Creating the Classroom Environment for Asynchronous E-learning

ADE G. OLA
Learning Scope
9301 Derbyshire Road
Richmond, VA 23229
U.S.A
lscope.ade@gmail.com

ABIODUN O. BADA
Dept. of Engineering Management and Systems Engineering
George Washington University
Washington, DC 20052
U.S.A.
aobada@gwu.edu

EMMANUEL OMOJOKUN
ADEYEMI A. ADEKOYA
Department of Computer Information Systems
Virginia State University
Petersburg, VA 23806
U.S.A.
eomojokun@vsu.edu; aadekoya@vsu.edu

Abstract: – In higher education, the trend continues to shift from traditional teaching methods to student-centered strategies that are known to promote learning. At the same time, the integration of online education into the mainstream of higher education is intensifying. This paper addresses the problem of adapting classroom strategies for asynchronous online learning, so as to derive a learning model that combines the flexibility of online education with effective classroom-based strategies. The paper prescribes methods for putting into practice, for online education, active learning strategies that have been proven to be effective in the traditional classroom environment. First, the paper presents an overview of various active learning strategies and common classroom activities. Next, it introduces an array of open technologies and standards relating to learning resources, collaboration and learning experience management, and media markup languages. Then, it describes methods, which are based on the open technologies and standards, for effecting the learning strategies and common classroom activities in asynchronous online learning. This line of research (devising methods to augment the flexibility and other advantages of asynchronous online learning with classroom strategies that are known to enhance learning) has the potential for changing the face of online education.

Key-Words: - Classroom strategies, Open technologies, Asynchronous online education, Active learning strategies

1 Introduction

In higher education, emphasis is being placed on putting into practice strategies that have been shown to promote learning. Thus, the trend continues to shift from traditional teaching methods to student-centered strategies. Furthermore, as the integration of online education into the mainstream of higher education intensifies, there is perhaps a greater onus on colleges to maintain and demonstrate the effectiveness of their online programs. This paper addresses the problem of adapting active learning strategies and classroom activities for asynchronous online learning, with a view to deriving a learning model that combines the flexibility of online education with effective classroom-based strategies. The paper prescribes methods for putting into practice, for asynchronous online learning, strategies that have been proven to be effective in the traditional classroom environment.

Asynchronous e-learning provides the learner with the flexibility of accessing a learning environment at any time and location to download learning resources and communicate with teachers or peers. In effect, the learner controls his or her own learning schedule. However, the flexibility offered by asynchronous mode of learning can become a source of impediments to learning—impediments such as being isolated from learning communities, which is essential to learning. Apart from not getting the benefit of group participation, learners that feel isolated also have the tendency to procrastinate or even drop out of a course. A study reported in [1] shows that students who were unsatisfied with online learning believed that the flexibility offered by asynchronous learning mode often results in laziness on the part of the student and, subsequently, ineffectiveness of the learning mode. The research in [2] also identifies isolation and lack of knowledge acquisition that occurs in the classroom as two of the problems associated with distance learning. This paper is about devising methods to augment the flexibility and other advantages of asynchronous learning with classroom strategies so as to overcome some of the disadvantages associated with online learning. It prescribes how active learning strategies that have been shown to be effective in the traditional classroom environment and other regular classroom activities may be put into practice for online learning, using a wide range of open standards and technologies.

Section 2 of the paper presents an overview of active learning strategies and other regular classroom activities that research studies have shown to be effective. Then, it discusses the requirements and challenges of implementing the strategies and activities for asynchronous e-learning. Section 3 presents brief overview of an array of open technologies and standards relating to learning resources, collaboration, learning experience management, and multi-media markup languages. It explores how the open technologies and standards—maintained by the Open Knowledge Initiative™ (O.K.I), the Advanced Distributed Learning (ADL), the IMS Global Learning Consortium (IMS), and various committees of the World Wide Web Consortium (W3C)—may be employed in effecting student-centered strategies. In Section 4, the paper presents methods, which are based on the open technologies and standards, for implementing active learning strategies in online learning and instruction. The paper concludes in section 5 with a discussion on the potential impact of this line of research on the evolution of online learning.

2 Learning and Teaching Strategies

There is a large body of research on Theory of Learning as evident by the number of major theories summarized in the Theory Into Practice database [3]. The cognitive-interactionist theory, the most current of the learning theories, seems to offer the most comprehensive explanation of how learning occurs [4]. The theory deems the learner as an active participant in the teaching and learning process. Thus, while there is no universally recognized current "best practices" in teaching and learning, there is general agreement that active participation of students in the learning process enhances learning. Refer to [5, 6] for commonly referenced practices.

2.1 Active Learning

Active learning calls for the student's active, positive participation in the learning process; its effectiveness is based on the premise that learning occurs most when the learner is actively involved in the process through various activities such as engaging in discussions with the instructor or peers, answering questions, writing about the topic at hand, and working on projects in a team. Because learning strategies (the methods that learners use to learn) often dictate strategies for instruction, active learning and other student-centered learning strategies often call for changes to how instruction is carried out. Thus, some of the activities referred to as learning strategies in this section of the paper may be methods of instruction and not learning activities per se. Here, two classes of active learning strategies—small-group strategies and student engagement and assessment—are presented.

2.1.1 Small-group Learning Strategies

A meta-analysis in [7] shows that the effect of small-group learning on achievement, persistence and attitudes among undergraduates in Science, Technology, Engineering and Mathematics was significant and positive. Small-group activities have also been found to enhance comprehension of course material [8]. Table 1 depicts examples of small-group learning strategies and techniques derived from many sources [8, 9, 10 and 11].

2.1.2 Student Engagement and Assessment

Studies have also shown that student engagement is linked positively to desirable learning outcomes such as critical thinking, application of skills, and high grades [12, 13]. By finding ways to get students to take active role in the classroom, the instructor gets immediate feedback on their level of understanding and comprehension, interest and misconceptions. The use of guided or interactive notes has also proven to be an effective strategy; a study in [14] reports improvement in note quality when guided notes are used. Other studies have shown improvement in test scores and recall of lecture material with the use of guided notes [15, 16].

Small-group Techniques & Strategies	
Tutorial	Group works on instructor-provided stimulus questions before members share and discuss their findings
Role play	Learners enact scenarios and participate role playing
Brain storming	Technique for soliciting ideas
Study group	Group reviews material and complete assignments
Problem-based Learning	Collaboratively solve challenging real-life problems and reflect on experiences
Support group	Learners encourage and support each other and act as info. source for classes missed

Table 1: Small-group Learning Techniques

Student Engagement Techniques / Strategies	
Classroom Opinion Polls	Gauge learners' opinion before a divisive subject
Quote Minus One	Instructor gives a quote related to current topic but omits a key word and ask students to guess
Guided/ interactive notes	Students get a note sketch with spaces to be completed
Documented Problem Solutions	Provides steps needed to solve specific problem types. Students adapt the steps to problems
Make Them Guess	Before a new topic, instructor asks intriguing questions to build curiosity and takes blind guesses
Background Knowledge Probe	Verify how much learners know about a topic using questionnaire (multi-choice or short answer)
Frequent Assessment	Quick quizzes and use of short journal entries

Table 2: Engagement and Assessment Techniques

An extensive list of interactive techniques drawn from various sources is provided in [17].

Assessing student's understanding is also central to active-learning and student-centered instructional design. Assessments allow the instructor to gather information to guide the adjustments both instructors and learners need to make to improve learning. An editorial in Science Scope [18] emphasizes the importance of assessment and monitoring of student engagement; it states that assessment should be used before, during and after concept instruction, and monitoring student engagement and behavior should be an integral part of teaching—one that is done constantly during each lesson. Studies have found that frequent assessment was associated with better student performance and greater retention of course concepts [19]. Table 2 presents examples of strategies and techniques for eliciting student engagement.

2.1.3 Common Classroom Activities to be Adapted for Asynchronous Online Learning

Attending a scheduled class is a basic activity of face-to-face learning; students are expected to get the course work for one week completed before the following week.

Common Classroom Activities	
Attend class	Learner picks contiguous time period to go through sequenced course material
Listen to lectures	As a learning strategy, listening to in-class lectures is still a major activity. See [20, 21, 22 and 23] for benefits of lectures
Note taking, including use of guided notes	Note taking is a significant classroom activity with proven advantages [24, 25]
Pose questions	Students ask questions to clarify concepts at any point in a lecture
Answer questions posed	Often, instructors ask learners to answer questions on topic at-hand to ensure understanding
Listen to other students	Listening to other students' responses and class discussions
Taking quick in-class quizzes	Studies show frequent assessment was associated with better performance and greater retention of course concepts [19]

Table 3: Common Classroom Activities

Thus, even though the online learner has the flexibility of choosing the time and place to learn, he should be expected to "attend class" or complete assigned course work within a given time period. To attend class in asynchronous mode, the learner should have access to online lectures, take notes, pose questions, participate in group discussions and respond to questions from the instructor or peers. Table 3 presents common classroom activities that may be adapted for asynchronous online learning.

2.1.4 Challenges of Implementing Classroom Strategies for Asynchronous Online Learning

Adapting the mostly in-class strategies and activities for the online learning environment poses a variety of difficulties and challenges. The difficulties and challenges include:

- Devising ways of simulating the classical classroom lectures
- Overcoming the difficulties involved in eliciting spontaneous feedback on the learners' level of comprehension or misconceptions
- Devising ways of incorporating various engagement activities into online learning process
- Incorporating student's feedback into the learning resources
- Instituting mechanisms for monitoring student engagement
- Facilitating and implementing group activities among online learners

2.1.5 Challenges of Implementing Small-group Techniques for Asynchronous Online Learning

While small-group learning techniques (outside the classroom) are more adaptable for the online environment, there are challenges that need to be overcome. Implementing small-group strategies requires student training; the instructor should not make the assumption that students will know how to interact in groups. An article [22] on restructuring the classroom for productive small-group activities, "… found relative effectiveness of structuring the interaction within groups by telling students what to say, providing them with explicit roles, or by teaching them strategies for discussion." There are also other pertinent requirements that must be met in order to implement small-group strategies effectively, among them are the following derived from [9, 26]:

- Defining and modeling the roles to be played by learners
- Providing scripts of the required interaction where applicable
- Providing enough trained individuals to facilitate group interactions
- Providing efficient ways of keeping a record of the feedback from learners
- Facilitating group activities and monitoring interaction among learners
- Training learners to interact effectively
- Assessing and grading interaction among students

2.2 Related Learning Approaches

Blended learning [27] combines face-to-face and online learning models. In blended learning, because learners are required to take part in some face-to-face meetings, some of the flexibility of asynchronous learning mode is lost. There have been projects that sought to take advantage of online learning while preserving the advantages of the traditional classroom; an example is the project reported in [28], which provided educational access to individuals with special needs. A related work—of implementing active learning strategies—is the QUEST project [29], which implements a Web based active learning system for managing collections of tasks or challenges that make up contests to be accomplished by learners within limited time periods. Experiments with QUEST suggest high students' satisfaction and sustained motivation among students.

Another approach that has been used to provide the classroom environment online is the use of pre-recorded lectures [20, 21, 22 and 23]. An example is the Virtual Learning Hall (VLH) [20]—a computer-based instructional platform that delivers PowerPoint slides threaded with audio clips. When students from in-class and online sections of selected college courses had access to live recorded lectures, results show greater VLH use was linked to higher midterm scores and student perceptions of the VLH were highly favorable. However, the use of pre-recorded lectures has its disadvantages, including these that are enumerated in [30]: :no direct contact between teacher and students, no minute-by-minute adjustments can be made based on feedback and questions, students' attention may wane, and lecture media may become obsolete. The approach in this paper goes beyond pre-recorded lectures; it utilizes pertinent open technologies and standards to replicate the classroom environment for online learners and produce lectures in a form that mitigates the problems associated with pre-recorded lectures.

3 Open Technologies for Learning

O.K.I., ADL, IMS and various committees of the World Wide Web Consortium (W3C) represent the leading organizations concerned with open standards and technologies for collaboration and learning. O.K.I. has defined an open and extensible architecture for learning technology specifically targeted to the needs of the higher education community. ADL is the custodian of the Sharable Content Object Reference Model (SCORM) [31, 32 and 33]—a technical framework for fostering creation of reusable learning content through a harmonized set of guidelines, specifications and standards—while IMS oversees the development of interoperability specifications for learning technologies.

3.1 Standards for Learning Resources

A learning resource is any representation of information that is used in a learning experience, and SCORM provides Content Aggregation Model (CAM) as a way for designers and implementers of instruction to aggregate learning resources for the purpose of delivering a desired learning experience. CAM allows the instructional designer to describe a collection of basic units of learning resources and the different ways in which the basic units are organized to provide a variety of learning experiences. The power of CAM lies in the fact that it allows the same collection of learning resources to be referenced and used in multiple learning experiences (in the model, a learning experience is referred to as an *organization*). By defining a common language, CAM allows learning content to be shared because any system that conforms to the standards knows how to handle SCORM-conforming content.

3.1.1 Content Aggregation Model

At its core, SCORM enables content to be shared through CAM which is made up of:

- *Content Model* (from Aviation Industry CBT Committee—AICC): nomenclature for defining the content components of a learning experience
- *Content Structure & Packaging* (from IMS Global Learning Consortium, Inc.)*:* defines how to represent the intended behavior of a learning experience (Content Structure) and how to aggregate learning resources so they can be moved between systems (Content Packaging)
- M*eta-data* (from IEEE Learning Objects Metadata 1484.12)*:* a mechanism for describing specific instances of the components of the content model
- *Sequencing and Navigation* (from IMS Global Learning Consortium, Inc)*:* a rule-based model for defining rules that describe the intended sequence and ordering of learning activities

These are the components of a learning experience:

- An *asset* is the basic form of a learning experience that does not communicate with the Learning Management System (LMS). Examples are JavaScript functions, WAV audio, Web page and Flash object
- A *SCO* is the lowest level of granularity of a learning resource that is tracked by a LMS; it is a collection of one or more Assets representing a single launch-able learning resource that communicates with a LMS
- *Content Organization* is a map that represents the intended use of learning content through Activities (i.e. structured units of instruction); a map shows how Activities relate to one another. Sequencing information may be applied to only Activities, and it is external to the learning resources associated with the Activities

Figure 1 shows the components of a learning experience; it shows an organization of items (activities) with references to learning resources. It is the indirection to the learning resources that facilitates sharing, reuse and updates.

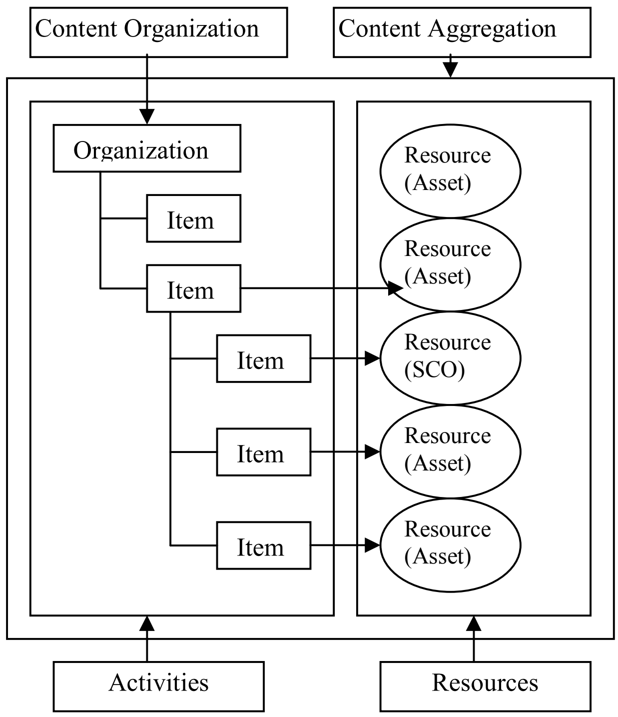

Figure 1: Components of a Learning Experience

3.1.2 SCORM Content Packaging and Metadata

Content organization allows the developer to specify cohesive units of instruction that reference collections of learning resources. A Content Package consists of two major components at the top level—a special XML file (called manifest file) describing the content structure, together with the associated resources, and the physical files that make up the content package. Figure 2 taken from [31] is a conceptual representation of a package.

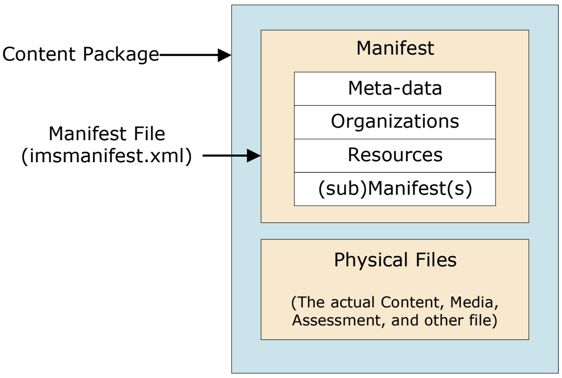

Figure 2: Conceptual Diagram of a Content Package

The Content Aggregation metadata describes the content aggregation (i.e., the content package) as a whole at the manifest level; every other level in the hierarchy also has a metadata. A LMS uses the metadata to interpret the content organization (i.e., courses, lessons, modules, etc.).

3.1.3 Sequencing and Navigation in SCORM

Sequencing and Navigation refers to the behaviors that a LMS must follow in order to present a specific learning experience as intended by an author or content developer. Through Sequencing, SCORM enables learning activities to be tailored to an individual learner based on his actions or performance at the time of delivery. A key concept in Sequencing is the use of *Objectives* to model sequencing behaviors. Objectives are variables that are used in sequencing rules and the values of which are set as the learner progresses through learning activities. Every activity has a primary objective (mapped to the Progress, Completion, and Satisfaction of the activity) and zero or more secondary objectives. The learning activity in figure 3, taken from [34], shows the use of sequencing objectives to provide remediation to a learner. In the figure, the learner goes through Lessons 1 and 2 then takes Assessment, which sets the Satisfaction Status for Obj_1 and Obj_2, respectively. The rules are evaluated to determine the learner's next course of action—the learner exits the module if both objectives Obj_1 and Obj_2 are satisfied, otherwise he goes through Lesson 1 (if Obj_1 is not satisfied) and/or Lesson 2 (if Obj_2 is not satisfied).

With the sequencing rules, the content developer may choose to structure the content organization as an adaptive guided path, invoking learning resources only if and when they are needed. Typically, activities are aggregated and organized into a conceptual tree; the learner may traverse through learning activities in two modes—User Choice (learner chooses activity in any order) or Flow (learner goes to "next" or "previous" activities where next or previous activity is determined by the system).

A study reported in [35] shows that adapting to learners' profile or performance does enhance learning. The approach for dealing with adaptive learning in this paper is based on open standards and technologies. The strength of SCORM content comes from the capability to define organizations of activities (multiple uses of same collections of resources) and being able to attach conditions to activities.

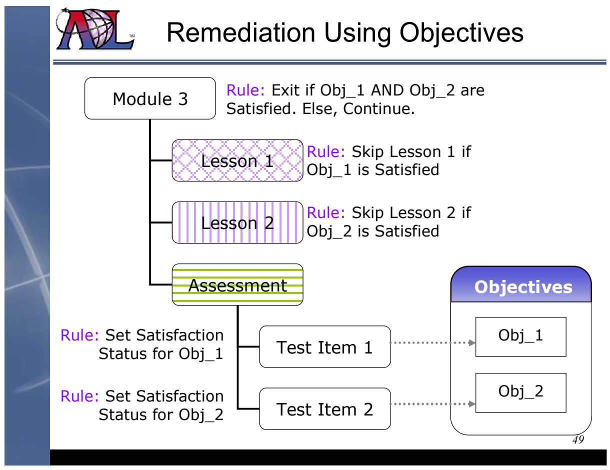

Figure 3: Using Objectives in SCORM

The capabilities of SCORM (derived from being able to define organizations of activities and to attach rules and behaviors to the activities) have strong implications for assessment of student knowledge, tailoring of content to match individual skill levels, and remediation.

3.1.4 IMS Learning Design specification

With IMS Learning Design (IMS LD) [36], one can describe and implement educational activities based on different strategies such as group work and collaborative learning. Learning Design is defined in three levels. Level A defines the basic entities or elements: activities, roles, and learning objects or services. The specification provides a language for describing how learners and other role players perform activities using learning resources—objects and services—and how the three entities are coordinated into learning flow. In essence, one or more players in roles (learners, teachers etc.) perform a series of activities (assessment, discussion, simulation) in an environment consisting of learning objects or services. Services offer generic functions such as email, conferencing, searching and announcements. The locations of services are not specified during design, but are made available at run time, after people have been assigned to their roles. Both services and learning objects are referenced by activities—allowing them to be reused and updated easily

Level B of the specification allows greater control and complexity through the use of properties and conditions; it adds properties (for storing information about a person or group) and conditions (for placing constraints upon flow). Properties are either internal (local) or external (global) to a learning design. Properties allow information such as test results or learner preferences to be stored about a person or information about a role such as whether the role (e.g. learner) is for a full-time or part-time learner. A learning design itself may also have assigned properties. For example, a learning design may specify a group assignment in which each learner has to complete specific activities before the group can proceed to the next set of activities; the runtime environment would check the constraint and synchronize access to the next set of activities. Level C offers the opportunity for more sophisticated learning designs through notifications (messaging), which allow new activities to be triggered automatically in response to events in the learning process. For instance, the instructor may be notified that a response is required when a student asks a question.

The capabilities provided by IMS LD have great implications for simulating classroom activities online. Learning designs make it possible for group work to be provided by services and allow activities engaged in by individuals to be coordinated and synchronized.

3.2 Multimedia Markup Languages

This section describes media markup standards and IMS specification for exchanging questions, tests, and result data between learning systems.

3.2.1 Synchronized Multimedia Integration Language (SMIL)

SMIL [37] is a standard for expressing synchronization of objects of various media types; SMIL is a HTML-like language, and its presentations may be specified using a simple text-editor. SMIL presentations can display multiple files, possibly from multiple Web servers at the same time, and contain links to other SMIL presentations. It has functions for defining sequences and the duration of elements as well as the position and visibility of the elements. The capability of SMIL which allows for creation of Web based presentations that integrate audio, video, images, text or any other media type makes it applicable to many learning techniques. SMIL is used in this paper as the platform for presenting online lectures.

3.2.2 Timed Text Specification

Timed Text is textual information with associated timing information. Typical applications of timed text include real time subtitling of foreign language media and captioning. The W3C Timed Text Working Group published a candidate recommendation of Timed Text Authoring Format-Distribution Format Exchange Profile [38]. One application of Timed Text is in replacing of audio narrations and instructions with Timed Text for individuals with special needs.

3.2.3 Pen Input and Multimodal Interaction

The Ink Markup Language [39] is a format for representing ink data entered with an electronic pen or stylus. The primitives of InkML permit ink data to be organized in a variety of ways, including as Archival InkML, which allows documents to be stored for later retrieval or processing, and as Streaming InkML, where ink data may be transmitted in real time as applications exchange ink messages. The fundamental data element in an InkML file is the <trace>. A trace represents a sequence of contiguous ink points—e.g., the X and Y coordinates of the pen's position. A sequence of traces accumulates to form meaningful units, such as characters and words. The <traceFormat> element is used to define the format of data within a trace.

Unlike today's collaborative whiteboards, which typically use complex or closed protocols for communication and are not interoperable across multiple platforms and do not support archival of collaborative sessions for later reference, InkML represents digital ink in a form that allows both transmission and higher-level semantic analysis [40]. Direct application of Ink data and InkML in teaching and learning includes storage and processing of dynamic handwritten notes. Using dynamic handwritten notes (i.e., notes where the actual trace of the written characters is shown), rather than static notes, allows synchronization of notes with audio narration and other objects of various media types.

3.2.4 IMS Question & Test Interoperability Specification

The IMS Question & Test Interoperability [41] describes a data model for representing questions and tests data and the corresponding results in reports. The specification facilitates the exchange of question, test, and results data between authoring tools, question banks, test constructional tools, learning systems, and assessment delivery systems. The QTI specification and tools make it easier to obtain and analyze feedback from students in the classroom or online. QTI Tools may also be used to produce guided notes.

3.3 Open and Extensible CLE

Institutions of learning have always faced the challenge of implementing systems in which a wide range of learning best practices are supported while the institution is insulated from technological changes. In response to the challenge, O.K.I. has defined a robust architecture (i.e., framework) for how software components can be assembled.

3.3.1 The O.K.I. Framework

The O.K.I. architecture is based on the approach that specifies what services are needed and how software components can reference and provide or use those services—without any reference to the specific technologies used to implement a service. The approach—of organizing systems around services—is referred to as Service-Oriented Architecture (SOA). The O.K.I. architecture is based on service descriptions (called Open Service Interface Definitions (OSIDs) [42]) that are intended to be consistent well beyond the life-time of the specific technology used to implement the services. Applications that acquire a service do so through the OSIDs, which should not change when a new version of the service is installed. The SOA framework provides a basis for building a flexible and robust collaboration and learning environment.

An example of a service is The *CourseManagement* OSID which primarily supports creating and managing a *CourseCatalog*. The *CourseCatalog* is organized into *CanonicalCourses* (general courses available at an institution and exist across terms). Then, there are *CourseOfferings* for *CanonicalCourses*, which occur in a specific term; the Offerings have a *CourseGradeType1*, a *Status*, etc. Furthermore, *CourseOfferings* have *CourseSections* which have a meeting location, schedule, student roster, etc. Thus, in *CourseManagement*, as is the case with OSIDs in general, there are no references to how the services would be implemented. From the perspective of an educational institution, O.K.I.'s Service-Oriented Architecture provides an open and extensible framework that enables acquisition of a robust learning environment. Institutions should select tools and modules capable of communicating with the central CLE through calls based on O.K.I./OSID specifications. The Campus Project [43] is a good example of how to build an open and extensible system for e-learning.

3.3.2 Open Tools for Implementing Small-group Learning Strategies

An O.K.I.-based CLE should be the base infrastructure for implementing small-group learning strategies for online education because most of the techniques require group collaboration and management. Sakai CLE is an example of a system that realizes the O.K.I. framework; it is suitable for use as a learning management and small-group collaboration system. In addition to the central CLE, acquired tools should conform to IMS Tools Interoperability Guidelines (IMS TI) [44]. TI provides a framework that allows tools to easily integrate into a CLE; this enables the LMS to present the external tools side-by-side with its native learning tools. For instance, Sakai CLE [45] has a TI implementation.

Small-group learning techniques that normally apply outside the classroom are more adaptable for the online environment, but adequate technology infrastructure must still be put in place to support group activities among online learners. The following consists of recommendations for facilitating group activities:

Forming cohesive groups
- Assessment of academic skills (using QTI tools)
- Survey information to determine interests and preferences of the learners (QTI tools)

Modeling interaction and team-building skills
- Providing demonstrations to show interaction, discussion, and roles using recording facility of O.K.I.-based CLE and IMS TI conferencing tools
- Providing interaction scripts or models in multimedia formats (using SCORM content & SMIL)

Monitoring interaction among learners in groups
- The instructor or the teaching assistant may participate in or moderate virtual meetings (using IMS TI conferencing or InkML applications)
- Inspecting the log of group discussions
- Monitoring interaction from recorded sessions of IMS TI meeting tools

Designing learning resources for tutorials
- Simulation of classroom instructor-led lectures using dynamic handwritten notes and audio narration (using SMIL/ InkML / Timed Text)
- Recording class sessions for after-class review (using O.K.I.-based CLE / SMIL/ InkML / Timed Text)
- Providing lectures tailored to groups with captioning using Timed Text instead of audio devices

4 Employing Classroom Strategies for Online Learning

At the core of classroom-based learning are instructor-led lectures during which students are expected to take notes, take part in discussions, ask questions, answer questions posed, take impromptu quizzes, and benefit from listening to responses to questions posed by the instructor and other learners. In addition to simulating the classroom environment and allowing the learner to engage in classroom activities, online lectures must retain the advantages of asynchronous learning model, which provides the learner with the flexibility of choosing the time to learn.

4.1 Methods for Implementing Active Learning Strategies and Classroom Activities

The proposed online lectures for asynchronous learning are designed to simulate the instructor-led classroom environment in which audio narration is synchronized with dynamic handwritten notes—streaming ink data—and other basic forms of learning resources. SMIL is used as the presentation format. The feature of SMIL in which presentations can display media files from multiple Web servers at the same time allows discussions, quizzes, tests and other learning activities to be inserted at any point during the lecture. With the ability to provide links within a SMIL presentation to other SMIL presentations, the instructor can refer learners to sections of previous lectures in response to learners' questions.

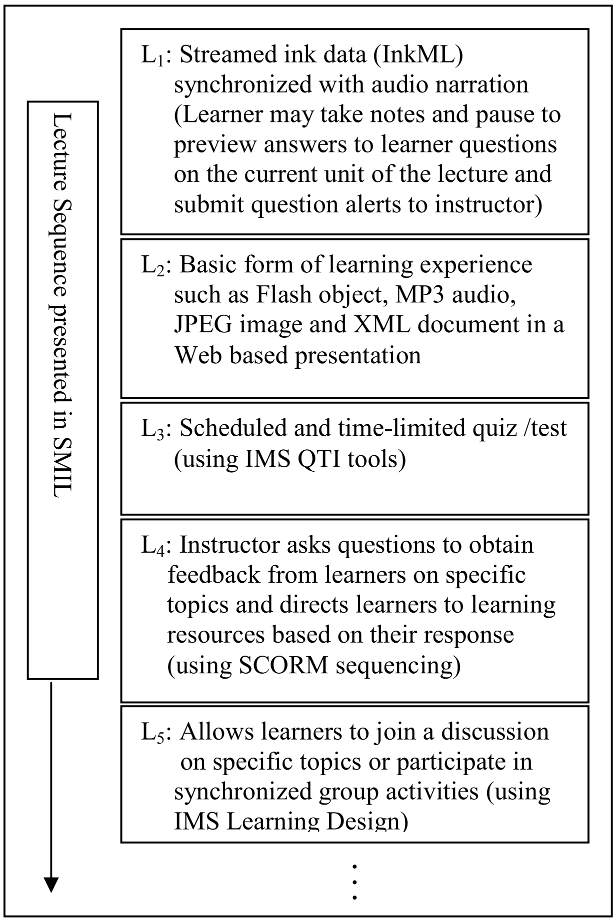

Figure 4: Online Lecture for Asynchronous Learning Mode

Figure 4 depicts a typical online lecture consisting of a sequence of learning units in which learners can listen to classical classroom lectures, take quizzes, branch out to take part in discussions, ask questions and answer questions posed by the instructor or other students. Figure 4 also shows five types of learning units labeled L_1, L_2, L_3, L_4 and L_5. Each type of learning unit provides a method for implementing a category of classroom activities or active learning strategies.

Method L_1: L_1 learning units mimic the traditional classroom lecture in which the instructor writes on the board while explaining a concept. Within a L_1 unit, the learner may pause to perform other learning activities that are allowed or made available by the instructor. The learner who has questions during a lecture would be able to preview answers to previously asked questions that are related to the topic at hand; he is also able to submit new questions, which would cause an alert to be sent to the instructor, teaching assistants or other learners.

Method L_2: L_2 represents a general Web based presentation using SMIL as the formatting platform. SMIL allows creation of Web based presentations that integrate audio, video, images, text, XML document and other media types. The capability of SMIL which allows display of files from multiple Web servers facilitates the use of learning resources from public repositories. The ability to provide access to digital resources is specifically useful in modeling, simulation or visual demonstration of mathematical, engineering or scientific systems.

Method L_3: A learning unit of type L_3 is an IMS QTI conformant quiz or test, which the instructor may intersperse among other learning units. A L_3 unit essentially provides a link to an assessment system that permits various question types such as multiple-choice, true-false, essay (inline, attachment, or both), fill-in-the-blank and matching. The assessment system may be native to the O.K.I. based collaboration and learning system or one that is integrated into the system using the IMS TI guidelines. L_3 units allow the instructor to implement active learning strategies such as taking quick in-class quizzes, which studies have shown to be associated with better performance and greater retention of course concepts.

Method L_4: The L_4 learning unit provides a mechanism for obtaining feedback from learners; it allows the instructor to get a quick and immediate feedback about how well learners understand the concepts under consideration. With learning units of type L_4, using SCORM sequencing rules, the instructor is able to solicit feedback from individual learners and direct each learner to appropriate learning resources based on his response.

Method L_5: A L_5-type learning unit, which is based on IMS Learning Design, directs the learner to a service where he joins a group for discussions, conferencing and other group activities. A L_5 learning unit may also be used to specify group assignments in which each learner in the group has to complete specific activities before members of the group can proceed to the next activity. The learning unit may also be used to support various in-class group activities for online learners; it may be used to permit learners to engage in question-answering on the topic at-hand as is done in a typical classroom.

4.2 Attending Lectures Asynchronously

Ordinarily, activities such as attending classes, taking notes and asking questions during a lecture do not apply in asynchronous learning. However, using the learning methods defined in section 4.1, an online lecture consisting of an organization of learning activities may be built to simulate the classroom learning environment. Going through the activities as dictated by an online lecture constitutes class attendance. The various types of learning units allow online lectures to be structured in the same way as classroom lectures. By adapting active learning activities for the asynchronous learning environment with open technologies and standards, learners get the added benefit of strategies that have been shown to promote learning while retaining the flexibility of asynchronous online education. There is the added advantage that online lectures, including the accompanying learners' actions and responses, can be recorded and made available for later access. The learner still has control over his schedule; he has the flexibility of choosing when to attend a class within a period of time (say, within a week). However, the learner may be required to coordinate his schedule with others in his group, so as to engage in in-class group activities.

The instructor or the learning resource designer has great flexibility in defining what constitutes lecture attendance. While allowing the learner to schedule when to attend an online class (within a time period), the instructor may place restrictions on the time spent on various sections of the learning resources. The IMS Learning Design provides features—properties and conditions—which can be used to store information and place conditions on a learning design. Conditions may be specified on group activities to ensure that individual members of a group completes sections of a learning resource before group assignment or discussion can begin; the runtime environment would record completion of the prerequisite activities and synchronize access to the next set of activities.

Common Classroom Activities for Online	
Attending a class	Sequence of learning units of type L_1, L_2, L_3, L_4 and L_5 replicates the classroom environment; learners schedule time to go through the learning resource
Listening to lectures	Learning units of type L_1 (traditional classroom lecture) and L_2 (general Web based multimedia presentation) support listening to in-class lectures
Taking notes	Learners may be required to take notes directly from type L_1 and L_2 learning units. An instructor may also design guided notes, using IMS QTI assessment system, to aid note taking.
Asking questions	Learners may pause when going through learning units to ask questions through IMS LD notification mechanisms
Answer questions posed	Learners may choose to answer feedback questions embedded in L_4 learning units
Taking quick in-class quizzes	A learning unit of type L_3 allows quizzes or tests to be interspersed among other learning units; it provides a link to an assessment system
Participating in in-class discussion and other group activities	Learners may also be required to coordinate their schedule. L_5-type learning units direct the learner to services where he joins a group for discussion, group work or conferencing

Table 4: Adapting Common Classroom Activities for Online Learning

Using the defined learning methods, typical classroom activities (note-taking, discussions, impromptu tests and quizzes, question and answer sessions, and listening to answers to questions posed by others) can be made available for asynchronous online learning. Table 4 summarizes the methods for accomplishing various classroom activities.

5. Conclusion

The paper has put forth a new paradigm for online learning by proposing methods to adapt classroom activities and active learning strategies for asynchronous learning. To produce a robust approach, the proposed methods have been based on open technologies and standards. The aim of the research is to develop an enhanced asynchronous learning model in which the effectiveness of classroom activities and active learning strategies are combined with the flexibility of asynchronous learning mode. In the next stage of the research, experiments will be carried out to determine the effectiveness of the various methods and to measure the level of acceptance by learners. If experiments show that the methods are effective, this line of research—devising methods to augment asynchronous learning with classroom activities and active learning strategies—has the potential for changing the face of online education. The resulting enhanced asynchronous online learning could form a basis for new business models for offering college education.

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