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# Object Oriented Adaptive Instructional Systems - A Model for Open and Distance Learning

**Dr. G. Mythili**

Staff Training and Research Institute of Distance Education  
Indira Gandhi National Open University

**Dr. K. Gowthaman**

Inter University Consortium  
Indira Gandhi National Open University

## ABSTRACT

*Innovations and research activities are going on for the advancement of teaching and learning process. Many tools and learning environments are being developed by the institutions and the industry. Some of the open source software are adopted and customise as the institutional requirements. Nowadays online learning such as e-learning, m-learning and web based learning are blended with formal, non-formal educational system. Many researchers focus learning style and learner preference so that the learner can enjoy the learning by the way they prefer. The traditional online environment has a gap between teacher and learner in online environment which is lack of individual attention. This study focuses on an adaptive instructional system and proposes a model to build the personalise the learning process to create the perfect online content for every learner which facilitate effective teaching/learning environment for each learner.*

### **Keywords:**

***Adaptive Learning, Adaptive Instructional System, Personalised Learning, Adaptive Hyper Media, Teaching and Learning Environment.***

## 1 Introduction

Information Communication Technology (ICT) has brought a lot of changes in the way education is delivered today. Educational activities are supported to be more interactive, individualized, accessible, and computer-mediated, followed by flexibility in interface. Technology supports people to learn more effectively at their own pace and in their own time. Over the past few decades, technology has completely transformed our lives in all possible ways. A successful ICT powered nation, has always laid a lot of emphasis on the use of ICT, not only for good governance but also in diverse sectors of the economy such as health, agriculture and education etc. Students can now browse through e-books, sample examination papers, previous year papers etc. and can also access to resource persons, mentors, experts, researchers, professionals, and peers-all over the world. Different Learning Environments offers different ways to visualize the Learning contents and also different functionality. A number of technical terms are now associated with typical instructional environments.

Flexible Learning is a set of educational philosophies and systems, concerned with providing learners with increased choice, convenience, and personalisation to suit the learner. In particular, flexible learning provides learners with choices about where, when, and how learning occurs. Flexible learning approaches are often designed using a full range of teaching and learning theories, philosophies and methods to provide students with opportunities to access information and expertise, contribute ideas and opinions, and correspond with other learners and mentors. This may occur through the use of internet-based tools such as Virtual Learning Environments (VLEs) or Learning Management Systems (LMSes), discussion boards or chat rooms; and may be designed as a "blended" approach, with content available electronically and remotely, as well as "face-to-face" classroom tutorials and lectures. [9]

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Blended Learning is the process of incorporating many different learning styles that can be accomplished through the use of 'blended' virtual and physical resources. Learning styles refer to the many ways in which people learn, through blended learning this can be accomplished by creating a variety of learning assignments and activities with the use of technology and instructor and peer interaction.

The instructor can also combine two or more methods of delivery of instruction. A typical example of the delivery method of blended learning would be a combination of technology-based materials and face-to-face sessions used together to present content. An instructor can begin a course with a well-structured introductory lesson in the classroom, and then to proceed follow-up materials online. The term can also be applied to the integration of e-learning with a Learning Management System using computers in a physical classroom, along with face-to-face instruction. [9]

E-learning is naturally suited to distance learning and flexible learning, but can also be used in conjunction with face-to-face teaching, in which case the term Blended learning is commonly used. E-learning is used interchangeably in a wide variety of contexts. it is defined as a planned teaching/learning experience that uses a wide spectrum of technologies, mainly Internet or computer-based, to reach learners. e-learning is used to define a specific mode to attend a course or programmes of study where the students rarely, if ever, attend face-to-face for on-campus access to educational facilities, because they study online. [10]

M-learning, or "mobile learning", now commonly abbreviated to "mLearning", has different meanings for different communities. Although related to e-learning and distance education, it is distinct in its focus on learning across contexts and learning with mobile devices. One definition of mobile learning is: *Learning that happens across locations, or that takes advantage of learning opportunities offered by portable technologies.* In other words, mobile learning decreases limitation of learning location with the mobility of general portable devices.[10]

The term covers: learning with portable technologies, where the focus is on the technology (which could be in a fixed location, such as a classroom); learning across contexts, where the focus is on the mobility of the learner, interacting with portable or fixed technology; and learning in a mobile society, with a focus on how society and its institutions can accommodate and support the learning of an increasingly mobile population that is not satisfied with existing learning methodologies.

These learning environments provide learning materials with different multimedia facility and learning management system to track the learner's activities. But these learning environments are not focused on "individual learner's perspective". As a result these methods are not able to identify and help the various types of learners.

Major focus in educational technology is the provision of instructional environments and conditions that can comply with individually different educational goals and learning abilities. Instructional approaches and techniques that are geared to meet the needs of the individually different student are called *adaptive instruction*. Adaptive instruction refers to educational interventions aimed at effectively accommodating individual differences in students while helping each student develop the knowledge and skills required to learn a task. Effort to match instructional presentation and materials with the student's preferences and needs have produced a number of learning styles.

Adaptive instruction mainly focuses on one-to-one tutoring. The tutor selects the most appropriate information to teach based on his/her judgment of the student's learning ability, including prior knowledge, intellectual ability and motivation. Adaptive instructional systems developed with the application of Artificial Intelligent methods and techniques. A new area of research combined adaptive instructional systems and hypermedia based systems. Hypermedia based systems allow learners to make their own path in learning. The adaptive hypermedia is to improve the usability of hypermedia through the automatic adaptation of hypermedia application to individual users. [22]

Taking into account the need and significance of adaptive instructional systems, this study proposes a model on object oriented adaptive instructional systems (OOAIS). The motivational aspects also included into OOAIS to ensure the learners' learning process.

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## 2 Review Literature

Fares Fraij and Victor Winter (2008) presents an *intelligent tutoring framework* that can be effectively utilized to assist teaching courses and therefore to achieve pedagogical goals. The courses generated using the framework is *adaptive*, i.e., they adjust their behavior to overcome the individual differences among students. The architecture of the framework provides three modules for an administrator, an instructor and a student. Furthermore, students explore the material of the course through two modes, namely *non-interactive* and *interactive (or adaptive)*. To achieve the goals of the framework, it is recommended to employ an agile software development process such as extreme programming. Furthermore, the development team of the framework must involve students and therefore proceeds in a *user-centered* fashion.[8]

Feng-Hsu Wang Dai-Yan Chen (2008) proposes a framework to solve the problem of integrating knowledge resources on the Web based on Semantic Web languages. As a consequence, knowledge modules of an Adaptive Learning (AL) system can be shared and reused on the Internet, resulting a service-based approach to developing distributed AL systems. Based on this framework, a prototype AL system was implemented to demonstrate how the knowledge modules of an AL system can be developed and integrated. A preliminary prototype evaluation result shows that the performance of the service-based approach is acceptable under light to middle traffics of requests based on current web service implementations. [2]

The GRAPPLE project aims at delivering to learners a technology-enhanced learning (TEL) environment that guides them through a life-long learning experience, automatically adapting to personal preferences, prior knowledge, skills and competences, learning goals and the personal or social context in which the learning takes place. In the GRAPPLE project 14 partners from 9 countries work together to achieve the ambitious goal of making adaptation a commonly used part or often used functionality of every learning environment.

A general purpose adaptation engine that can adapt any (xml) information, either as part of a pipeline from source to user-interface, or as a stand-alone adaptive learning environment that performs adaptation and complete user-interface presentation. User modelling (or UM) services that keep track of each user s learning process in order to provide input to the adaptation engine to base the adaptation on. A distributed user modelling (UM) architecture will be designed and developed to link different ALEs and UM services together, and to perform retrieval and reasoning over UM information coming from different services, as well as reason about where to send updates to a user model to. The adaptive functionality will be integrated in different existing learning management systems, either open source ones (Moodle, Claroline, Sakai) or proprietary systems aimed at corporate learning applications (realized by GRAPPLE s industry partners)[11].

An evaluation framework will be set up and used extensively to evaluate the usability and effectiveness of adding adaptive behaviour to learning applications, in higher education and in corporate settings. Documentation and training material, mostly for authors of adaptive learning material, will be developed and used during training sessions for educators willing to introduce adaptive TEL in their organization and to participate in the GRAPPLE evaluation process. Authoring tools to define CAMs, capturing relationships between concepts that are of a navigational and/or pedagogical nature, e.g. prerequisite relationships. In order to package a learning application consisting of domain-dependent information and CAMs extensions to standards will be proposed that can represent all required information to port learning applications between different adaptive learning environments (or ALEs). [12]

Jens O. Liegle Han-gyun Woo (2008) proposed a general framework and data model for web-based adaptive Intelligent Tutoring System (ITS) that allows knowledge to be stored in such a way that is not only independent of the knowledge domain, but also supports the storage of transfer knowledge, relationships and prerequisite knowledge. [20]

Adaptive Hypermedia and Intelligent Tutoring Systems are both used for computer-based instruction, but their strengths lie in different areas. Adaptive Hypermedia is better suited to the instruction of concepts, while Intelligent Tutoring Systems generally assist in the use of these concepts to solve problems. A general instruction system requires both of these methods of instruction to provide a full learning environment. Amanda Nicholas and Brent Martin (2008) describes a proposed method of combining Adaptive Hypermedia

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and Intelligent Tutoring Systems using Knowledge Spaces, a method of mathematically modeling a domain. [3]

Samy S. Abu Naser (2008) is developed an intelligent tutoring system for helping students enrolled in computer sciences (an introductory C++ programming course) at the Faculty of Engineering and Information technology in Al-Azhar University. The C++ Intelligent Tutoring System is called CPP-Tutor. Author presented an overview of the CPP-Tutor architectural design and user interface. This pilot project is for constructing a model domain of a subset of the C++ programming language. The completed project proves the concept and that a fully developed C++ Intelligent Tutoring System provides an interactive learning environment for students. According to the success of other similar Intelligent Tutoring Systems, it is also hypothesized that students able to learn to program in C++ and gain knowledge more quickly and effectively than students using traditional methods of teaching. [4]

Sasakura, M.; Yamasaki, S. (2007) identified that E-learning systems have become important in higher education, especially in universities. An adaptive e-learning system, which dynamically generates suitable courses for each student, is one of the most remarkable research fields. In this paper, Authors propose a general framework for adaptive e-learning systems, and discuss the role of information visualization in adaptive e-learning systems. [5]

Yong Se kim, Hyun Jin Cha (2006) proposed a method for integrated motivation diagnosis and motivational planning is described in a manner applied to an operable system. By applying the mechanisms, a tutoring system with motivation diagnosis using fuzzy logic and motivational planning has been implemented. [21]

Michael Steehouder and Nicole Loorbach (2004) identified that motivational elements increase the performance, self efficacy and appreciation of the product. The motivational elements do increase the pleasure of reading, without harming performance or self efficacy. [23]

Rodrigues and Carvalho (2004) presented that the expert overlay architecture integrated to the student emotional model allows a better customisation of ITS, for it considers cognitive and emotional issues increasing the possibility of truly motivating the student. Also the authors presented that motivation module, to attend the momentary needs of the student, and to prescribe immediate and long term actions, based on the emotional and cognitive data. [24]

Liu, Lee and Wang (2002) designed a guided learning system to correct the misconception of elementary students. They expected to achieve the best effect of computer-assisted instruction through the internet. [25]

Masoud Mohammadian (2005) explored the design and development of hierarchical fuzzy logic systems using an evolutionary algorithm. The development of hierarchal fuzzy logic systems is considered by a new method which determines the number of layers in the hierarchical fuzzy logic system. The advantage and disadvantage of using hierarchical fuzzy logic systems for financial modelling is also considered. Finally evolutionary algorithm is then used to design a fuzzy logic system from a set of data in an unsupervised learning manner. [26]

## 2.1 Extracts from review of literature

A critical analysis of the reported recent studies, following significant conclusions can be drawn:

- ) Research shows that designing adaptive learning system can be shared and reused on the internet, resulting a service based approach to developing distributed adaptive learning system. [5]
- ) Intelligent Tutoring Systems are designed and used specifically tried for some area like mathematic in education. A generic framework is missing. [4]
- ) One of the most urgent needs in the elearning system is to import an adaptive learning technique which provides more personalised attention to each student to achieve their goal. [6]
- ) The recent researches only focus on adaptive learning environment models and framework for individual models are developed. Therefore development relationship between all the models available in adopting learning environment as emerges on an essential problem. [7]

- ) Motivation is important factor to student success in learning which is not fully addressed is intelligent tutoring system. This very much essential in the current era of education.
- ) Intelligent tutoring systems focussed on the constructing method for a student model which represents the knowledge acquisition aspects of students. On the other hand, considering the actual teaching environment human teachers try to teach the student. Motivation level of students should consider whole teaching/learning environment, would lead to more achievement by the students. [21]
- ) Adaptive navigation support is an interface than can integrate the power of machine and human intelligence: a user is free to make a choice while still seeing an opinion of an intelligent system. In other words, adaptive navigational support has the ability to decide what to present to the user, and at the same time, the user has choices to make. [6]

Conclusive findings indicate that the teacher/academics/content developer have to change the teaching/learning environment. For example, e-learning, m-learning and web based learning provides one learning/teaching environment to all the students. Each student has different learning style. There is a gap between teacher and student in online environment is individual attention. There is a need to work in adaptive instructional systems to built the personalise the learning process to create the perfect online lessons for every learner. So a study may be initiated to design and development of an object-oriented adaptive instructional systems that may possibly prove effective teaching/learning environment for each student.

### 3 Statement of the Problem

The main problems of the above learning environment are:

- (i) Lack of success is that “information is not instruction” [Jim L’Allier] and “information is not training” [Schank], which means that even hypermedia presentations do not teach by themselves, but instead only present information. The pure information presentation fails as a technique for education, and criticized page turning, ‘next button’ oriented multimedia application for not supporting learning.
- (ii) The formal Learning Management System (LMS) support well for interaction between learner and lesson, learner and teacher. However, every student has individual features such as knowledge, goal, experience, interest, background etc.

A potential solution to this problem is the adaptive instruction systems (AIS) with built-in artificial intelligence. This system adapts the current knowledge stage of learner and support different learning strategies on an individual basis and a unified approach for adaptation of learners’ current knowledge and learning styles and effective teaching strategies, combined with an object oriented approach for system development and maintenance.

- (iii) Adaptive instructional systems concerned mostly domain based aspects of the instructional process overlooking its motivational aspects. AIS consider learner’s motivation and emotion both at learning design time and at learning run time. There is a need to provide attention to design ITS to detect the learner’s motivational states and respond to effective learning style. [21]

### 4 Objectives

The basic goal of the proposed study is to critically study adaptive instructional system and design and develop a model which also support feedback and motivation to the learners. In order to achieve this goal, following objectives of this study are:

- ) To explore the essential instructional ingredients;
- ) To explore various learning objects which supports the adaptive instructional systems;
- ) To explore component object based approach for instructional/tutoring content;
- ) To build the model with motivational aspects to improve the student achievement.

## 5 Object Oriented Adaptive Instructional Systems: A Proposed Model for Open and Distance Learning

Many adaptive learning models and artificial intelligence tools were developed for online teaching learning environment. The proposed model (figure 1.0) is emphasizes on the open and distance learning system which facilitate the learners from unreached places. The model consists of five major components which are interlinked to provide adaptive instructional system for the learners. The main and most important component of this model is adaptive tutoring system which fetches input from the learners' interface, content repository, teaching learning environment and the teachers' interface. Details of each component of this model is discussed below.

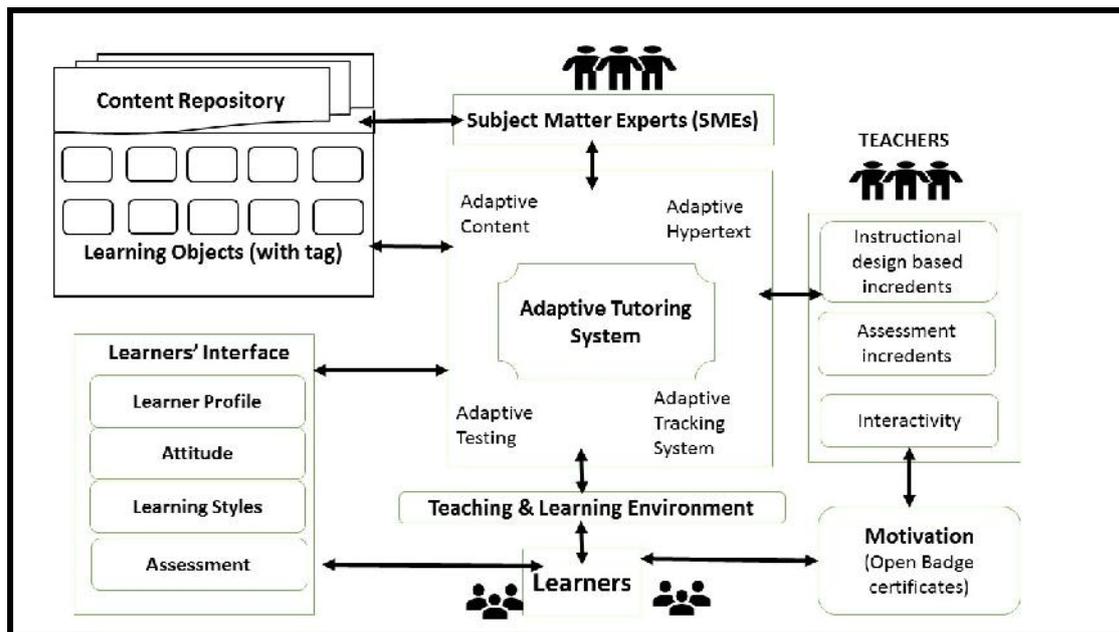


Figure 1.0 A Model for Object-Oriented Adaptive Instructional Systems

### Content Repository

The one of the important components of this model is content repository. The content repository consists of learning objects. “Learning Objects (LO) are the core concept in an approach to learning content in which content is broken down into bite-size chunks”[10]. These chunks may any text, image, audio, video animation of content which can be reused, independently or included in other content. The learning objects are created by the subject matter experts[13]. Each learning object has unique identity and distinguishable. LOs are tagged with level, format, adaptive hyperlink to locate and distribute to the learners according to their needs. Newly created LOs are stored along with their tag and existing LOs may be updated based on the curriculum of the courses.

### Learners' Interface

This component capture the learners profile, their attitude towards learning in the online environment, learning style and their assessment. These are the important information about the learners and input to the adaptive tutoring system. Learning style is differing from each learner. Based on the learning style and assessment each learner receives different kind of learning resources and guidance from the adaptive tutoring system and the respective teacher. The leaning analytics tools such as “TinCan App” can be incorporated to analysis the learner’s learning behaviour, their access to the content, participants in the activities and interaction with peers and teacher will facilitate the personalised learning for the learners.

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### **Adaptive Tutoring System**

Adaptive Learning is next generation of E-Learning, which is very important because it enables learners to select their modular components to customize their learner-centric learning environments. Secondly, it enables them to offer flexible solutions that dynamically adapt content to fit individual real-time learning needs [14]. Adaptive Learning Environment is to improve student learning outcomes has been noted by researchers and practitioners as a promising alternative approach for accommodating the diverse learning needs of individual students, including those with exceptional talents and those with special needs [15]. In the proposed model adaptive tutoring system plays important role because it includes the adaptive learning techniques. It fetches content from the content repository based on the learner's requirement, learning style and performance in the assessment.

This model also uses adaptive hypermedia which is the next-generation of hypermedia applications. Where hypermedia serves the same pages and the same set of links to all users, adaptive hypermedia improves the usability of hypermedia by building a model of the preferences and knowledge of an individual user and uses this information to adapt the hypertext to the needs of that particular user [16]. As the amazon.com provides the list of products based on the customer's views and likes. Similarly, the adaptive tutoring system provides content based on the learner performances and requirement. No learner receives same treatment including content. This entirely based on personalised approach. The adaptive system tracks each learner based on their history and provide assessments too.

### **Teaching Learning Environment**

Any Learning Management System (LMS) such as Moodle, Black-board, WebCT etc., can be integrated with this model as a Teaching Learning Environment. Learning Management System is software facilitate to manage the delivery of self-paced, e-learning courses. The LMS helps to publish courses and place them in an online environment. Learners log into the LMS using a browser, select courses from the learning environment. The LMS tracks the learners' activities with the courses. The LMS provides online reports for each course and learner [17]. The learners get the week wise or topic wise schedule in the LMS. In the traditional LMS all the learners get the same content and assessment whereas this model facilitates each learner to go through the adaptive tutoring system to get personalised approach[19]. The interactivity also built in for peer interaction and to interact with teacher.

### **Teachers' interface**

The teachers' interface facilitates the teachers to create curriculum for the courses. They also take part to develop learning objects for course from the subject matter experts. Teacher need to update the content based on the learner requirement. Instructional design place important role here in this interface. Teacher needs to create bank of assessments as the adaptive system required verity of assessments depending upon the levels and format. Teachers role to initiate interaction through discussion forum or chat to engage the learners in the teaching learning environment. Based on the performance, teacher can motivate the learners by providing open badges as the reinforcement. Earning badges motivates the learners for better performances[18]. This component also facilitate for learning analytic to predict the learners' performance to avoid the dropout.

## **6 Conclusion**

Online learning is integrated in the formal, non-formal and distance education. Nowadays the pedagogy of the formal system blended with ICT. Even school educational system provides learning management system for teaching learning process. The studies mention that learners are equipped with technology and they prefer technology based learning. This is right time to move further to provide leaner centric teaching and learning for the 21<sup>st</sup> century learners. The proposed model for Object-Oriented Adaptive Instructional Systems will provide personalised learning environment for facilitate to fulfil individual learning requirement. However

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this proposed model need to be developed and tested by the experts to integrate the components along with LMS for the personalised learning.

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