A MODEL FOR LEARNING OBJECTS REUSABILITY

*Priyanka Gupta
*Meenakshi Gupta

Abstract

Designing systems from scratch is an old fashioned concept nowadays. Availability of reusable components allows the developers to concentrate less on coding but more on reuse of these components in their application. If an application can be developed with such an approach then why not the material designed for E-learning. This paper focuses on Learning objects (LO), the core concept in E-learning reusability and suggests a model to check for reusability of an LO under consideration. Various metrics used in software engineering are used for that purpose.

Keywords: E-learning, Reusability, Learning objects, software metrics.

1. Introduction: E-learning is the delivery of instructions using network and multimedia computer facilities, and has become an important part of modern education for universities and corporations by complementing traditional in-class education. One of the challenges for distance learning is the creation of high quality course materials (lecture notes, references, tests, etc). While intelligent technology is still under development to automatically aggregate sufficient course materials, an instructional technology learning objects (LOs) currently leads other candidates for the position of technology of choice in next generation of instructional design, development and delivery. It is important to share and reuse well-developed learning objects (i.e., decomposed reusable objects as a course material) to reduce the load on instructors, and to make them available across a wide variety of platforms. Thus, the concept of reusability in e-learning is an interesting issue for education professionals, system developers, and learners [2].

According to Learning technology standards committee (LTSC) “Learning Objects are defined as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning. Examples of technology-supported learning include computer-based training systems, interactive learning environments, intelligent computer-aided instruction systems, distance learning systems, and collaborative learning environments. Examples of Learning Objects include multimedia content, instructional content, learning objectives, instructional software and software tools, and persons, organizations, or events referenced during technology supported learning” (LOM, 2000). Also “any digital resource that can be reused to support learning” can be called as learning object.[3]

2. Factors contributing reusability in LO Metadata: To make reusability of learning objects possible it is necessary that they are easily accessible from the libraries so as to enable computer agents to automatically and dynamically compose personalized lessons for an individual learner.

*Associate Professor, Department of Computer Applications Maharaja Agrasen Inst. of Management and Technology

The Learning Objects Metadata Working Group is working to create metadata for learning objects (such as Title, Author, Version, Format, etc.) so that people and computers will be able to find objects by searching, as opposed to browsing the entire digital library one object at a time until they find a satisfying one.

3. Combination: Once the LOs are collected from the libraries, now they need to be arranged in a proper sequence to fulfill the required objective and that is said to be as the combination or sequential aspect of LOs.

4. Granularity: Another aspect related to reusability of LO is the granularity, means the size of the learning object. Bigger the size, the room for reuse becomes lower. Smaller the size, the cost of creation of metadata increases. From efficiency point of view the decision regarding LO granularity can be viewed as a trade off between the possible benefits of reuse and expense of cataloging.

5. Granularity Framework: Learning objects can exist at different levels of granularity or aggregation. At the lowest level of the granularity hierarchy are assets, which are normally single files such as an image, some text, or a video, or audio clip. The next level of granularity occurs when assets are aggregated into some meaningful structure called an information object. Structured information objects can then be aggregated into coarser grained components, and the process repeated again and again to produce increasingly coarser grained learning objects [5]. The objects at each level of aggregation can all be considered learning objects, although they may correspond to the educational terms of topics, lessons, modules, or courses. Figure 1 shows a learning object granularity hierarchy that can be used as a basis for creating increasingly granular learning objects.

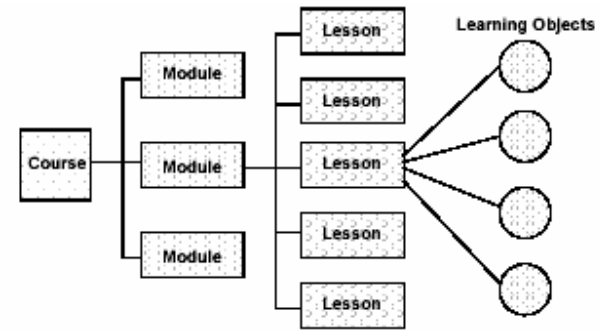


Fig. Learning Object Granularity Hierarchy [6]

6. Coupling and cohesion in LO: Coupling and cohesion, two key software engineering principles, played an important role in the design of learning objects. In object oriented software engineering coupling refers to degree to which a particular object is connected to or knows about other objects. The principle of low coupling is directly application to the design of LOs. Coupling between learning objects is

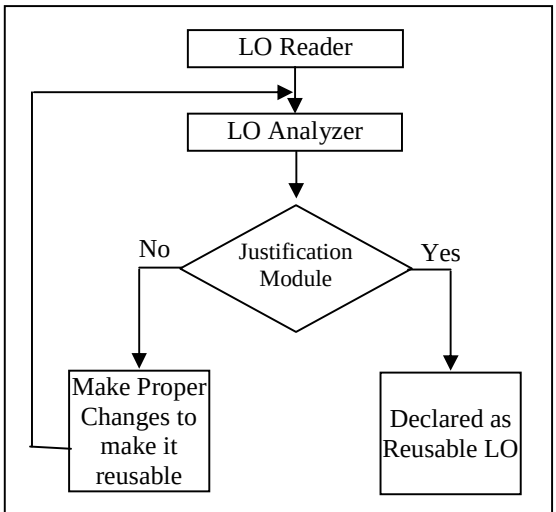
manifested by links that allow one LO to be accessed from another. It is also manifested by one learning object making forward or backward references to another LO.

If a LO is to be reused all the LOs that are linked to, or referred to, by this learning object must also be reused. This makes maintenance difficult and also makes reusability difficult since the features of the coupled learning objects must also be taken into consideration [4]. Thus, low coupling is an important principle for creating learning objects that can be reused in different contexts. The principle of cohesion in object-oriented software engineering refers to the extent to which the functionality of an object is logically related. In the context of learning objects, a highly cohesive learning object is designed to achieve one or more well-focused learning objectives that are closely related. The content of the LO is also tightly integrated so that the learning object does not do too little or too much. A learning object with low cohesion is evidenced by bloated content that is badly focused and which addresses several learning objectives at the same time. Thus while designing the learning objects it should be kept in mind that the levels of cohesion are high and coupling low. So as to integrate them into higher level coarser-grained units of instruction.

7. A general model for LO reusability: As coupling and cohesion play an important role to determine the reusability of LO, a model can be prepared which on the parameters of metrics use to measure level of granularity, coupling, cohesion and complexity and can predict whether the LO under study is suitable for reuse under the framework or not.

8. Algorithm:

1. Read the LO whose reusability has to be defined.
2. Analyze the read LO to find for complexity, no. of contents (size), inter and intra module relationship, depth of reuse tree, clarity, understandability and granularity.
3. Call for a justification module, which on the basis of metrics determine the reusability probability of concerned LO.
4. If the justification module gives a green signal to the reusability level of the concerned LO, this can be declared as a reusable LO. Otherwise, necessary changes depending upon the recommendations of justification module can be done and the LO is reanalyzed for further consideration.



Model for Learning Object Reusability

9. Working of Justification Module: In this module the recommendation of various metrics from the field of software engineering is given to check for the reusability of a learning object. Particular metrics and their purpose used above in the model are Weighted methods per class (WMC), Coupling between object classes (CBO), Depth of inheritance tree (DIT), Lack of cohesion of methods (LCOM) [7].

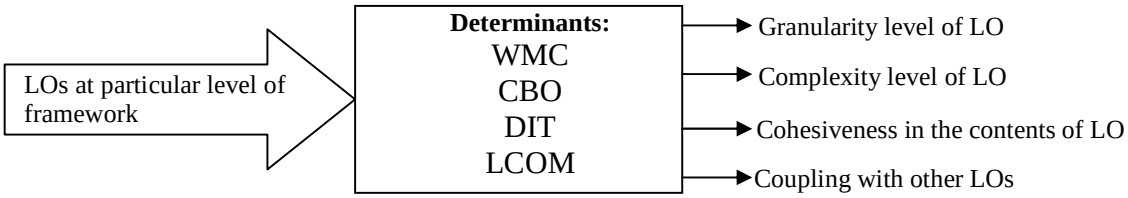


Fig. Working of Justification Module

WMC metric can be taken the aggregation of complexities of the interactive activities of a composite LO which could be used as a predictor for the reusability of the LO. LOs with large number of interactive activities are likely to be more application specific limiting the possibility of reuse. This type of LO should be reconsidered to redefine the functionality.

DIT metric is the count of depth of LO in the framework. LOs that are deeper in the framework are more complex and application specific,thus less predisposed to reuse.

CBO metric is the count of the number of LOs to which the one under consideration is coupled. High number of relationships to other LOs entail that the LO is not self contained and hence less reusable. Coupling of such module should be decreased somehow.

LCOM metric measures disparateness of objectives (as stated in metadata records) for the activities that are part of a LO are indicators for ill define objectives and hence hampers reuse driven by particular LO.

Conclusion

Reusability in the e-learning material is applicable with the help of concept of learning objects. Granularity along with coupling, cohesion and complexity is a measure factor to determine the reusability level of a particular LO. Various metrics from traditional software engineering can be well implemented for this purpose.

10. References

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