Learning Design Palette:
An Ontology-aware Authoring System for Learning Design

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Abstract: We introduce our Learning Design Palette which is a cost-effective and ontology-aware authoring system for Learning Designs. The Learning Design Palette is designed in compliance with some international standards in order to enhance shareability and reusability of Learning Designs. We also introduce briefly the standards in this paper. The Palette has three advantages in its supporting functions: first, it reduces the complexity of design processes for Learning Design of blended learning. Second, users of the Palette can create Learning Designs in compliance with international standards, and reuse other Learning Designs as long as the Designs conform to the standards, no matter the users do not know them. Third, the Palette can provide to the users effective Design Patterns as partial Learning Designs inspired by Learning Theories in order to enhance reuse of Learning Designs and bridge between theories and practices.

Keywords: Instructional design for e learning, Ontology in education, Authoring systems and tools, Standardization of learning technologies, Computer-Supported Collaborative Learning (CSCL)

Introduction

The idea of e-learning, which is also known as Technology Enhanced Learning or Digital Learning, brings us so many opportunities of learning and training: we can learn anytime and anywhere. At the same time, the importance of self-directed learning and life long learning has been emphasizing. In the e-learning environment, we often have no instructor and can learn as we like. Who can ensure educational benefits in such environment? How can we confirm exactly what we learned?

There are many learning styles such as Individual Learning, network-based Collaborative Learning, Lecture, etc. We can select appropriate learning styles from a variety of the learning styles depending on what educational benefits we want to get through the learning session. The flexibility provides us many candidates for learning, and also brings us the difficulty in selecting what appropriate learning style is. The concept of "Blended learning" has been well known, which is a mixture of various learning styles. Many instructors and educational practitioners will want to blend some learning styles depending on their learning objectives (expected educational benefits for learners), learners' states, and so on. The educational benefits also have been diversified. Traditional teaching-learning process tended to emphasize the process of knowledge acquisition, especially it was important how to memorize knowledge in textbooks and make a structure of the knowledge into the learners' minds. For the last two decades, interaction and collaboration among learners, learning environments, and resources have been emphasized, and skills for such learning activities have been getting more important. On the other hand, in the e-learning environment, there are many learning management systems (in short, LMS), and Learning Resources such as learning contents, tools, and learning support systems with some intelligence (i.e., Intelligent Educational Systems). These LMSs and Learning Resources are developed for certain learning objectives in a specific context, and many of them are not interoperable and reusable. To construct original Learning Design which includes the Learning Resources; a learning plan; learning goals; designs of technical environments; support systems; arrangements of learners; arrangements of

interaction among learners, instructors, and the Learning Resources; etc. needs too many costs, and the low-compatibility is inconvenient for users.

So, to solve these problems, we have been conducting a project to construct a supporting environment to design, analyze, and execute learning processes, and to reuse the data of the processes. As one of the products of the project, in this paper, we introduce our Learning Design Palette which is a cost-effective authoring system for learning designs. The learning design created with the Palette can be shared and reused among users. To reduce the complexity of learning design processes, we design the Learning Design Palette to allow users to describe learning design with phased specifications. It is also useful to enhance reusability of learning designs, because we can rarely find a learning design totally equal with what we want, but we can find partially similar learning designs. On the other hand, to increase the shareability and reusability of the learning design, we refer to international standards concerning information technology on learning, training, and education. Moreover, to enable users to create effective learning designs easily, it would be helpful to store effective learning designs. As effective learning designs, we consider to store learning designs inspired by learning theories, and ones extracted from best practices by other users. We call research findings of human learning processes in psychology, pedagogy, sociology, and cognitive science, the term "learning theories" (for example, Bandura, 1971; Collins, 1991). To bridge between learning theories and actual learning designs, we need the same framework to represent each of them. So, we have been constructing learning goal ontology and representing learning designs inspired by the theories (Inaba, et al., 2000a; 2000b; Supnithi, et al., 1999), and considering recommendation functions which select and recommend suitable learning designs for the users' needs.

In the next section, we describe the importance of instructional/ learning design in e-learning environment and the complexity of learning design authoring. Next, we introduce international standards concerning information technology on learning, education, and training, briefly. And then, we describe our Learning Design Palette on its conceptual structure and advantages.

Instructional Design and Authoring Systems for Learning Design

Importance of Instructional/ Learning Design

As we mentioned in the previous section, we have big problems: we are exactly not sure what we learned, and there is no (social) system to ensure educational effects for us. So, we recognize the value of individually tailored instruction/ learning. The promise of training technologies depends on their ability to tailor instruction/ learning to the needs of individuals. In contrast to classroom learning, these approaches fit the pace, sequence, content, and method of instruction to each learner's learning style, objectives, and goals. These technologies allow individually tailored learning to be delivered anytime, anywhere, and to anyone who needs it. Such accessibility pays off both for the individual who wishes to advance knowledge, skill, and career opportunities and for the organization that depends on his or her growing competencies to compete successfully in the global marketplace (ADL, 2004). To realize it, sophisticated learning designs are required. If there is no design, it is hard to expect what educational benefits will be acquired by a learner and also support the learner. Therefore, instructional and/or learning design should be liable for educational benefits through the learning process.

Recently, international standardizations have been developed in the area of learning technology; such as LOM (IEEE LTSC wg12, 2002), SCORM (ADL, 2004), and IMS-Learning Design (IMS, 2003). Many people have been engaging to establish international standards which work as common data models and meta-languages for Learning Resources, which mean learning support software and learning objects, in e-learning environment. The models and meta-languages are expected to contribute to an increase in compatibility, reusability, and interoperability of the Learning Resources. At the same time, the contribution also involves de-contextualizing of the Learning Resources. Since the Learning Resources are pedagogical neutral, they do not have specific pedagogical/ instructional/ learning theories and models (Allert, et al., 2003). Most learners have no instructor, and it is desired to manage their learning processes in themselves in the life-long learning environments and self-directed learning environments. However, it is hard for learners to lead themselves into effective learning processes with such pedagogical neutral Learning Resources. So, we need sophisticated models of effective Learning Designs to construct tailor-made Learning Designs for us with the de-contextualized Learning Resources.

Although many instructional design theories and learning theories have been developed, there is a gap between the theories and actual learning designs. Why does the gap exist? One of the reasons, why the designers of learning processes and learning resources do not refer to the theories, is that they do not know the theories and it is difficult to understand the theories for them, because they are not experts of the theories. Useful data should be used by users, even if the users are not experts in the area. So, it is one of our research problems: how do we make it possible?

Complexity of Learning Design Authoring: Diversity of Learning Styles and Educational Benefits

Due to the diversity of educational benefits that learners want to get through their learning processes, learning styles, and learning resources; there are many factors that the designers should consider. A Learning Design also must be complex, and there are considerable variations. In the case of blended learning, the complexity and diversity increase more and more. Variations of Learning Designs can be regarded as a combination of several learning styles. Considering a specific learner, some Designs will be effective, and some will not be. It is beneficial and cost-effective to reuse the designs to create tailor-made Learning Design for a specific learner. To make it possible, we need an elaborated authoring system for Learning Design.

From the analysis of the current state of the art of the educational systems research (Mizoguchi & Bourdeau, 2000; Redfield, 1997) it appears that there is a deep conceptual gap between authoring systems and the authors. The authoring tools are neither intelligent nor user-friendly. Special-purpose systems provide extensive authoring guidance, but the disadvantage is that changing such systems is not easy, and the knowledge and content can hardly be reused for other educational purposes (Murray, 2003). All this means that structured authoring guidance is needed in this complex design process (Aroyo, et al., 2004).

We can use different authoring tools to construct Learning Resources: learning contents authoring, metadata authoring for the learning objects, courseware authoring (Jin, et al., 1999), and intelligent educational system authoring (Aroyo, et al., 2004; Murray, 2003), however, there is few authoring tools to construct Learning Designs. Moreover, we have not had yet a Learning Design authoring tool for blended learning which is a mixture of learning styles, and a learning management system which interprets and executes such a complex Learning Design. It is also important the Learning Design that the authoring tool creates is reusable, and can be interpreted by many LMSs even if it is partial. Therefore, we divide the Learning Design into several layers, and we adopt data models in compliance with some international standards. Next section, we introduce some standards for learning support technologies.

Reusability and Interoperability of Learning Designs

Remarkable efforts have been invested in standardizations of data models and vocabularies concerning Learning Resources to enhance reusability and interoperability of them, and to increase effectiveness of e-learning environment. Especially, Learning Object Metadata (LOM) (IEEE LTSC wg12, 2002), Shareable Content Object Reference Model (SCORM) (ADL, 2004), and IMS-Learning Design (IMS-LD) (IMS, 2003) became frequently referred to and actual standards. We briefly introduce these three standards and two more standards which are developing now and focus on collaborative learning.

LOM, SCORM, and IMS Learning Design

LOM

The IEEE Learning Technology Standards Committee (LTSC) has been providing for the development and maintenance of the LOM standard since 1997. The LOM standard specifies the syntax and semantics of metadata for Learning Objects, defined as the attributes required to fully/adequately describe a Learning Object. Learning Objects are defined here as any entity, digital or non-digital, which can be

used, re-used or referenced during technology supported learning. The LOM standard focuses on the minimal set of attributes needed to allow these Learning Objects to be managed, located, and evaluated (IEEE LTSC wg12, 2002).

We can describe and share information about Learning Objects in compliance with the LOM standard. The information is divided into nine categories: General which is general information such as identifier, title, language, keywords, etc.; Life Cycle including version and status; Meta-Metadata which shows the metadata scheme, information about creator of the metadata, etc.; Technical which means format, size, system requirements, location of the resource, etc.; Educational including interactivity type, learning resource type, interactivity level, difficulty, and intended user; Rights including costs and copyright; Relation which means relation between the target object and other objects; Annotation including information of the creator of the learning object and created date of the object; and Classification shows purpose, kind of taxonomy, keywords, etc.

SCORM

Prior to 1999, many organizations like ARIADNE (1996), AICC (1998), IEEE LTSC (1997), and IMS (1997) were drafting a variety of different standards and/or specifications. This variety affected different aspects of Web-based learning systems and also lacked a common framework. The Department of Defense (DoD) and the White House Office of Science and Technology Policy (OSTP) launched the Advanced Distributed Learning (ADL) Initiative in 1997. The mission of the ADL Initiative is to provide access to the highest quality education and training, tailored to individual needs, delivered cost-effectively anytime and anywhere. As a foundation for accomplishing those goals, ADL's SCORM aims to foster creation of reusable learning content as "instructional objects" within a common technical framework for computer and Web-based learning. SCORM describes that technical framework by providing a harmonized set of guidelines, specifications, and standards based on the work of several distinct e-learning specifications and standards bodies. These organizations continue to work with ADL, developing and refining their own e-learning specifications and standards, and helping to build and improve SCORM.

SCORM puts together a model for creating and deploying e-learning that assumed the presence of strong, server-side, LMS-based learning content distribution. SCORM targets the Web as a primary medium for delivering instruction. It does so under the assumption that anything that can be delivered by the Web can be easily used in other instructional settings that make fewer demands on accessibility and network communications. By building upon existing Web standards and infrastructures, SCORM frees developers to focus on effective learning strategies. To realize a common reference model, SCORM adapts the object properties into high-level requirements for all SCORM-based e-learning environments. These requirements are known as ADL's "ilities," and they form the foundation on which all changes and additions to SCORM are based. These "ilities" are as follows (ADL, 2004):

> ***Accessibility**: the ability to locate and access instructional components from one remote location and deliver them to many other locations.*
>
> ***Adaptability**: the ability to tailor instruction to individual and organizational needs.*
>
> ***Affordability**: the ability to increase efficiency and productivity by reducing the time and costs involved in delivering instruction.*
>
> ***Durability**: the ability to withstand technology evolution and changes without costly redesign, reconfiguration or recoding.*
>
> ***Interoperability**: the ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.*
>
> ***Reusability**: the flexibility to incorporate instructional components in multiple applications and contexts.*

LMS means a suite of functionalities designed to deliver, track, report on and manage learning content, student progress and student interactions. The term "LMS" can apply to very simple course management systems, or highly complex enterprise-wide distributed environments. Within SCORM context, LMS implementations are expected to vary widely. SCORM focuses on interface points between content and LMS environments and is silent about the specific features and capabilities provided within a particular LMS. SCORM Run-Time Environment (RTE) provides a means for interoperability between Sharable Content Object-based learning content (SCO) and Learning Management Systems, and SCORM RTE

Data Model is a standard set of data elements used to define the information being communicated, such as, the status of the learning resource. In its simplest form, the data model defines elements that both the LMS and SCO are expected to "know about." The LMS must maintain the state of required data elements across sessions, and the learning content must utilize only these predefined data elements if reuse across multiple systems is to occur.

IMS-LD

The IMS Learning Design Information Model represents an integration of the Educational Modelling Language (EML) work by the Open University Netherlands (Open University Netherlands, 2000), and existing IMS specifications. A key task of the Learning Design WG in IMS was "the development of a framework that supports pedagogical diversity and innovation, while promoting the exchange and interoperability of e-learning materials". The Open University carried out extensive examination and analysis of a wide range of pedagogical approaches prior to developing EML as a relatively concise 'meta-language' that could capture this diversity. (Koper , 2001).

The IMS LD allows different pedagogical approaches to be integrated into a single 'Learning Design' where different approaches may be appropriate for different types of learners. The meta-language also supports blended learning, enabling traditional approaches such as face-to-face teaching, the use of books and journals, lab work and field trips to be also specified as learning activities and combined with ICT supported learning. A Learning Design is a description of a method enabling learners to attain certain learning objectives by performing certain learning activities in a certain order in the context of a certain learning environment. A Learning Design is based on the pedagogical principles of the designer and on specific domain and contexts variables. The "Learning Design" element is the root element for the IMS LD Specification. The conceptual model shows three levels of semantic aggregation. The semantically highest level is the Learning Design, it aggregates a collection of Components, Objectives/ Prerequisites, and a Method. At the lowest level of aggregation, there are the Resource, Play, Condition and Notification. The resources are aggregated into Components and Objectives/ Prerequisites. The Plays, Conditions and Notifications are aggregated into the Method. (IMS, 2003)

They argued the framework supports pedagogical diversity. Actually, we can describe any pedagogical Learning Designs with the framework; however, each element is de-contextualized and pedagogical neutral. So, if we, who are not experts in pedagogy, want to describe a pedagogical model with it, we need strong support or guide for it.

International Standards for Collaborative Technology for Learning, Education, and Training

The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) form the specialized system for worldwide standardization. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. The main task of the joint technical committee is to prepare international standards. Subcommittee SC 36 of ISO/IEC JTC1 treats Information Technology for Learning, Education, and Training. Especially, working group 2 in the SC36 has been discussing the standards for "Collaborative Workplace (CW)" and "Learner-to-Learner Interaction Scheme (L2L)" for collaborative technology. For these standards, a committee draft and working drafts are available now (ISO/IEC SC36 wg2, 2003a; 2003b), and they are not stable yet.

The JTC1 CW standard defines data models to describe collaborative workplace and collaborative workplace log data. The data model for collaborative workplace is defined as information to set up virtual shared workspace for learners, and includes ID and name of a workplace; group ID in the workplace; Resource ID; Log ID; etc. The data model for log data of collaborative workplace has Time stamp, Workplace ID, Group ID, Trigger ID, Resource ID, and Description (ISO/IEC SC36 wg2, 2003a). The JTC1 L2L standard provides a data model to describe properties of collaborative learning settings. The properties are related to objectives of collaborative learning; expected outcome; evaluation of the outcome; types of groups; involved participants; their roles and their groupings; required learning material and tools; and to the expected learning duration (ISO/IEC SC36 wg2, 2003b). These are intended for supporting to set up a specific collaborative learning setting.

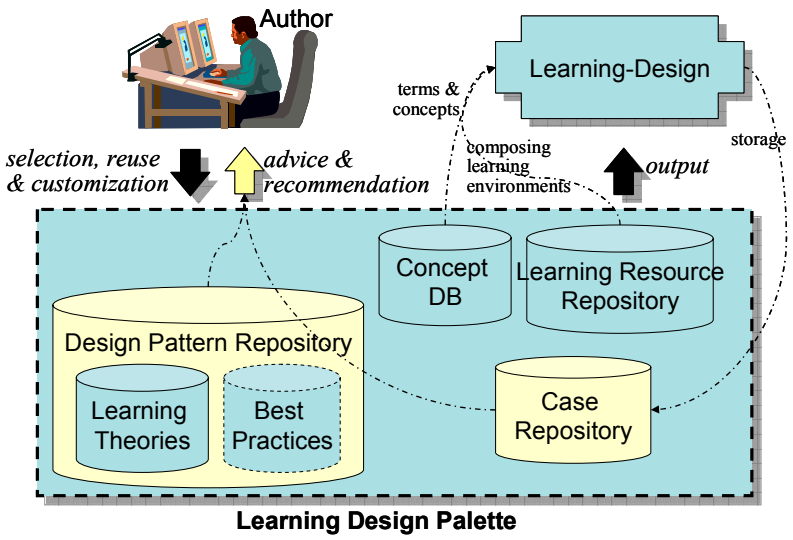

Figure 1: Outline of the Learning Design Palette

If these standards are stable and distributed, specific educational settings for collaborative learning (i.e., learning design for collaborative learning), specific technical settings for collaborative learning (i.e., combination of learning resources), and log data of collaborative learning will circulate, and we will be able to share and reuse them.

Learning Design Palette: An Ontology-aware Authoring System towards Blended Learning

We have been developing an ontology-aware authoring system which we call "Learning Design Palette". The intended users for the Learning Design Palette are designers for Learning Designs, for example, educational practitioners, instructors, course designers and self-directed learners. In this section, we introduce its overview; relations among the standards we described in the pervious section and the Palette; how to use the Palette; supporting functions; and its advantages.

Learning Design Palette

The Learning Design Palette is designed to reduce the cost of creating Learning Designs towards blended learning including collaborative learning. Figure 1 shows an outline of the Learning Design Palette. The Learning Design Palette has Concept DB, Learning Resource Repository, Design Pattern Repository, and Case Repository. The Concept DB is something like a vocabulary to represent Learning Design. Each concept defined in the DB is labeled with a term distinguishable from others. All elements in Learning Designs are represented with the terms in the concepts DB, and we use labels in our ontology as the vocabulary (Inaba, et al., 2001). A design pattern in the Design Pattern Repository is a conceptual partial structure of a Learning Design. The pattern represents typical structure of concepts and can be referred by designers as a design template. There are two types of Design Pattern Repositories: One stores design patterns inspired by Learning Theories, and another stores design patterns abstracted from Best Practices of designers and educators. We store three types of patterns; Learning Group, Learning Activity, and Learning Room. The Learning Resource Repository stores various learning resources: materials and tools with metadata. The Case Repository stores Learning Designs that are learning scenario and description of educational and technical settings.

The Learning Design Palette can interpret SCORM and LOM to search, reuse, and recommend existing Learning Resources to the authors. Although the Palette does not have the functions to edit metadata and to create Learning Resources themselves, it can collect, search, and use of them suitable to the authors requirements, if adequate Learning Resources with metadata exist in worldwide. The data format of Learning Design conforms to SCORM, IMS LD, JTC1 L2L, and JTC1 CW. We will construct our LMS in compliance with SCORM-RTE, and expand the LMS which can interpret the IMS LD, JTC1 L2L, and

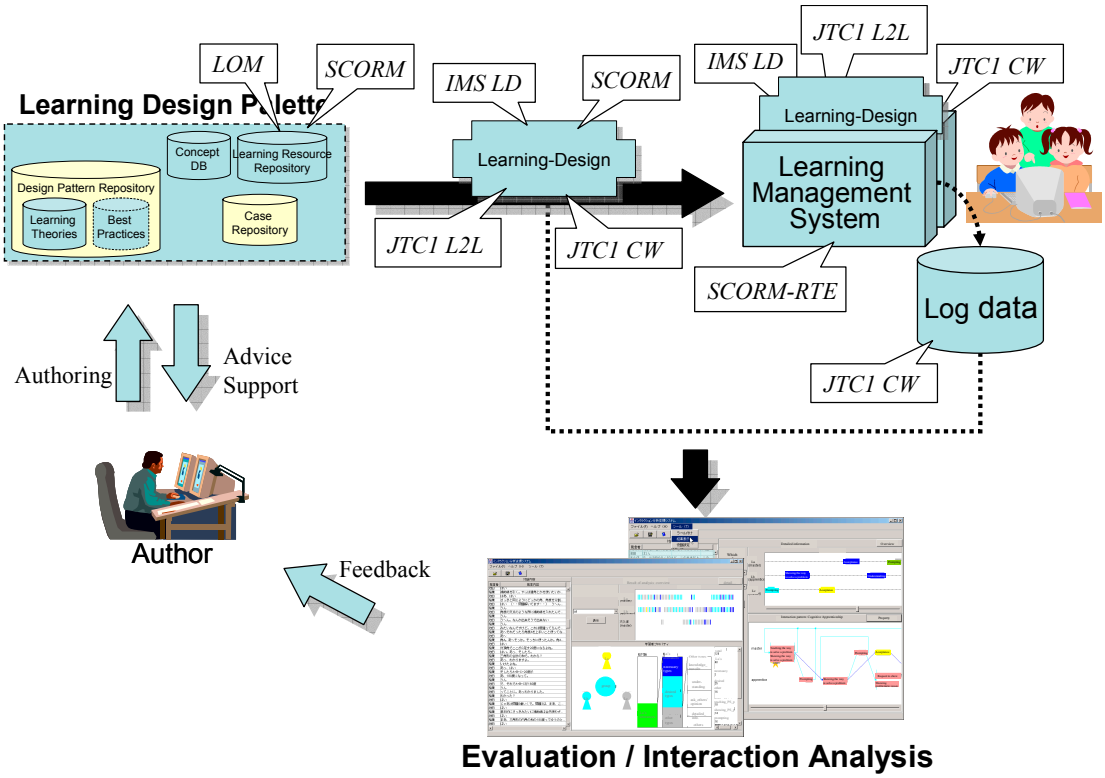

Figure 2: International Standards and the Learning Design Palette

JTC1 CW. Then, the LMS can provide learners various learning environments in various orders without minding what the learning style is (i.e., the LMS can interpret any learning style; individual learning, collaborative learning, group learning with an instructor, and so on). The data format of log data of the LMS conforms to JTC1 CW. Then, an effective tool for interaction analysis is expected to be developed in compliance with the JTC1 L2L and JTC1 CW, because we can get both the plan (i.e., design intention) of collaborative learning and the result of it (i.e., log data), and construct a tool to interpret both of them and compare them. We have already developed a theory-based interaction analysis support system (Inaba, et al., 2002). So, we will improve the data model of the system in compliance with the appropriate standards. Figure 2 shows the relations among the standards and the Palette.

Functions and Advantages of the Palette

Figure 3 shows examples of interface during creating a Learning Design with the Learning Design Palette. First, a user creates a "Learning Process" in the main window (Figure 3 a). Each Learning Process is shown as an icon of a folder. The user can connect Learning Processes each other as a sequence or a structure. If the user selects one Learning Process, another window (b) appears, and the user can set the Learning Process in detail: for example, Learning Style for the Process, Learning Activities in the Process, and Learning Environment (we call it "Room") for the Process. If the Palette requires more detailed information, another window (c) appears. In this figure, the user selects "group learning with role-assignments" as a Learning Style for Learning Process "Experiments". So, some information is required: what Learning Goals are set to each learner and what Role is assigned for each. When the user finishes setting all information that the system requires, the system reifies the Learning Design as Direct Manipulation Interface (Figure 3 d). The user also can modify the Learning Design, and add some elements on this window. Through these operations, the user can create complex Learning Designs in step by step.

Figure 4 shows the phases to set a Learning Design. The top level concept is "Learning Design", and the Learning Design is represented as a set of "Learning Processes" and a set of "Goal of the learning unit". The "learning unit" means duration of learning represented in the Learning Design. A Learning Process is represented as "Arrangement of learners (Learning style)", a sequence of "Learning Activities", and "Learning Room (Environment)". A Learning Style is selected from Individual Learning, Lecture, and Group Learning. If the user selects the Group Learning, the system requires more information on

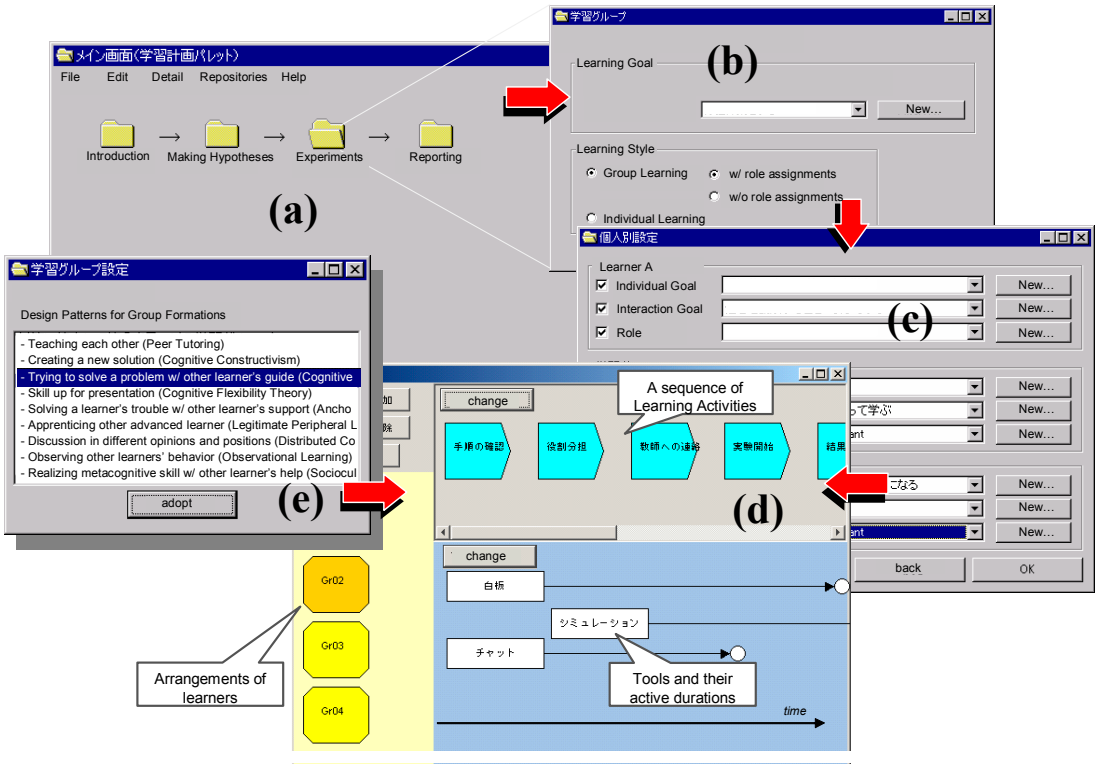

Figure 3: An Example of the Learning Design Palette

arrangement of learners: such as learner's Role and Goals for each learner (both Individual goal and Interaction goal). A Learning Room is a set of Learning Resources like Tools and Learning Materials. A sequence of Learning Activities is represented as a sequence of Support Activities which mean activities by instructors and systems to support learners, and a sequence of Learning Activities which mean activities by learners.

The Learning Design Palette has three advantages in its supporting functions for users of the Palette. First, the users can create complex Learning Design as a result of a set of simple operations. The user is not required to consider all elements to be designed simultaneously, because the Palette knows required elements for each Learning Style, and provides candidates for each element step by step depending on its layer. Most operations can be done by a mouse, and the system stores and provides typical candidates in each category as a list. If there is no candidate that the user feels appropriate, the user can create and define new one and store it in the Palette. The Palette covers a Learning Design of blended learning reasonably, because each Learning Design can be represented as a set of Learning Processes, and each Learning Process can have its own Learning Style. So, blended learning is represented as a simple sequence of Learning Processes with different Learning Styles. When the user finishes creating the Design, he/she can see and check the Design as a reified diagram.

Second, the Learning Design is reusable and shareable. The Learning Design as output of the Palette conforms some international standards. So, if many Learning Designs in compliance with the standards exist in worldwide, the users can refer to, adopt, and customize them for their own Learning Design. It contributes to enhancement of shareability, reusability, interoperability, and compatibility of Learning Designs.

Third, the Learning Design Palette is an ontology-aware authoring system for Learning Design. The Palette can provide to the users effective Design Patterns of partial Learning Design inspired by Learning Theories. As we describe in the previous section, the Palette has Design Pattern Repository. We prepare Design Patterns on Learning Group, Learning Activity, and Learning Rooms. Especially, there are typical patterns of Learning Group in the learning theories, so we have been extracting the patterns and proposing a system of concept to represent them as Collaborative Learning Ontology (Inaba, et al., 2000a; 2000b; Supnithi, et al., 1999). If the user wants to refer to design patterns, the system can provide a list of the patterns like window "e" in Figure 5. The user can see what the pattern is, and adopt it in his/her Learning Design to simply click "adopt" bottom in the window. Of course, after adopting it in the Learning Design, he/she can customize it to fit his/her needs. As Figure 1 suggests, the Learning Design Palette has a function to recommend appropriate Design Patterns from the Repository. The Palette could

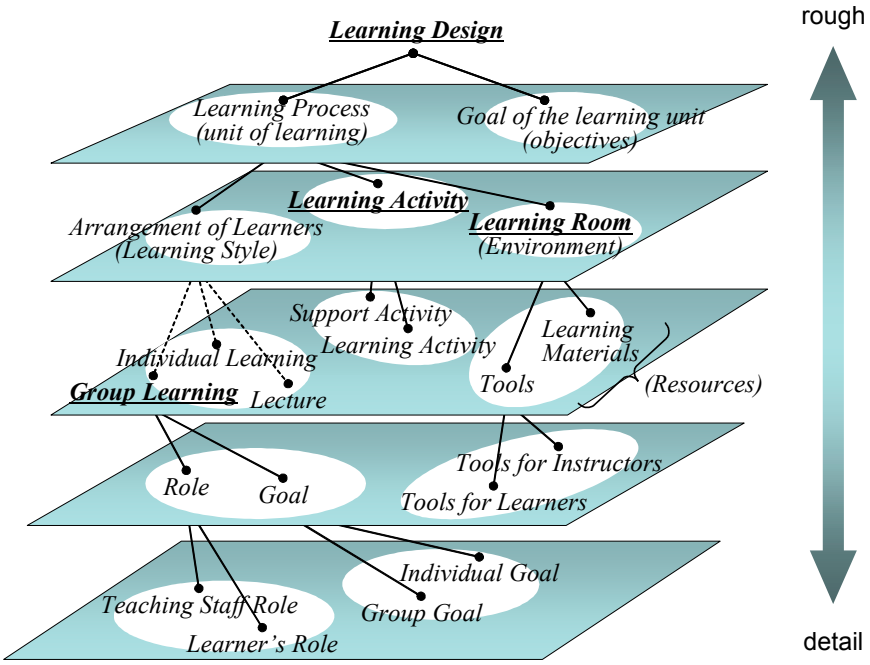

Figure 4: Phased Specifications in the Learning Design Palette

explain relevant theories in response to the user's request: it could give the user some possible justifications for teaching and learning strategies from a theoretical point of view. In the case of the Learning Group, if the user asks the Palette to recommend appropriate Design Patterns, the Palette asks the user what readiness of the intended learners and what learning goals the user wants learners to acquire through the group learning. Since the Palette has some typical patterns of Learning Group inspired by learning theories, the Palette searches its Repository, recommends some patterns if the Repository has appropriate patterns, and explains why the patterns are appropriate for the learners.

Concluding Remarks

We introduced our Learning Design Palette which is a cost-effective authoring system for Learning Designs. The Learning Design Palette is designed in compliance with some international standards in order to enhance shareability and reusability of Learning Designs. The Palette has three advantages in its supporting functions: first, it reduces the complexity of design processes for Learning Design. Second, users of the Palette can create Learning Designs in compliance with international standards, and reuse other Learning Designs as long as the Designs conform to the standards, no matter the users do not know them. Third, the Learning Design Palette is an ontology-aware authoring system for Learning Design. The Palette can provide to the users effective Design Patterns of partial Learning Design inspired by Learning Theories. Now, the Palette can provide an ontology-based supporting function in designing of Learning Group. There are some efforts to bridge the gap between theories and actual designs: Test Ontology (Soldatova & Mizoguchi, 2003), and Instructional Design Ontology (Bourdeau & Mizoguchi, 2000). In the near future, we include design support functions based on these ontologies into the Learning Design Palette. Moreover, we will extract patterns on when the learners should switch from one Learning Style to another Learning Style for effective blended learning, and include supporting functions based on the patterns.

Concerning the second problem we described in the first section "how we can confirm exactly what we learned", we will be able to contribute to it by considering evaluation/ interaction analysis support systems which are suggested in Figure 2. Thanks to the international standards and circulation of Learning Designs, we will be able to share design intention of a Learning Design, and expected educational benefits of the Design. If we execute the Design, we can get log data of the process, and evaluate whether actual learning process is consistent with designed learning process or not. In the past Learning Designs, it was hard even to estimate what educational benefits learners got through learning processes according to the Designs, because many of the Designs followed neither any theory nor practical evidence. On the other hand, in theory-based Learning Designs which we have proposed, if

designed activities are observed in the learning process, we can argue the learners should get educational benefits designed in the Learning Designs with justification by Learning Theories.

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