role Play as a Learning Objects or Learning Designs*, Wills and McDougall pose questions about the nature of learning objects and learning designs, and the extent to which either are reusable. The authors discuss how role-plays can be reused as learning objects, drawing on examples tracked over a period of more than 10 years. The discussion highlights some of the difficulty in clarifying the differences between learning objects and learning designs. Lockyer, Kosta, and Bennett, in *An Analysis of Learning Designs that Integrate Patient Cases in Health Professions Education,* present the outcomes of an analysis of case based learning in health professions education, identifying three broad approaches and eight generic learning designs into which variations can be categorised. Each learning design illustrates the integration of patient cases as learning objects. The authors argue that generic learning designs could function as a design support for educators enabling them to effectively integrate learning objects and plan their teaching. In *Reconceptualisation of Learning Objects as Metaschemas*, Chinnappan argues that the current view of learning objects in mathematical education is limited and offers an alternative conceptualisation that introduces the idea of "embedded learning objects" which would serve as overarching schema to organise multiple learning objects. This proposal is consistent with the notion of using a learning design that describes the overall pattern of a learning activity as a means to structure the integration of learning objects. In *Designing Learning Objects for Generic Web Sites*, Huijser considers what the notion of the "Net generation" might mean for the pedagogical foundations of learning design, and further explores the issue through a case study of an academic learning support site for students. The results are used to examine some of the assumptions made about learners and the implications of those for learning objects and their integration into learning designs.

The final three chapters consider standards and specifications for learning objects and learning designs and the roles these might play in supporting design and development. In *Standards for Learning Objects and Learning Designs*, Munro and Kenny trace the history of learning object and learning design standards and specifications, and examine how they have been applied in particular cases. The authors then provide a critique of current standards, offering advice on the selection of standards for a particular application and suggestions for further development. *Design Languages for Learning Designs*

and Learning Objects (Boot, Botturi, Gibbons and Stubbs) describes a decision model intended to support the selection and application of design languages for formalising learning designs and labelling learning objects. The aim of the model is to improve communication between instructional designers and other stakeholders in the design and development process by enabling designs to be documented using a formalised description. Two validation studies are used in support of the authors' arguments for standardisation. *Principled Construction and Reuse of Learning Designs* (Paquette, Mariño, Lundgren-Cayrol, and Léonard) draws on 15 years of instructional engineering work to frame an argument for a principled approach to learning design modelling and learning object reusability. The authors outline the guiding design principles that underpin the approach, explain the role of learning design standards, and describe how learning objects can be integrated to create "reusability-centred designs." This chapter highlights the need to support complexity in the design process, while also achieving interoperability through the use of standards.

THE FUTURE

Worldwide interest in supporting learning has excited the re-examination of the design of learning settings. This renewed interest has been the catalyst for the learning object and learning design research movement. This handbook could be considered as one step in the building of a collaborative research agenda around learning design. We hope this handbook will serve as a catalyst to spark the motivation for further studies and the formation of an international alliance so that the learning design field can continue to move forward.

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