

Integrating Learning Objects into Learning Contexts

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Abstract

The paper describes learning objects in the context of a learning process. It examines options of integrating learning objects into context and supporting the integration with learning activities. The paper then examines the technology needed to support the creation and utilization of learning objects. It suggests customizable portals as the solution. It then illustrates an application to teaching.

Keywords: Portals, Knowledge Management, Learning Objects, Customization

1. Introduction

Learning communities are now beginning to take many forms. There are the conventional classroom situations that still predominate, but increasingly we are beginning to see new forms such as work based learning, distance learning, and virtual universities. Although the learning contexts are different, the material taught can often be based on the same subject material. Increasingly web based technologies are being used to provide services that support these learning environments. Considerable work has taken place in using a variety of such services. Wade and Power [10] for example outlined a number of requirements for computer supported learning systems and described alternate technologies for supporting learning activities. Neal [7] has carried out work on their use in distance teaching emphasizing the delivery of materials. It is however fair to say that much of this research has been in specific settings. Two issues that have been raised as important here are the reuse of learning material in different settings and provision of services through interfaces that are intuitive for learning.

A body of opinion is beginning to form that what is needed, especially for reuse, are learning objects that can be adapted to any of the learning environments. Standards are now being developed for learning objects. Perhaps the two most quoted standards are

the Dublin core (<http://www.dublincore.org>) and the Learning Technology Standards of the IEEE (<http://ltsc.ieee.org>). These standards describe the elements that are used to describe learning objects this enabling access to these objects to be shared across the WWW. Most learning takes place in a context. This context may be a University or it may be a business entity. Learning objects take a new meaning in their context and can better add to knowledge if they are placed in a context. This paper examines the idea of learning objects and ways to deliver them in context. Context, however, is often specific to the learning environment such as a University or business enterprise. The question arises then on how to combine standard learning objects into the learning context. Two options appear possible here. One to include context in the metadata definition of the learning object, or at least include elements to link to a context. The other is to provide higher level services that integrate the standard learning object into the context using the delivery infrastructure and includes the services needed to support the learning process. The difference is that in the former experiences can be shared by all users of an object, whereas in the latter they are confined to participants in the context.

Another important issue is support for a learning process. The learning object can thus be related to the other dimensions shown in Figure 1. Any learning object is then embedded in metadata and can be linked to other learning objects within the metadata as shown in Figure 1 to facilitate discovery. It is related in a context to provide a goal for learning, and to a learning process to achieve the goal in a most effective manner.

The paper thus examines the elements needed to describe a context from a learning process perspective and then looks at the way this can be integrated with standard data elements. This paper uses Nonaka's knowledge creation process (1994) as underlying theory to define learning on the assumption that learning creates new knowledge either for individuals or groups. The paper uses Nonaka process as a basis for defining learning activities and processes for them. These activities include socializa-

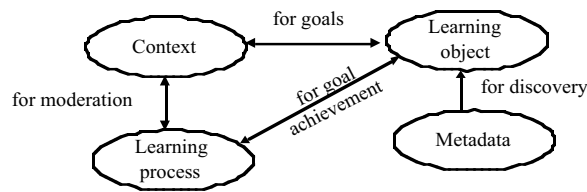


Figure 1. Objects in context

tion, developing an understanding of concepts, articulation of ideas, followed by artifact construction and evaluation.

Information technology must then provide ways to create a learning place or environment by integrating standard learning objects into a context and providing activities to support the learning process. From the technological perspective the paper proposes that customizable knowledge portals can be used to integrate learning objects into a context. These resources can include standardized learning objects together with the services and background that make up the learning context. The paper then describes a system, called LiveNet, which can be used to customize such learning models, and ways that it has been used in a teaching environment with a variety of services.

2. Evolution Towards Learning Objects

The evolution of learning objects is basically illustrated in Figure 2. Here information is gradually focused through appropriate classification schemes on a particular learning objective and then used to create the learning object. The learning object in many library based system is often restricted to subject material, which must eventually be placed in its context by the learner.

There are in fact two contexts here as illustrated in Figure 3. One is the context within which learning takes place and sets the objective for learning. This outer context may be a University, or a workplace, or a project. The other context is the subject context within which the subject is being taught. This sets a framework for discovery and is usually implemented as links within the metadata structure. Thus teaching

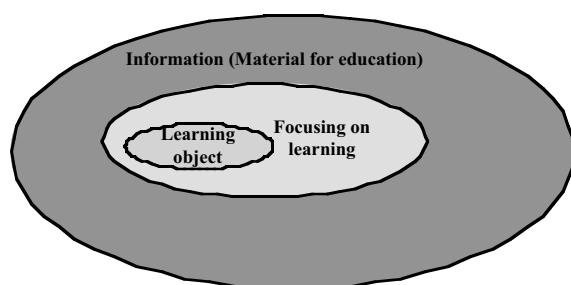


Figure 2. From information to learning object

for example about databases may place it within the context of businesses or applications. The context of the learning object can also be related to other concepts such as for example how does database design relate to the development process.

3. Some Underlying Ideas

Learning can itself be defined as a process that can include a number of roles with responsibilities for maintaining knowledge and passing on their expertise. Such communities are often called as communities of practice.

3.1. Communities of Practice

Communities of practice depend on the kind of application. The community of practice can include a variety of roles. The simplest is where there are simply teachers and learners. These can be expanded to include tutors or assistants that work together with the teacher. In more elaborate environments, there can be owners, experts, novices or apprentices as well as a variety of users. They can also be people responsible for specific business process steps. These become the portal roles, each with their responsibilities and provided with appropriate services. Thus the responsibility of the owners may be to create and update the body of knowledge. They can also give permissions to users to access the portals. They can also consult with experts on adding to the body of knowledge. Communities of practice can also include a variety of experts such as subject specialists to discover, classify and distribute knowledge. The IEEE standard defines a variety of roles for this purpose.

3.2. Learning Process

Our in defining a learning process is to develop a framework for generic services using the work of Nonaka (1994) as grounded theory. Nonaka sees knowledge sharing and creation following the process shown in Figure 4. These identify the kind of activities that are fundamental to knowledge management.

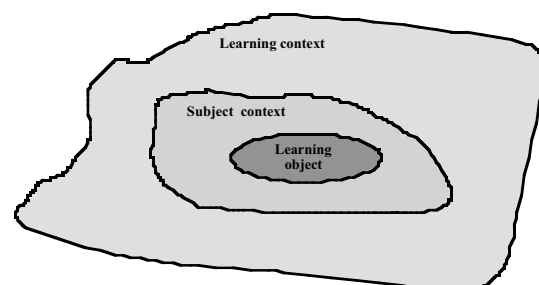


Figure 3. The Context

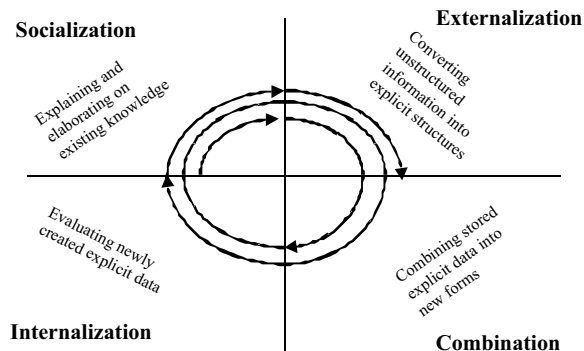


Figure 4. Nonaka's knowledge creation process

Nonaka's process includes four phases. The first phase is socialization where people bring together their experiences and share insights in an area. For example, this may be exchange of views of how a particular product was sold to clients. The next step, externalization, is where some of this captured expertise is interpreted into a form that can lead to some actions. In other words how to market the product in a customer's specific context to maximize the likelihood of achieving a sale. The discussions now focus on identifying new ideas that are now externalized in familiar contexts to see their relevance to specific issues. This often requires the interpretation of new concepts in local terms requiring a clear terminology to articulate the ideas within new contexts. It also includes showing in explicit terms how a product could be used. The ideas are then combined where necessary with existing information and then applied in practice during internalization. Any outcomes of any actions evaluated in further socialization and the cycle is repeated. Nonaka goes further and defines the environments under which knowledge sharing can effectively take place. He suggests that knowledge is only meaningful within a context and its environment. The context defines the relevance of what is discussed and provides the basis for any interpretations. Nonaka defines four different kinds of environments to match his process.

These are:

- Socializing – requires easy and usually informal ways to exchange experiences, develop trust, share values,
- Dialoging – sharing of mental models, articulation of concepts, development of common terms. Usually consciously constructed requiring the interpretation of experiences into familiar contexts,
- Systemising – requires ways to visualize interactions, construct artifacts, combine explicit knowledge and explain how knowledge gained from known experiences is to be used in new ways, Exercising - communicate artifacts and embody in working context. Reflect on the outcomes.

Our goal is for portals to provide such generic services and provide ways to customise them to particular application needs.

4. Learning Structures

Standards are now emerging for learning objects. These generally center on providing ways to classify objects, which in turn is based on an accepted ontology. Learning objects exist within a context and as such should embrace both the context and the body of knowledge. We thus distinguish between a standard for learning objects and a standard for the learning environment. The distinction is illustrated in Figure 5. It shows the learning environment composed of three main parts, namely, the subject material, the context and the learning activities. The latter are defined here from Nonaka's model.

The paper further argues that it is not possible to have a single structure for learning objects but a classification. In that case composite learning objects can be created from more basic objects.

Customization then includes:

- Providing ways to combine the standard subject into the context, and
- Choosing the activities suitable for the learning process.

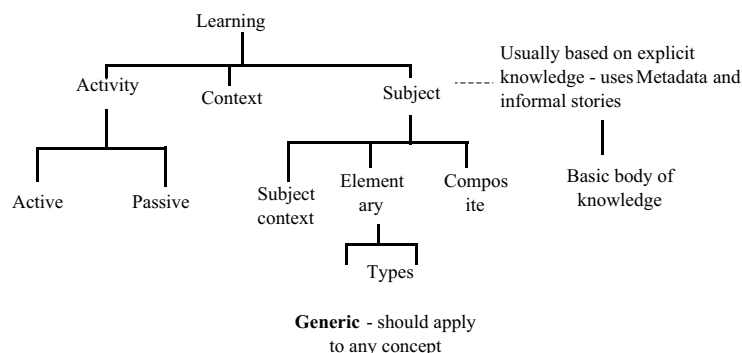


Figure 5. Classification

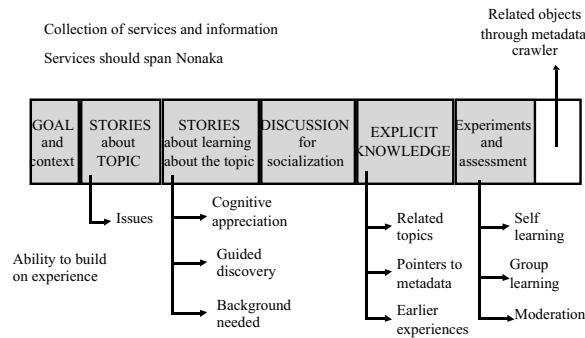


Figure 6. Generic Structure

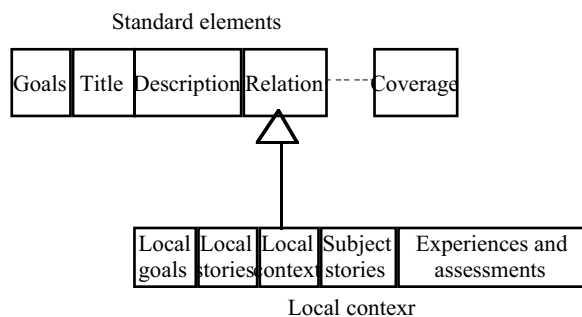


Figure 7. Integration

4.1. The Learning Infrastructure

The abstract object structure proposed for learning is illustrated in Figure 6. This is the structure that is seen by the learner. It combines Nonaka's framework and contains components that support the aspects of Nonaka's process. These for example, are stories, discussions for socialization, and experiments and assessments for learning within the environment context. The explicit knowledge is predominantly derived from standard learning objects.

Deriving the learning structure from standards is shown in Figure 7. It uses the idea of object inheritance where local learning objects inherit features of standards and enhance them with local content.

5. An Example

An example of a subject that uses both approaches is the introduction of technology in its application to electronic business. The way that the subject is taught is illustrated in Figure 8.

- First there is the learning of process and design concepts and ways to describe what business processes. It requires students to understand the design process and its techniques through theoretical exercises. The service here includes a process description and access to exercises and solutions. Socialization is supported to follow-up with questions on the solutions.

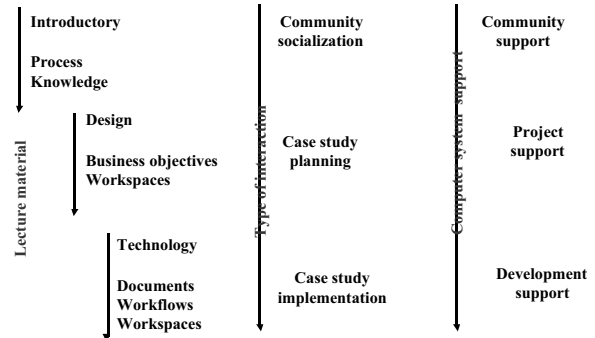


Figure 8. The learning Process

- Then various technologies are described. Students here are required to carry out in-depth research in selected topics and provide in-depth but short reports. This requires searches through a variety of objects. Services needed are discovery services and support for providing in-focus documents.
- The students carry out a group case study implementing a system using the methodology. Support is needed here for group interaction and managing of their projects. The services here are to provide group support for joint case study planning and system development.

The concept learning takes place as individuals whereas in the design process students are organized into groups to discuss design alternatives and make design choices. Metadata ideas are useful here to facilitate discovery in both the technology studies as well as the design process. Technology use evolves to support this approach. Initially access concentrates on getting information and socializing. Then a project space is created for each group where alternatives can be considered and design documents maintained. Finally there is the prototype development where students choose technology to implement the design.

The goal is for learners to progress from simple learning of concepts to the application of these concepts in the work environment. It introduces technology and learning in a gradual way. First there is some objectivist learning to describe what business processes using community workspaces. The next step is when the actual design process is introduced and students organized into groups to discuss design alternatives and make design choices. Correspondingly a project space is created in which such alternatives can be considered. Finally there is the prototype development where students choose technology to implement the design.

5.1. An example of a metadata structure

We have developed a simple ontology to describe the concepts taught in this subject. These allow learners to create an ontology of related terms and

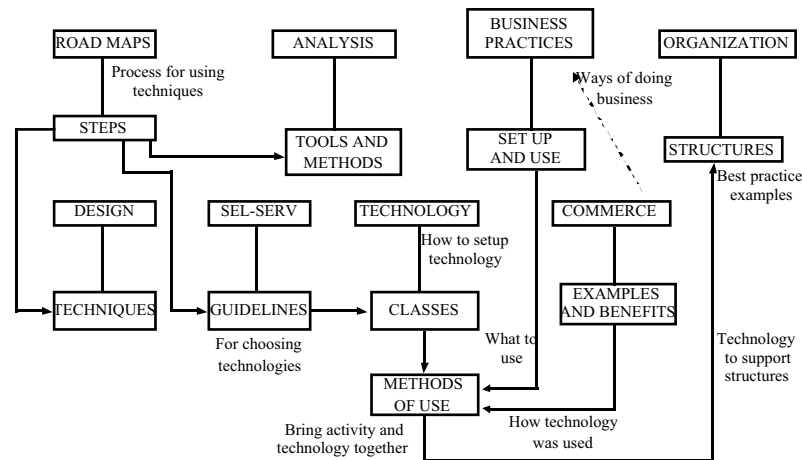


Figure 9. Structuring the Knowledge

add to the ontology by elaborating it using insights gained from experience and outcomes in business actions. As an example, we have, developed an ontology for teaching about electronic commerce. This is illustrated in Figure 9. It divides knowledge into seven categories:

- Business practices used in electronic commerce including customer relationship management, supply chains and so on,
- Analysis to describe ways to analyze new systems and define requirements,
- Design approaches to design new systems,
- Commercial applications, business services and
- Technologies used in electronic commerce,
- Business services and how to select technologies to provide them,
- Organizational relationships needed within electronic commerce.

The body of knowledge then contains relationships between these areas. A learner can begin at one concept and then follow links to see how the concept fits into the wider context. Thus it is possible to start with a business practice and then follow links to technology to see what technology can be used to support the practice.

Apart from the ontology of concepts the body of knowledge also includes exercises and solutions, exams, case studies and other study material. It can include previous experiences and suggested actions in a business process step. It can also include guidelines for filling in forms and check-lists for deciding on actions.

6. Using Portals For Integration

There are now many portals that make generic services available to users but require the users themselves to choose the most appropriate service for a given business problem. Our goal is to provide was to

customize and integrate the generic services for particular business applications. Business services are constructed from the generic services. We illustrate the integration of services needed in the subject described above within our portal.

6.1 An Example Portal

Currently we have been using a system, LiveNet, to integrate teaching services. The approach is to emphasize collaboration through an entry interface that emphasizes collaboration while providing access to the body of knowledge. Figure 10 illustrates the basic structure of this interface. It includes menus for defining a community of practice in terms of its roles, interactions between them. The interface shows all the information in the subject. It also provides different roles with different views. Thus for example the folder names 'information-to-tutors' can only be seen by tutors thus reducing the need for meetings and saving peoples time. The interface can then be used to enter the body of knowledge and use its associated knowledge services.

It also provides awareness and notification features to alert members to events important to them. It defines the explicit body of knowledge and providing the actions needed to use it. These include links between objects as well as self-learning through multi-choice questions.

We are currently developing further services to support group formation. Students can form project groups, integrate their learning concepts into the project space and develop a collaborative application. A proposed interface for this purpose is shown in Figure 11.

Here students can form groups, setup meetings, raise issues within the context of a case study. We have used an earlier version of this system concentrating on document management but found that group learning must provide flexible ways to arrange meetings and keep track of progress. The goal here is

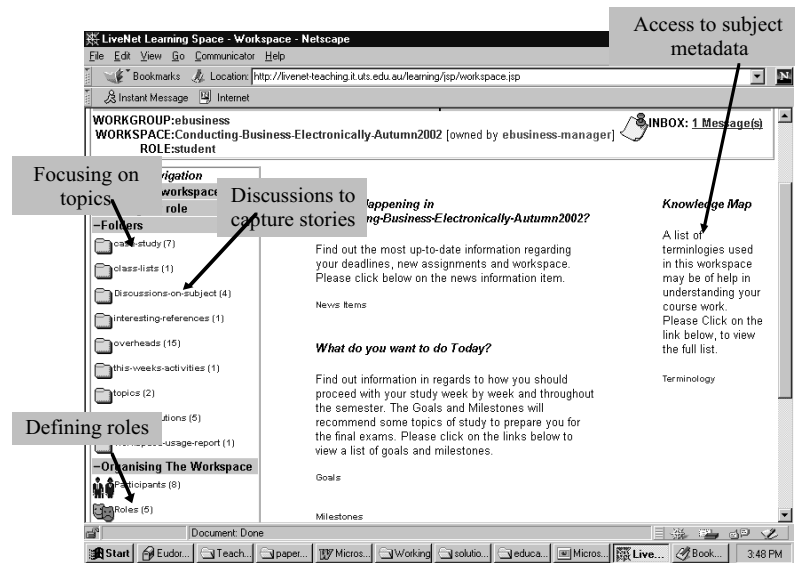


Figure 10. A LiveNet collaborative services interface

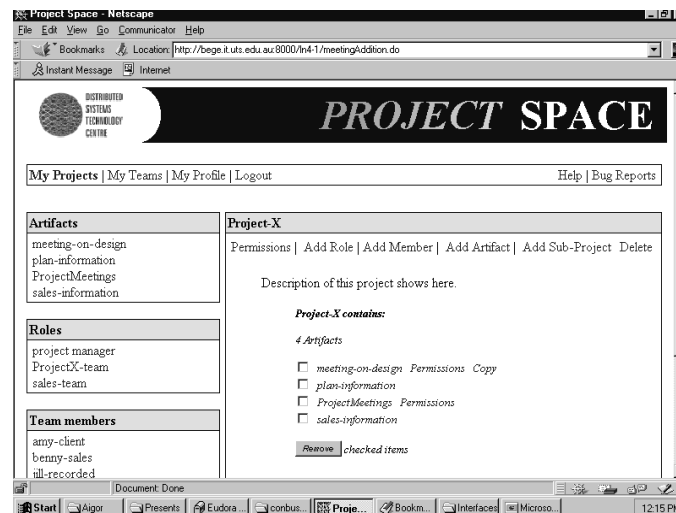


Figure 11. A Project Interface

to bring together case study materials, design guidelines and design documents and provide a governance structure, through roles, and facilitate learning through interaction and moderation by teachers, as suggested in the IEEE standard. The interface can include any number of folders, some keeping stories, other concentrating on issues and still others on managing outcomes and collecting suggestions. The structure of these can be customized to the preference of the learners.

6.2. Some comments

The learning strategy shown in Figure 8 proved successful in that students apart from various technical problems found the learning of value. This basically introduces technology in gradual stages. These

begin with familiarization using the community interface in Figure 9, going on to the private group workspaces for developing project goals and finally through students using the software to develop the prototype for a case study. In the case study students were given a number of milestones to aim for, starting with analysis, through design specification to setting up a prototype LiveNet system. Generally, these were successful in the sense that students understood the basic LiveNet modeling method and workspace description and set up prototypes with little effort. The social effect of this is to require students to pace their work according to the process rather, as is often the case, leaving it to the last minute. This has an obvious learning benefit although it is perceived as a nuisance by some students in that it requires them to follow a process.

Summary

The paper described the integration of learning objects into their environment through portals. These included of a body of knowledge as well as ways to present knowledge from different perspectives. It also described ways to encourage group learning through flexible project interfaces. Our goal is to determine a range of generic services that should be provided by portals to support learning processes.

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