University of Wollongong
Research Online

Emerging Technologies Conference 2008

Faculty of Social Sciences

2008

Supporting the use of learning objects in the K-12 environment: A design-based research project

W. Cotton
University of Sydney

Publication Details

This conference paper was originally published as Cotton, W, Supporting the use of learning ojbects in the K-12 environment: A design-based research project, Proceedings of the Emerging Technologies Conference, University of Wollongong, 18-21 June 2008.

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: research-pubs@uow.edu.au

Supporting the use of learning objects in the K-12 environment: A design-based research project

Abstract

This paper outlines the methodology behind a Design- Based Research project conducted at the University of Wollongong. The focus of the research project was on the systematic development of a support system to aid K-12 teachers as they integrated learning designs with learning objects. The foundations of the support system were based on a combination of existing design theories and on an analysis of the practical problems faced by teachers as they attempted to create effective pedagogical experiences which incorporate learning objects. The focal point of this paper is the journey through the Design-Based Research process rather than outcomes of the project.

Publication Details

This conference paper was originally published as Cotton, W, Supporting the use of learning ojbects in the K-12 environment: A design-based research project, Proceedings of the Emerging Technologies Conference, University of Wollongong, 18-21 June 2008.

This conference paper is available at Research Online: http://ro.uow.edu.au/etc08/6

emerging technologies
CONFERENCE
Supporting a Learning Community

Supporting the use of learning objects in the K-12 environment: A design-based research project

Wayne Cotton
University of Sydney, NSW, Australia

Abstract:
This paper outlines the methodology behind a Design-Based Research project conducted at the University of Wollongong. The focus of the research project was on the systematic development of a support system to aid K-12 teachers as they integrated learning designs with learning objects. The foundations of the support system were based on a combination of existing design theories and on an analysis of the practical problems faced by teachers as they attempted to create effective pedagogical experiences which incorporate learning objects. The focal point of this paper is the journey through the Design-Based Research process rather than outcomes of the project.

Introduction

There is an abundance of research, policies and programs concerned with the design, development, and installation of computer-based technologies for use within educational settings to improve teaching and learning outcomes. As a consequence private organisations and governments around the world are spending considerable amounts of money connecting their educational institutions to the Internet. A subsequent trend to this growth has been in the expansion of educational software, with one significant area of focus being the development of learning objects. Learning objects, put simply, are any digital resources that can be used to support learning (Wiley, 2000). Basic examples might include educational videos, pictures, or web sites; while more advanced examples may include in-depth interactive applications. Whilst learning objects have been around in one form or another for decades, it has only been in the last 10 years that there has been a worldwide focus to develop learning objects specifically for schools and to make them freely available to teachers via on-line databases or repositories (Friesen, Roberts, & Fisher, 2002; Laurillard & McAndrew, 2003; Suthers, 2001).

The Problem

Despite the recent development of learning objects, and the vast investments by governments and organisations around the world, there is a growing body of evidence indicating that the uptake of learning objects by K-12 teachers is still in its infancy (Hand et al., 2004; Johnson, 2003; McCormick, Scrimshaw, Li, & Clifford, 2004). This evidence suggests that practitioners are not taking full advantage of the new range of resources. To add to the problem there has been an uneven focus on the work conducted on learning objects, with much of the interest concentrating on the development of the learning objects and on the technical aspects of the storage and retrieval processes (Bannan-Ritland, Dabbagh, & Murphy, 2002). Conversely little attention has been paid to the way the learning objects are to be disseminated and how practitioners will actually use the learning objects in their teaching.

To ensure that this vast investment in learning object development is effective, it is imperative to find ways that successfully make use of

this technology and to provide the necessary professional development to train teachers in these ways (Bratina, Hayes, & Blumsack, 2002; Porter, Garet, Desimone, Yoon, & Birman, 2000). One idea that has been suggested as a potential approach to support teachers as they attempt to utilize learning objects is by using generic frameworks which are based on effective pedagogical strategies (Laurillard & McAndrew, 2003; Wiley, 2003). Various frameworks that have been explored in the educational technology research arena include the IMS Learning Design (IMS Global Learning Consortium, 2003), Patterns (Goodyear et al., 2004), the Learning Design Visual Sequence (The Learning Design Project, 2003) and the Learning Activity Management System (The LAMS Foundation, 2006). Regardless of the terminology or orientation, the commonality of these frameworks, or learning designs, is the focus on providing guidance on sequencing learning experiences through definition of learning activities, resources, and supports.

A gap in the educational research associated with learning designs relates to the disproportional amount of research conducted in tertiary settings. There is however one type of pedagogical framework that has been used and tested in K-12 settings. This type of learning design is known as a WebQuest.

A WebQuest is "an inquiry- oriented activity in which some or all of the information that learners interact with comes from resources on the internet"(Dodge, 1995 , p. 1). A WebQuest will typically present students with a challenging task, which can either be simple and short-term (making an invitation to a class presentation), or more complex and long-term (planning a 4 week holiday overseas in a targeted culture). Students complete these tasks by working through a standardized WebQuest framework. The WebQuest framework is clearly structured into specific attributes: an introduction (sets the scene for the activity); tasks (describes what is to be accomplished); a process (the steps needs to complete the task); an evaluation (how students will be assessed); and a concluding (closure) section.

This study set out to explore the notion that an Electronic Performance Support System (EPSS) could be designed and developed to assist K-12 teachers as they worked through the process of incorporating learning objects into a WebQuest. More specifically the study addressed three research questions:

- *What are the issues that teachers face as they combine learning objects with learning designs?*
- *What design principles guide the development of systems and supports which assist teachers as they combine learning objects with learning designs?*
- *How do systems and supports address the issues teachers face as they combine learning objects with learning designs?*

Accordingly, it was necessary to situate this study within an appropriate research paradigm.

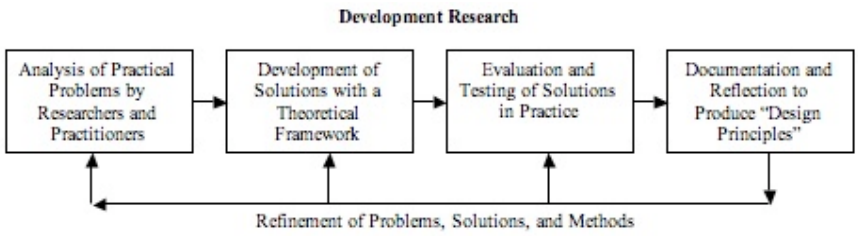
The Methodology

When it comes to selecting which particular type of research methodology to use, Guba (1981) suggests that "…it is proper to

select that paradigm whose assumptions are best meet by the phenomenon being investigated" (p.76). Due to the analysis, design, development and evaluative nature of the research questions, the research methodology for this study was guided by the principles of development research.

Development Research, a term synonymous with Design-Based research (Reeves, 2000), focuses on solving broad based, complex, real world problems that are critical to education, while at the same time maintaining a commitment to theory construction and explanation (Reeves, Herrington, & Oliver, 2004). This mixed method approach also aims at making both practical and scientific contributions in the chosen field (van den Akker, 1999). Reeves (2000) elaborated on this with his original illustration of the development approach to research shown it Figure 1.

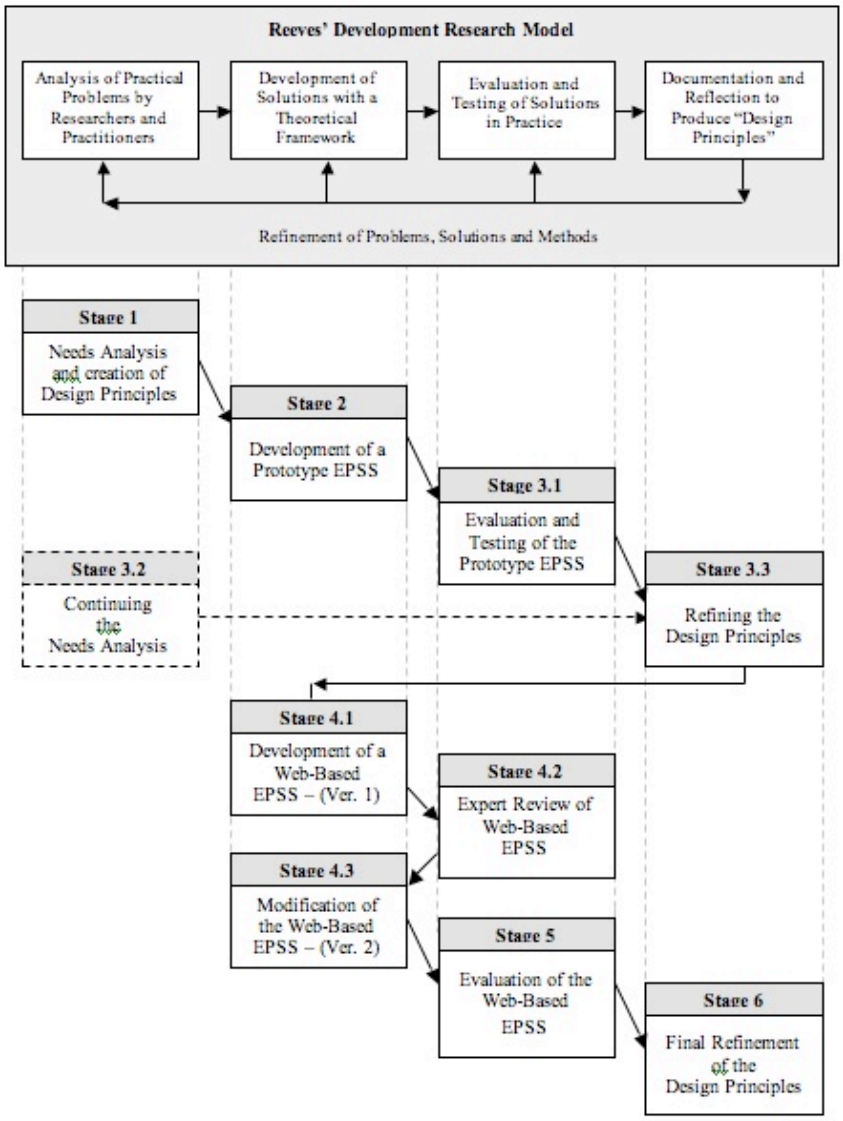
Figure 1: Development Approach to Research Reeves' (2000)



Reeves' illustration clearly shows four distinct phases of the development research process. In order to accommodate these four phases and the cyclic nature of development research, this study was conducted in 6 stages.

A diagrammatic outline of these 6 stages and how they relate to Reeves development research model can be seen in Figure 2.

Figure 2 An outline of how Reeves' (2000) Development Research model provided a base for the methodology used in this project



A detailed breakdown of the six stages shown in Figure 2 is given below:

Stage 1 involved an initial needs analysis to identify what issues practitioners (i.e., K-12 teachers) faced when they attempted to combine learning objects with a learning design. Data for the needs analysis was gathered during and subsequent to a series of four 2-hour workshop sessions in which participants created WebQuests (i.e., learning designs) which incorporated learning objects. The data collected came from: a general information questionnaire about the background of the participants; field notes taken by two observers in the workshop sessions; resource sheets completed by the participants indicating where and why they selected the learning objects used; post workshop interviews with the participants; and, evaluations of the participants' completed WebQuests. This data was then used to create a series of design principles to guide Stage 2. These design principles were in the form of heuristic statements or single sentence 'rules of thumb'.

Stage 2 of the project involved the development of a prototype EPSS designed to support practitioners as they attempted to combine learning objects with learning designs. The underlying structure of the prototype was based on the design principles created in Stage 1, as well as guidelines for developing electronic support systems revealed by a review of literature on the topic. The prototype took the form of a paper-based flowchart, WebQuest templates and a supporting web site.

The third stage of the research involved evaluating and testing the prototype EPSS as well as continuing the needs analysis and refining the design principles. Data for this stage was gathered during and after a subsequent series of four 2-hour Workshop sessions in which participants created learning designs in the form of WebQuests which incorporated learning objects. To ensure reliability the workshop and data collection and analysis techniques were the same as the Stage 1. The analysed data of the project thus far was then used to inform the refinement of the design principles.

Stage 4 of the research process entailed the design and development of a web-based EPSS. The structure and content of the system was based on the design principles developed in this project. This stage also involved an expert evaluation, and subsequent modification of the web-based prototype.

The penultimate stage of the research involved evaluating and testing the web-based EPSS with practitioners within another a similar workshop setting. The workshop was conducted in a similar fashion to the workshops in Stages 1 and 3, and as in these stages data was collected via questionnaires, field notes, resource sheets, interviews and evaluations of the participants completed WebQuests.

The sixth and final stage involved the refinement and continued development of the series of design principles based on the analysed data from Stage 5.

Discussion

The application of these six stages with a real world problem gave the opportunity to critique Reeves' (2000) development research model. This opportunity showed a number of strengths of the research framework, as well as several areas that need improving. These strengths and possible areas for improvement are discussed below in relation to the four phases of Reeves' model.

Analysis of Practical Problems by Researchers and Practitioners

This phase of the development research model was implemented twice during the study, initially at the start of the study, and then it was revisited during Stage 3. A major issue associated with this phase related to the decision of what data to collect and how to collect it. The answers to these questions will vary depending on the research, however, in this study data was collected via questionnaires, observations, resource sheets, evaluations of the participants completed WebQuests, and post workshop interviews. This method of data collection provided more than enough information to give detail descriptions of the practical problems faced by the practitioners.

Development of Solutions with a Theoretical Framework

The second phase in Reeves' development research model involved developing a solution to solve problems identified in the first phase. This step was difficult to implement as it required two other additional steps. Firstly, design principles needed to be derived and constructed from the initial needs analysis, and secondly existing design principles reported in currently literature needed to be considered. These additional steps were vital in this study as they combined current research and informed solutions to a real world problem.

Evaluation and Testing of Solutions in Practice

The third phase of Reeves' development research model involved evaluating and testing the constructed solution. This step initially appeared straight forward, however in practice, if Reeves' model was to be closely followed it was harder to implement. An example of this issue came from Stage 4.2 of this study, where the developed EPSS was reviewed by experts. Expert reviews are considered the "life blood" of the development process (Reeves & Hedberg, 2003) as they have the ability, not only to provide feedback about whether a developed system meets its objectives, but they also provide a form of quality control (Clark, 1995). This necessary procedure in the development the EPSS, and the subsequent modifications of the EPSS forced the researcher to amend Reeve's model and take a step backwards to redevelop the solution without producing any design principles. An example of this backwards step can be seen after Stage 4.2 in Figure 2. If Reeves' model was to be followed exactly design principles should have been produced directly after this step, instead the EPSS was refined before being evaluated and tested.

Documentation and Reflection to Produce "Design Principles"

The final phase of Reeve's model involved the production of a series of design principles. This phase proved to be the strength of the model as these practically tried and scientifically tested design principles actually do provide solutions to real world problems. Consequently no issues were found with this phase.

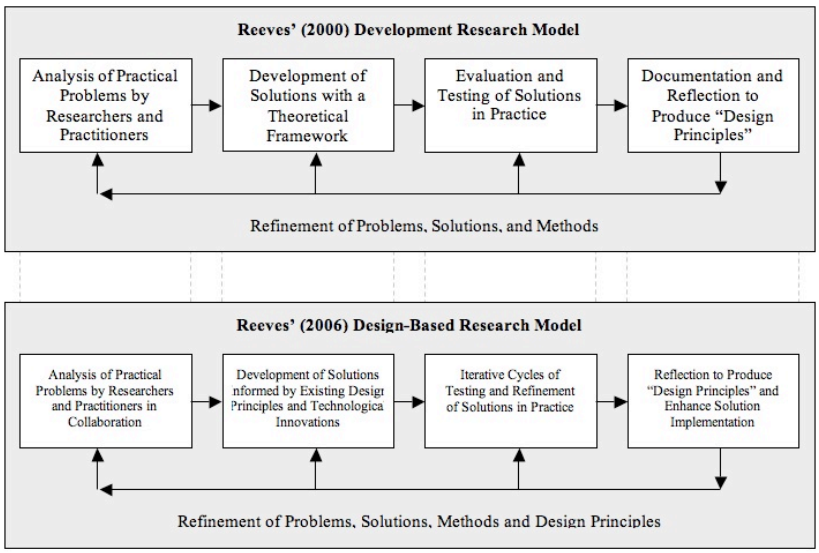
Conclusion

During the time taken to conduct this research, Reeves' (2000) development research model evolved, with the name of the model also evolving. Reeves (2006) has elected to call his second version of the original development research "design-based research". This model while structurally the same does contain a number of significant modifications. An overview of this evolution can be seen in Figure 3.

The similarities of the two models shown in Figure 3 are obvious through the design and layout of the models, however the minor changes in the descriptions involved in each step are significant, particularly the second and third steps. The second step in Reeves' 2006 design-based research model includes the introduction of existing design principles. Interestingly, the concept of these existing design principles directly mirror issues associated with this step in this study. The other major change in Reeves' current model is iterative cycles introduced in the third step. Interestingly again, this change can also be seen to mirror the design, development, expert review and modifications seen in Stage 4 of this study. The reason why these two points are interesting is that the changes Reeves made to his model accurately reflect the necessary steps involved in this real-world

study, indicating support for the modifications of Reeves' design-based research model.

Figure 3 The evolution of development research into design-based research



In conclusion the issues associated with implementing Reeves' development research model appear to have been resolved in his revised design-based research model. Although to what extend will only be decided through future testing and research.

Acknowledgments

s.

References

Bannan-Ritland, B., Dabbagh, N., & Murphy, K. (2002). Learning Object Systems as Constructivist Learning Environments: Related Assumptions, Theories and Applications. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects* (pp. 61-98). Bloomington, Indiana: AIT/AECT.

Bratina, T. A., Hayes, D., & Blumsack, S. L. (2002). Preparing Teachers To Use Learning Objects. *Technology Source, Nov-Dec 2002*.

Dodge, B. (1995). Some Thoughts About WebQuests. Retrieved 25th March, 2004, from http://webquest.sdsu.edu/about_webquests.html

Friesen, N., Roberts, A., & Fisher, S. (2002). CanCore: Metadata for Learning Objects. *Canadian Journal of Learning and Technology, 28*(3).

Goodyear, P., Avgeriou, P., Baggetun, R., Bartoluzzi, S., Retalis, S., Ronteltap, F., et al. (2004). Towards a pattern language for networked learning. In S. Banks, P. Goodyear, V. Hodgson, C. Jones, V. Lally, D. McConnell & C. Steeples (Eds.), *Networked Learning 2004* (pp. 449-455): Lancaster University Lancaster.

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *Educational Technology Research and Development, 29*(2), 75-91.

Hand, T., Gosper, M., Woo, K., Gibbs, D., Kerr, S., & Rich, D. (2004). Learning objects: User perspectives on the conditions surrounding their use. In P. Kommers & G. Richards (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2004* (pp. 66-72). Lugano, Switzerland: Chesapeake, VA: AACE.

Herrington, J., McKenney, S., Reeves, T., & Oliver, R. (2007). Design-based research and doctoral students: Guidelines for preparing a dissertation proposal. In *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2007* (pp. 4089-4097): Chesapeake, VA: AACE.

IMS Global Learning Consortium. (2003). IMS Learning Design specification V1.0. Retrieved 25 August, 2005, from http://www.imsglobal.org/learningdesign/index.cfm

Johnson, L. (2003). Elusive Vision: Challenges impeding the learning object economy. Retrieved 15th May, 2005, from http://download.macromedia.com/pub/solutions/downloads/elearning/elusive_vision.pdf

Laurillard, D., & McAndrew, P. (2003). Reusable educational software: a basis for generic learning activities. In A. Littlejohn (Ed.), *Reusing online resources. A sustainable approach to e-learning* (pp. 81-93). London: Kogan-Page.

McCormick, R., Scrimshaw, P., Li, N., & Clifford, C. (2004). CELEBRATE Evaluation report (version 2) [Electronic Version]. Retrieved December 23, 2004 from http://www.eun.org/eun.org2/eun/Include_to_content/celebrate/file/Deliverable7_2EvaluationReport02Dec04.pdf.

Porter, A. C., Garet, M. S., Desimone, L., Yoon, K. S., & Birman, B. F. (2000). *Does professional development change teaching practice? Results from a three-year study*: Department of Education, Washington, DC. Office of the Under Secretary.

Reeves, T. (2000). Enhancing the worth of instructional technology research through "design experiments" and other development research strategies. Paper presented at the Annual AERA Meeting, April 24-28, New Orleans. Retrieved 15th Oct, 2003, from http://it.coe.uga.edu/~treeves/AERA2000Reeves.pdf

Reeves, T., Herrington, J., & Oliver, R. (2004). A Development Research Agenda for Online Collaborative Learning. *Educational Technology, Research and Development, 54*(4), 53-66.

Suthers, D. D. (2001). Evaluating the Learning Object Metadata for K-12 Educational Resources. Retrieved September 29, 2003, from http://lilt.ics.hawaii.edu/lilt/papers/2001/suthers-icalt-2001-lom.pdf

The LAMS Foundation. (2006). LAMS: The Learning Activity Management System. Retrieved 12th July, 2006, from http://lamsfoundation.org/

The Learning Design Project. (2003). Learnng Designs: Products of the AUTC project on ICT-based learning designs. Retrieved 10th July, 2006, from http://www.learningdesigns.uow.edu.au/index.html

van den Akker, J. (1999). Principles and Methods of Development Research. In J. v. d. Akker, R. Branch, K. Gustafson, N. Nieveen & T. Plomp (Eds.), *Design approaches and tools in education and training* (pp. 45-58). Dordrecht: Kluwer Academic Publishers.

Wiley, D. (2000). Connecting Learning Objects to Instructional Design Theory: A Definition, a Metaphor, and a Taxonomy. In D. A. Wiley (Ed.), *The Instructional Use of Learning Objects: Online Version*. Retrieved 14th October, 2003, from http://www.reusability.org/read/

Wiley, D. (2003). Learning Objects: Difficulties and Opportunities. Retrieved April 7, 2003, from http://wiley.ed.usu.edu/docs/lo_do.pdf

Contact: wcotton@usyd.edu.au

Cite paper as: Cotton, W. (2008). Supporting the use of learning objects in the K-12 environment: A design-based research project. In I. Olney, G. Lefoe, J. Mantei, & J. Herrington (Eds.), *Proceedings of the Second Emerging Technologies Conference 2008* (pp. 48-55). Wollongong: University of Wollongong.

Copyright © 2008 Author/s: The author/s grant a non-exclusive licence to UOW to publish this document in full on the World Wide Web within the Emerging Technologies conference proceedings. Any other usage is prohibited without the express permission of the author/s..