

An Approach to RLO Design for Data Structures and Algorithms Courses Using Topic Maps

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Abstract

As the area of Data Structures and Algorithms (DSA) is crucial in computing science, the materials for teaching and learning DSA are often reused in related courses in such programs as Computer Science, Information Technology and Business Computer. This paper presents an approach to the design of Reusable Learning Objects (RLO) using XML Topic Maps (XTM) to organize a wide range of course materials, including programming codes, Java applets for data-structure demonstration, and algorithms visualization tools. The approach is intended to create a highly interactive Web-based learning and exploration environment, in which students can learn through experimentation. The RLO design applies Topic Mapping for classifications of learning resources in two dimensions. In one dimension, the Concept Space is defined as the knowledge representation in form of a DSA ontology. In the other dimension, the Engagement Taxonomy with six different levels of engagement in combination with Visualization materials is used to describe the Media Space.

Keywords: Computer Science Education, Reusable Learning Objects (RLO), Topic Maps.

1. Introduction

In accordance with ACM Computing Curricula 2005, the Data Structures and Algorithms (DSA) is considered fundamental in many areas of Computing such as Computer Sciences (CS), Information System (IS), Software Engineering (SE), Computer Engineering (CE), Information Technology (IT) and Business Computer (BC)[1]. DSA is intended to help students understand the concept of creating algorithms and extremely useful in writing software programs. However creating an efficient software is rather difficult for the students. Writing programs requires the complicated thinking process in a system manner. Therefore, to create programs the learners should have the opportunity in practices in order to improve their thinking process. Due to the abstraction of DSA content, most of the students are not able to get through the process, not understand the algorithmic content. Thus Information Visualization (IV) has been applied in teaching DSA course to enhance student's learning and better understanding in algorithms. Jeliot 3 and JHAVE 2.0 [2], [3] shown in Figure 1 and 2, respectively, are example IV tools for

DSA. IV tools are commonly used for collecting and fast presenting huge data in graphic animation. With this type of application software, the students can experiment themselves and learn DSA outside the classroom.

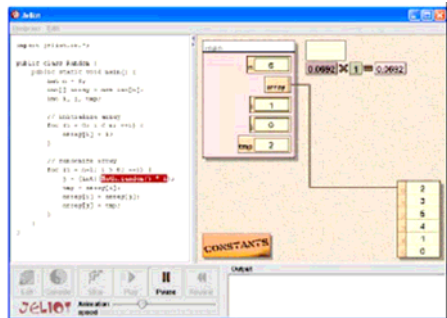


Figure 1 Jeliot 3 Software

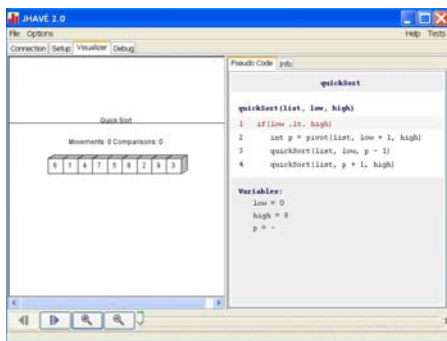


Figure 2 JHAVE 2.0 Software

This research designs the DSA course in e-learning approached to Reusable Learning Object (RLO) [4], [5] which is based on an LMS (Learning Management Systems) environment. The design can support various types of the components of course content. This research is aimed at contributing the effective learning methodology by making use of the most RLOs for DSA courses in many majors.

Learning Object (LO) can be any teaching, for example, programming codes, Java Applets that demonstrates algorithms

step by step, supplementary text-documents, including Text presentation documents, and animation multimedia, etc.

Our approach to RLOs design uses Topic Maps to categorize the learning resources of into two dimensions: Concept Space and Media Space [6]. Concept Space is defined as the knowledge representation in a Ontology form. The other dimension is Media Space which categorizes the learning resources by Visualization tool. Different levels of engagement in course content combined with Visualization tools can be classified: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation.

2. XML Topic Maps (XTM)

Topic Maps is XML based XTM Conceptual Model specification [7], [8]. It is the standard for the presenting on web-site. XTM has the schema and structure requirements, can form the structure of Information resources being used for naming the topic, having correlation topic with name and sources of information resources. Topic Maps can be appropriate to be used as the database for knowledge management.

Topic Maps is part of the concept of Semantic Web. Figure 3 shows the revolution of Semantic Web.

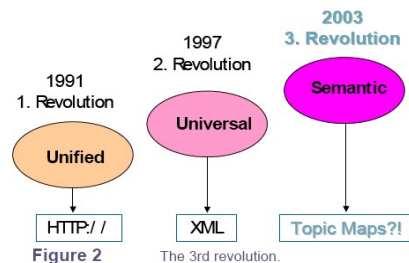


Figure 3 The 3rd revolution of H.Holger Rath

are presenting Figure 6 as part of the architecture.

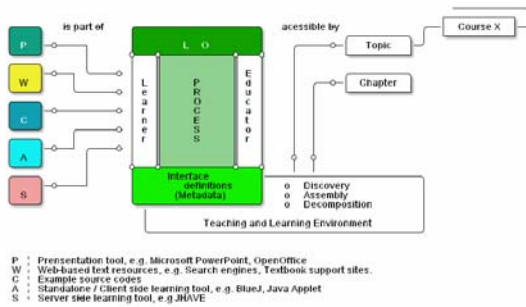


Figure 6 Architecture of Reusable Learning Object under LMS

The basic structure of Teaching and Learning method, connect the RLOs between the learners and the educators in LMS environment. The LMS used in this research is Moodle. The Architecture are composed of these three core elements.

- **Learner:** is learn through LO; Digital and Non-digital
- **Educator:** is be designed the RLO lesson according to the curriculum.
- **Process:** is the process here both learners and teacher actively participate in teaching and learning, such as Presentation or Simulation in Animation. This can be potentially led to make a more complete learning.

In term of functionality, the architectural accommodate three functions, as follows.

- **Discovery:** Search for RLO and telling the copywriters and what subject is.
- **Assembly:** Taking RLO to adapt with the other context.

- **Decomposition:** Taking a few parts of RLO tree to add up to create a new RLO.

4. Experimentation

This research experiments instruction design of DSA an open-source in LMS called namely Moodle [11]. This system helps decrease lesson preparation time, and help in storing lesson content in the web-based system more conveniently. In preparing RLO under LMS we can package several types of content, including course material, announcement, assignments, exercises, quizzes and tests. As shown in Figure 7, the data storing LO which is the resources as early discuss in previous topic by using Reload program [12], [13]. As shown in Figure 8, Moodle can be used to unpackage the RLOs into a new lesson. Figure 9 shows the Moodle system used to import SCORM Package. Moreover, we can use Data Saving function, Learner status Tracking, and Knowledge-Test level Tracked Access information functions. Figure 10, shows the access to the student information and instruction information.

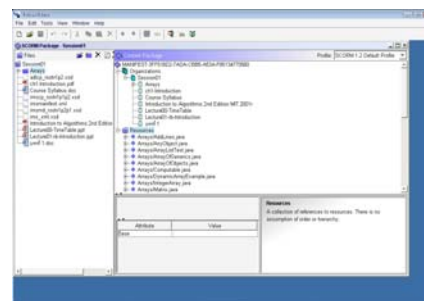


Figure 7 The Data Storing LO by using Reload program

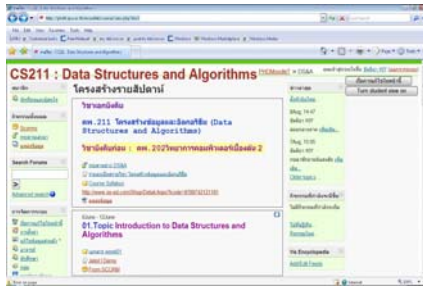


Figure 8 Moodle screen for unpackage the RLO



Figure 9 Moodle screen import SCORM Package



Figure 10 The monitor of accessing to the information of students and teacher

5. Conclusion

For an academic lesson designer, in order to contribute the RLOs including sharing them to other teachers, this research uses Moodle LMS in experiments with Reload software.

This paper describes an approach to instruction design, by taking for creating Reusable Learning Object (RLO) of course contents. DSA course as for example includes Code Programming Language and Supplementary etc. In addition to RLO design, Topic Maps is applied to categorize the resources of Learning Object (LO) into 2 dimensions: Concept Space and Media Space.

1) The Architecture as a result is composed of three core elements: Learner, Educator and Process.

2) The Process element requires to accommodate the components of course can be grouped into 5 categories: Presentation tool, Web-based text resources, Source codes, Standalone / Client-side tool and Server-side tool.

Finally our experiment uses Protégé software prepared by the Ontology of CS211 and creates RLOs in SCORM package in Moodle for further use in BC302.

In the future the researcher would like to develop Moodle Plug-in program in order to (1) build RLO automatically in SCORM package and to (2) track RLO used in the design of other lessons or courses. This method helps the educators in protecting intellectual property of his/her course design, and allowing them to freely assign RLOs authentication to other teachers with ease.

6. References

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