# ARCHITECTURE OF MULTIMEDIA INSTRUCTION OBJECTS FOR DISTANCE EDUCATION IN PAKISTAN

*By*
*Nazir Ahmad Sangi*[*]
*Muhammad Daud Khattak*[**]

***Abstract***

*The term Learning Object (LO) generally means a small re-usable segment of educational resource. It is relatively new in the educational institution of the developing countries. The adoption of LOs from the developed countries in the developing countries is not an easy option. This paper initially discusses the need of indigenous development of Multimedia Instruction Object (MIO) with special focus on conformance to international standards. It proposes architecture of a MIO with respect to structure, granularity level, and aggregation schema. The structure of a MIO being presented, comprises of four components, each carries multimedia instructions. The paper suggests a finest granularity level for MIOs, maximizing its re-usability along-with educational value in variety of related courses. It also suggests an aggregation schema for an ad hoc path for stepwise learning through MIOs in order to achieve a larger concept of knowledge. Finally, the paper describes implementation of MIOs architecture on a bachelor level course curriculum of Allama Iqbal Open University, Islamabad.*

**Keywords:** Learning Object, Multimedia Instruction Objects, Granularity, Aggregation Schema, Unit

## Introduction

The e-Learning has capability to integrate different digital media such as text, picture, audio, animation, and video to create a multimedia instructional material. The multimedia has attracted the learner's attention (Sun & Cheng, 2007) in the learning process. The multimedia course instructions have a demanding potential value in education (Mitchell, 2003), especially in distance education. These offers many potential benefits (De Castro, Carvalho & Carrapatoso, 2005) to modern distance learners such as instructional consistency, ease of delivery and access, increased retention level, and increased learner

[*] Vice Chancellor, Allama Iqbal Open University, Islamabad
[**] Assistant Professor, Computer Science Department, Allama Iqbal Open University, Islamabad

motivation etc for better teaching and learning. In many developing countries, the design and development of multimedia instructions for distance learners is not an easy job, and Pakistan is no exception. These are mainly designed and developed as large integrated packages with video as a significant component. Therefore, these are often delivered offline on CDs/DVDs. The video data loaded with heavy graphics may cause problems in local online delivery. Similarly, due to limitations of ICT and Internet bandwidth at the learner's end may raise many questions on online use of large integrated packages of multimedia instructions. Therefore, development of small self-contained objects referred to as Multimedia Instruction Objects (MIOs) is a desirable option (Sangi, & Khattak, 2009).

## Literature Review

The rapid development of Internet and other digital communication technologies turned traditional distance learning into modern distance learning (e-learning). It is rapidly growing in distance learning universities as well as in formal universities. The e-learning system consists of different components like curriculum, learners, technology, and e-contents. Each component is of vital importance however, e-contents are of prime importance. The design, development, and delivery of e-contents are greatly influenced by the rapid development of computers and Internet technologies (Mac Donald, et al, 2005). These e-contents may be organized as a comprehensive pedagogical entity commonly referred to as Learning Object (LO).

## Learning Objects

The term Learning Object (LO) generally means a small re-usable segment of educational resource. There exist many definitions of the term "Learning Object" (Koohang, et al, 2008), however, it consists of two words "Learning", i.e. holding information that enables learning and "Object", meant for small segment or portion of learning resources. The LOs are initially inspired by object oriented programming practice in computer science, which meant to create reusable components (objects) (Toyonaga et al., 2007)

## Organization of a Learning Object

A LO is identical to a book chapter providing sequence of learning, and may be organized as learning objectives, actual learning contents, and a feedback. However, according to the LO practitioners, there is no agreeable standard of LO organization (Thompson & Yonekura, 2005). According to Jones & Boyle (2007), there are four components of the LO organization as introduction, objectives,

actual learning contents, and exercise. Similarly, Thompson & Yonekura (2005) argued that, a LO may have components such as learning objectives, content, practice, and assessment.

**Granularity and Aggregation of Learning Objects**

Two design issues are of prime importance that may be considered prior to the development of a LO. These are granularity and aggregation of LOs. The term granularity refers to as the size of a LO. There are various aspects that may be considered to determine the size or granularity of a LO (Berge, 2006). These are course, module, unit, lesson, or topic in educational terms; number of pages, or duration for completion in terms of instructional time; and bits, bytes, MB, or GB in terms of physical size. Polsani (2003) argued that neither the instructional time nor the physical size is a valid criterion for determining the size and granularity of a LO, as the amount of course instructions in a LO is difficult to measure. Balatsoukas, Morris & O'Brien (2008) and Abdul Karim, Chaudhry & Khoo (2007) suggested the amount of course instructions provided to the learners an appropriate concept of defining granularity of a LO. Similarly, Li et al. (2009) argued that the granularity of a LO is a term used to describe the size of a unit of learning i.e amount of information conveyed to the learner. A few possible granularities in educational terms of a typical LO are shown in the figure 1.

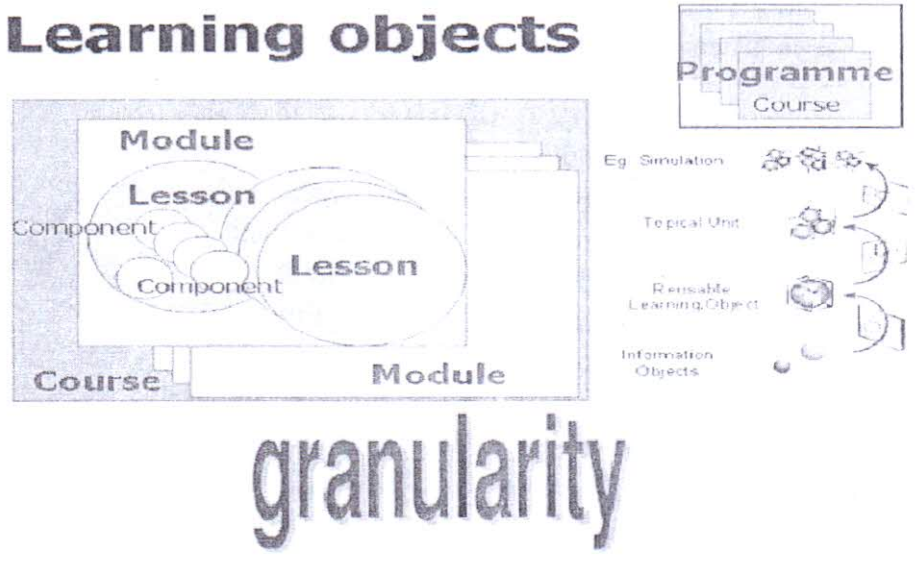


Figure 1. Granularities of LOs, McGreal (2004)

The figure shows that, granularity of a LO may be a small topic or a lesson (aggregation of few topics), a module (aggregation of few lessons) or a complete course (aggregation of course modules). Due to various granularity levels, it may be established that the granularity of a LO may vary from a small topic to a whole course (Del Moral & Cernea, 2005; De Salas & Ellis, 2006). However, there is no universally defined size or granularity of a LO (Abdul Karim, Chaudhry & Khoo, 2007). Despite this fact of undefined universal size of a LO, the granularity is closely related to its re-usability by variety of learners (Ilona, Jurij & Vytautas, 2009). Similarly, Verbert & Duval (2008) and Griffiths, Stubbs & Watkins (2006) argued that low granule of a typical LO has high re-usability.

**Learning Objects and Developing Countries**

Despite the fact that LOs have potential to play a key role in learning, it is relatively new in the educational institutions of the developing countries. The adoption of LOs from the developed countries in the developing countries is not an easy option (Lujara, et al., 2007), due to major differences in accessibility mechanisms (ICT infrastructure), expertise of faculty/instructional designers, cost/effort needed in the development of LOs, localization issues and different norms among teaching and learning communities. On the other hand, the modern distance education/e-learning needs in the developing countries are growing rapidly in a global competitive environment. Therefore, there exists a dire need and growing demand of the development of; localized LOs that may comply with international standards, and suitable to locally available ICT infrastructure.

**Multimedia Instruction Objects (MIOs)**

The MIOs may be designed in a manner suitable for delivery in a localized environment. In addition, it may also be tailored to local parameters (e.g. learner's profile, ICT infrastructure, Internet access, and learner's preferences) for compatibility with local conditions. Furthermore, it should also conform to international standards such as SCORM with certain localized characteristics related to pedagogy, technology, academic requirements, and architecture. The subsequent paragraphs discuss the architecture of a MIO, and its conformance to international standards with respect to structure, granularity level, and aggregation.

**Structure of a MIO**

Considering the above mentioned requirements, the structural model of a MIO is proposed. This conceptual model consists of various components aggregated into a coherent object as given in the figure 2.

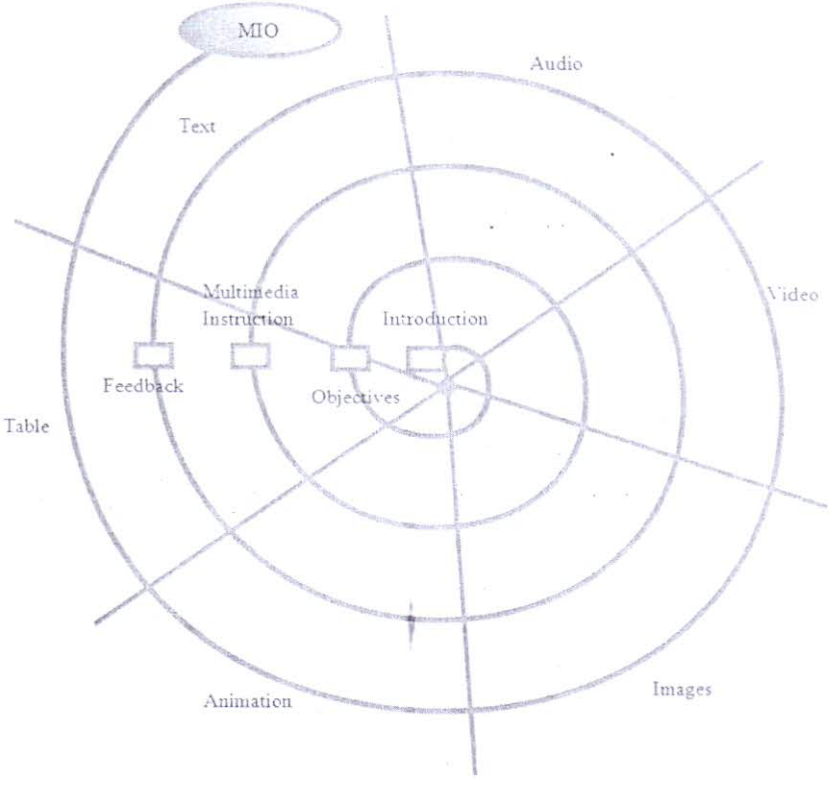


Figure 2. Structure of a MIO

A MIO may consist of four layered components. The introduction gives a brief description and background information about the course instructions presented in a MIO. At second layer, objectives describe learning objectives that a MIO may fulfill. At core, the actual multimedia instructions contain a detailed self-learning contents/course instructions about the topic(s) included in order to satisfy learning objectives. Appropriate feedback is also included for self-assessment of the learner. All these four basic building blocks make an appropriate MIO, which may be synthesized for conformance to standards and technology. Each component of a MIO may be given in the form of multimedia, and may consist of text, audio, video, animation, image, or table, where needed. The proportion of various components depends upon the technology constraints.

For example, in low bandwidth situation, video component may be of less proportion than a high bandwidth situation.

**Comparison of the Proposed Structure with Similar Structures**

A LO is an educational resource that has a pedagogical value. However, there is no agreeable standard for the structuring of a LO. Similarly there is no agreeable form of a LO. According to the practitioners around the world, a LO may takes many forms such as a case study, a film, a simulation, an audio, a video, an animation, a graphic image, a map, or a book etc (Keith, H. 2005). All these forms may have various necessary components (introduction, objectives, content, and feedback) in their structure. But all these forms of LOs may not be equally beneficial in learning context. For example display of a map or only audio or only an animation or a text may not be sufficient for learning. The proposed structure combines digital forms of an audio, a video, an animation, a text, or a graphic image in the form of a multimedia component. This is integrated with each component of the proposed structure of a MIO for consistent learning.

**Granularity of MIOs**

Due to wide spread levels of granularity and optimized re-usability of LOs, there is a need to design and develop LOs with such granularity that ensures effective implementation across multiple related courses and effective usability/re-usability. For this, course structure of Allama Iqbal Open University (AIOU) was considered being a mega distance learning university with student's representation in all parts of the country. The curriculum of a typical AIOU three credit hour course consists of nine units as defined by the university. Each unit is the composition of one or more related topics coherent to a concept of knowledge. The topics of a single unit are usually covered by the learners in approximately two weeks duration. Considering this, a lesson (a single topic or composition of fewer topics) may be a finest level of granularity. This small size increases re-usability, but of less educational value than larger size like a unit (composition of one or fewer lessons) or entire course. In order to keep the balance between re-usability and educational value, a unit may be of appropriate granularity size of MIOs representing a coherent concept of knowledge with certain measurable learning objectives. Therefore, the size of a MIO is limited to a unit of a course curriculum as shown in the figure 3.

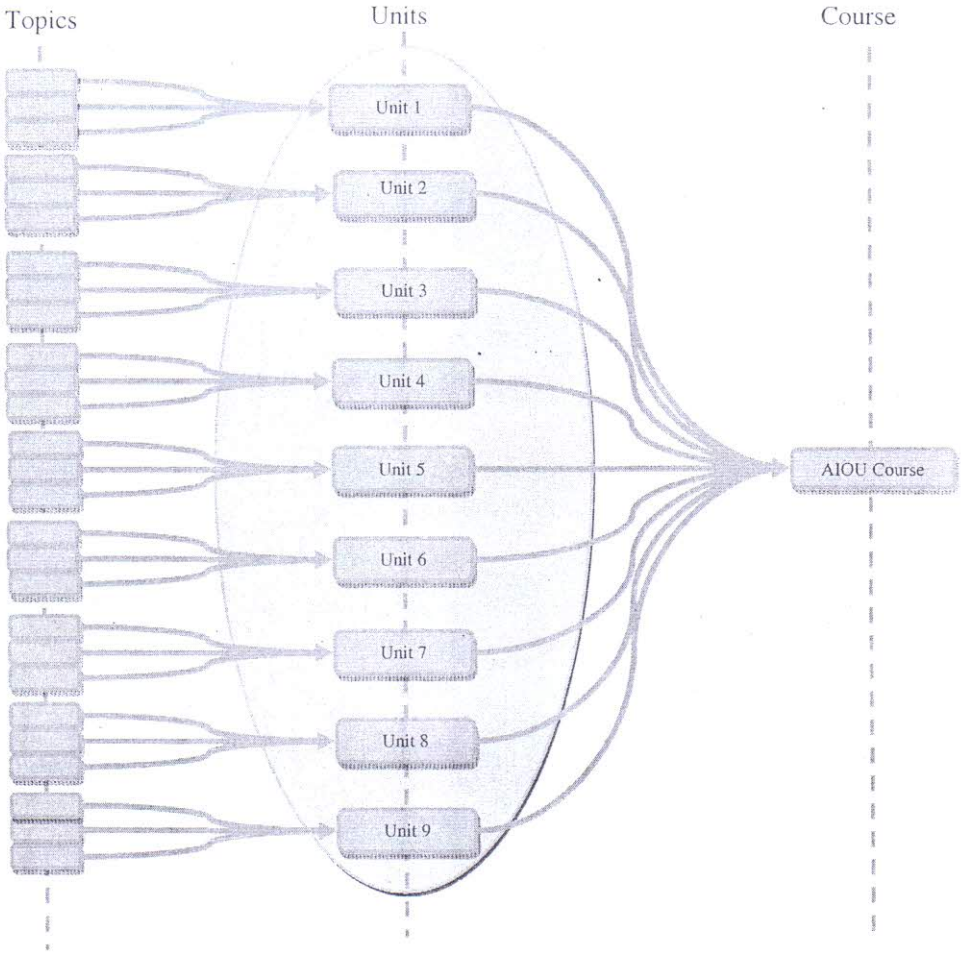


Figure 3. Proposed Granularity for MIOs

**Aggregation Scheme for MIOs**

The LOs have an important capability of combining with other related LOs to form an aggregated LO. This provides basis for stepwise ad hoc path to be followed by the learners to achieve a larger concept. This hierarchical representation has close resemblance with curricula of a course organized in lessons, modules or units, or topics. In similar way, the MIOs may organize in hierarchical manner to represent aggregation scheme, as shown in the figure 4.

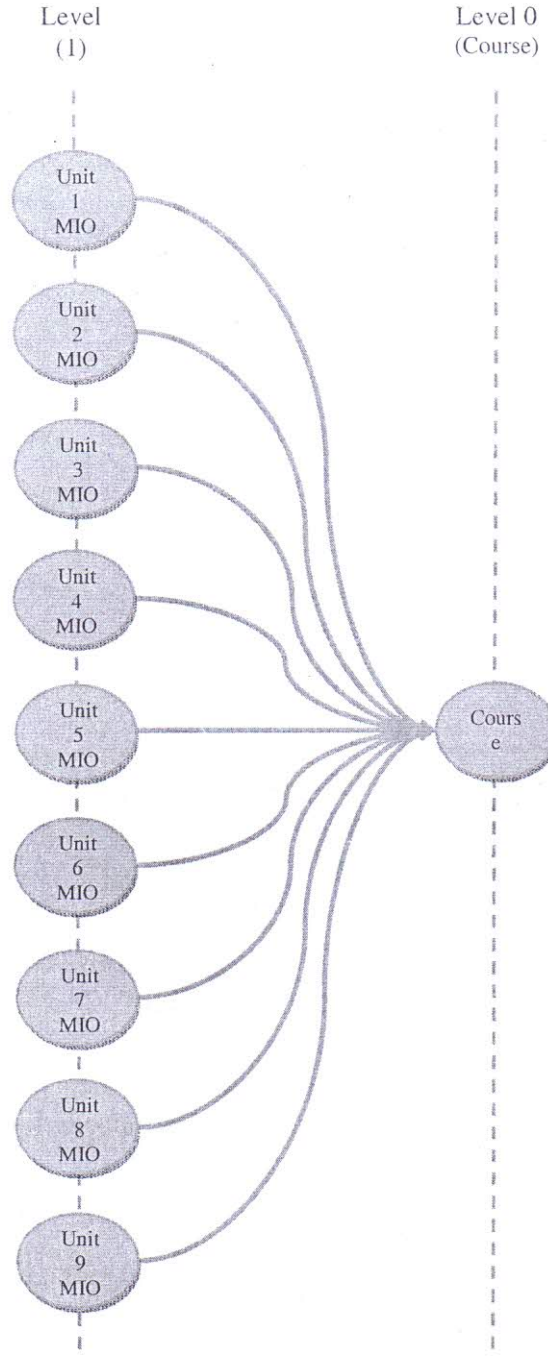


Figure 4. Proposed Aggregation Scheme for MIOs

The figure 4 shows aggregation scheme for MIOs organization. A MIO contains self-learning multimedia course instructions of a unit (composition of fewer related topics) representing a coherent object. A MIO may have one or fewer learning objectives and are represented at level 1 in the hierarchical organization of MIOs. Many related unit/module MIOs may be further combined together to form the largest concept of knowledge suit referred to as course MIO, that fulfils learning objectives of a particular course. The Course MIO is represented at level 0 in the hierarchical organization of MIOs.

**Implementation of the Proposed Architecture**

The proposed architecture of MIO was implemented on the course "Programming Concepts" of BS (Computer Science) program of AIOU for the development of MIOs. The curriculum of the course consists of nine units, each comprising of few or more related topics coherent to a concept of knowledge. A MIO was developed, containing multimedia based course instructions of a unit course curriculum according to the proposed structure, and granularity. Each unit of the course was converted into a corresponding MIO, thus the entire course was presented in nine MIOs. The transformation of a single unit of the course curriculum into corresponding MIO is shown in the figure 5.

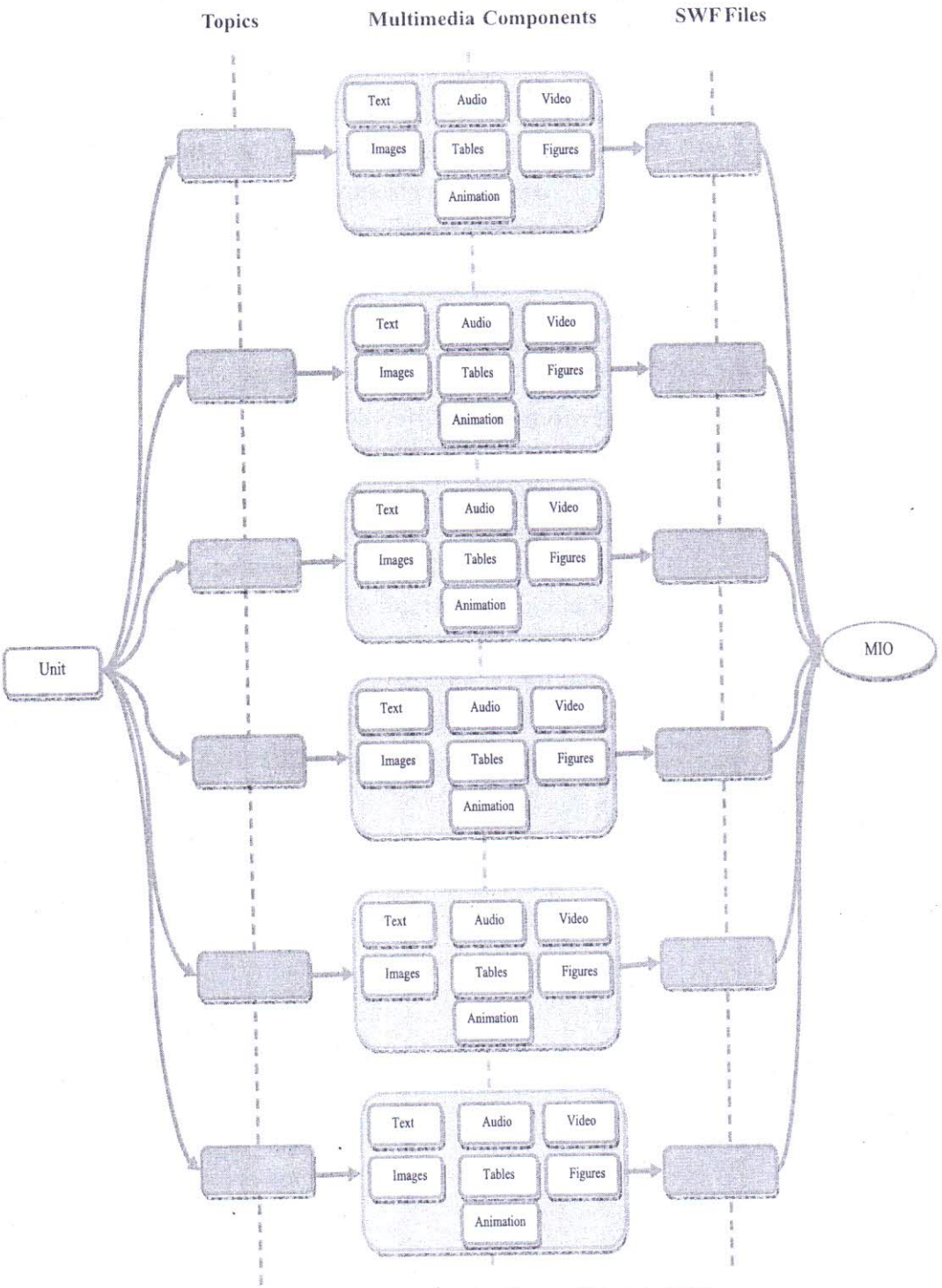


**Figure 5 - Transformation of a Course Unit into MIO**

The detailed course instructions of each topic in the unit were organized as multimedia components using flash macromedia. A SWF file was generated for each topic in which various multimedia components such as text, audio, video, image, table, figure, or animation were synchronized. The sequential organization of these files was made according to sequence of topics within a course unit for step by step learning and grouped together to produce a MIO.

## Conclusion

This paper suggested architecture of localized MIOs with respect to structure, granularity level, and aggregation. The paper initially discussed the need of indigenous development of MIOs with special focus on conformance to international standards. The structure of a MIO was presented, comprising of four components, each may carry multimedia instructions. The paper also presented various granularity levels (lesson, module/unit, and course). It was highlighted that smaller granularity level has direct relationship with re-usability. Therefore, a unit of course curricula was suggested to be the finest granularity level of a MIO for maximizing its re-usability with educational value in a variety of related courses. The aggregation schema of MIOs was presented to build an ad-hoc path for stepwise learning to achieve a larger concept of knowledge. Finally, the paper described implementation of MIOs architecture on a bachelor level course curriculum of Allama Iqbal Open University, Islamabad.

## Future Direction

The present research was primarily focused on the architecture of MIOs for the purpose of online delivery over limited Internet bandwidth to the learner's end, across the country. However, in future, MIOs may be designed in a manner deliverable through mobile phones to the learners. These may be further enhanced with video as a significant component for broadband delivery. The aggregation schema and metadata of the MIOs may be also be designed in a manner to accommodate the learners as well as teachers for organizing a course or segment comprising of topics/lessons of their own choice.

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