Reuse in Modelling Instructional Design

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Background

In recent years, there have been many advances in learning theories, instructional design and the technologies of development and delivery educational systems. The usage of computer-based interactive technologies in education seems to have presented a broad range of possibilities to create powerful presentations and instructional messages. Rapid development of networking and communication technologies further empowers the student learning experience (Latchman et al., 1999). However, incorporating these new technologies effectively in education is not a simple task as many factors still need to be considered such as social and cognitive aspects, psychology, and human-computer interaction issues (Sims, 1997).

Learning theory can be classified into three perspectives: Behaviourism, Cognitivism, and Constructivism (Mergel, 1998). These learning theories often guide the design of learning environments and activities, specially the process of how students learn. Instructional Design (ID) incorporates learning theories. Instructional Design is defined as “science of creating detail specifications for the development, evaluation, and maintenance of the learning situations of subject matter” (Richey, 1990). In other words, ID is a mechanism to systematically analysing, designing, developing, implementing, and evaluating instruction with the intention to improve students’ learning and performance in a variety of settings in educational institutions or workplaces.
ID is treated as a technology for the development of learning infrastructure (i.e. process and environment) which facilitate student’s acquisition of knowledge and skills (Merrill et al., 1996). ID is a complex process, which involves Analysis, Design, Development, Implementation, and Evaluation, also known as the ADDIE model. The ADDIE model is an iterative evolutionary process where activities in each phase lead from one to the other and dynamic in nature in order to ensure continual refinement during the creation of learning material. Working in such a flexible model enables instructors to design authentic learning tasks that initiate, facilitate, or stimulate effective learning (Hoogveld et al., 2002; Nichols, 2003).

Automated instructional design (AID) potentially eases in supporting the ID process (i.e. Analysis, Design, Development, and Evaluation) by using computer algorithms. Instructors might need cognitive scaffolding in ID activities such as understanding instructional strategies (e.g. methods and techniques), applying the instructional strategies to meet the learning goals, organizing the instructional strategies, referencing from other resources, and evaluating the effectiveness of the instructional strategies based on the feedback from students (Schweizer, 1999). A well-designed AID can greatly simplify many tasks and reduce the need to train novice instructors. Tasks that at one time might require days or weeks could now be accomplished in minutes or hours.

AID can enable utilization of ID as a dynamic model consisting of codified tacit knowledge (e.g. Merrill’s knowledge objects). In this case, AID functions as a tool to scaffold refinement of instructors’ mental models during planning and designing of instruction. Assimilation and accommodation of their mental models will result in an iterative loop of updates and refinements.
OntoID

First, ID practices currently are often implemented with one learning theory in mind, rather than a continuum of learning theories. Applying only a certain learning theory in ID seems could be relevant for only certain learning situations. Each learning theory has its strength and weakness thus we should not restrict to theory-specific learning systems, which are not extensible. We intend to encourage instructors to use eclectic strategies (i.e. methods and techniques), throughout the Behaviorist, Cognitivist, and Constructivist continuum, to create layers of ID that suitable for different needs at different stages of instruction. OntoID (Fig. 1) explicates methods and techniques across learning theories for instructors to choose according to the students’ needs.

Second, young instructors who lack teaching experience often face anxiety during the lesson analysis, design and development phases in ID. An effective AID should be able to assist instructors physically (e.g. increasing productivity by reducing costs) as well as cognitively (e.g. scaffolding the information processing of cognitive operation and decisions) in ID. OntoID offers cognitive scaffolding in order to increase instructors’ cognitive skill level and help them to reach better ID decision. OntoID enables systemic and visualised instructional design environment through analysis, design, development, and evaluation that helps the instructors especially novices have “big picture” of ID world. Besides, the auto-generated instructional design suggestions, the step-by-step pedagogical guide, the ID cases and the instant help utilities in OntoID assist the instructors to reduce cognitive overload throughout the ID process as well as refining their knowledge to make better instructional decisions.
Third, there always exists common solution to problems in a context. Such common solution or design pattern may help instructors to resolve recurring learning situations in instructional design. Incorporating design patterns (especially structural and creational) in instructional design enable rapid prototyping as well as reuse and extensibility of pedagogical data and knowledge. The Eclectic Instructional Design Builder pattern is adapted from the “Gang-of-Four” software design pattern (Gamma et al., 1995) to enable reusability and extensibility in the architecture of instructional design tool. The Unified Content Model pattern is also adapted (Gamma et al., 1995) to resolve dynamic assembly and retrieval of learning resources in various learning object models or standards.

Fourth, the dilemma of “knowledge loss” could happen in some universities as the instructors retire or leave the universities. As such, pedagogical tactic knowledge that remains in the minds of the instructors should be captured, codified, and evaluated to formulate teaching and learning scenarios and best practices. Codified knowledge needs to be managed and structured efficiently within contexts of use in order to ease knowledge sharing through more effective knowledge reuse. OntoID provides a framework to capture tacit knowledge from the instructors, codify this knowledge to enable knowledge sharing, and enable instructors to evaluate this codified knowledge to form best practices (successful techniques and tasks which carried out in the actual classroom).

**Summary of Chapters**

Chapter 1 presents current ID issues, proposed solution, significance of study, methodology, and overview of chapters in this thesis. Chapter 2 presents a literature
review of educational model, instructional design model, automated instructional design, and design patterns. Related studies also elaborated in this chapter. Chapter 3 presents the Eclectic Instructional Design Builder pattern in ID architecture and the Unified Content Model pattern in learning object. Chapter 4 presents the architecture and features in OntoID automated instructional design tool. Chapter 5 presents method of investigation. Chapter 6 presents analysis of data, discussion, and conclusions. Chapter 7 summaries and concludes the main contribution of the thesis.

Figure 1 OntoID automated instructional design tool
References


