

# Adaptive Educational Hypermedia Systems: A Systematic Review



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## ABSTRACT

Adaptive educational hypermedia system (AEHS) is a moderately innovative course in the field of hypermedia and client displaying. Adaptive Hypermedia System (AHS) states all hypertext and hypermedia contexts with firm attributes of user's in user's model and have gift to modify hypermedia by using that model. Adaptive Educational Hypermedia (AEH) was the main application of adaptive hypermedia system and now it is the most conspicuous and very much researched. There are different models and system are being introduced but the Adaptive Educational Hypermedia (AEH) is a popular system which provides a form of support driven acquisition of the learning material. The undertaken study aims to present an analysis of various types of (AEHS) and techniques used to support adaptively according to their users. This study will be helpful for researchers, scholars and academicians.

**Key words:** Adaptive Hypermedia, Personalized systems, Intelligent Tutoring System, Personalization, E-learning, Student Model.

## 1. INTRODUCTION

Adaptive hypermedia (AH) is a new field of research for client displaying on hypermedia's platform, which overcomes all the gaps of personalized systems, i.e. "one size fits for all". AHES open opportunities to fit all the constraints according to the users interests. Whereas static hypermedia systems exhibits similar and static explanation and mention the same page to all student with broadly varying learning objectives. Essentially, a static electronic reference book shows the similar data and same arrangement of connections to correlated articles to

pursue with various information and concern. Adaptive Hypermedia (AH) is relative to "one-size fits-all" approach to improve structures of hypermedia. Adaptive Hypermedia Systems (AHS) designs a model of learning styles for every individual and the model can be modified by using their communication. The main objectives of these system are the modification of hypertext with reference to the user interests. Likewise the Educational Hypermedia System uses hyperspaces to represent the specific learning material of all subjects. The student only have to learn the hyperspaces of that material [1]. Up to that time, the AHS were modified by using the learner's earlier data and individual interests without considering the techniques of pedagogy. As a result, those systems neglect the whole figure of investigation that exists in the field of education and fails to explore the benefits of instructional methods utilized for the learning backgrounds [2]. Therefore to provide the best support to the students, an assessment approach was proposed which combines both methods i.e. The Adaptive Hypermedia (AH) and the Information Recovery method [3]. The goal of this study is to present the different AEHS techniques used to support adaptively to their users' interest. This will be helpful for researchers, scholars and academicians.

## 2. RELATED PAST WORK

Lot of research has been done regarding the AHS systems but [1] has mentioned classification, methods and techniques of AHS while [4], [5], [6], [7] provided a comprehensive review of AHES. Valerie Shute and Josep Sotka [8] defined the historical perspective of Intelligent Tutoring system [8] and [9] mentioned personalized learning for an educational, technological and standardization perspective. While [10] provided a new perspective of using personas to

detect students' learning styles on LMS and have facilitated the e-learners by their subject e-teacher [11],[12].

### 3. TECHNIQUES OF EDUCATIONAL HYPERMEDIA SYSTEM

#### 3.1 Tutoring Educational System (TES)

TES is structure and method for training a student with a specific contraption associated with a PC structure containing a database with a larger part of lessons wherein each lesson has different lesson segments with educational parts and assessment portions. Tutoring system was developed as a small effort used to combine an (ITS) and a learning hypermedia[13], [14],[15]. The main objective of (ITS) is to replicate the revealed benefits of personalized and one-to-one tutoring in contexts where students can access the one-to-many instruction from a teacher (e.g., classroom lectures) or no teacher at all. [13]Majority give practically zero learning material. (ITS) is an outcome of the earlier computer-Assisted Instruction model, which was a frame-based system with hard-coded links used for instructional purpose.[16][17]. CAI give more intellectual assessment of student knowledge than traditional "yes-no" and "multiple-choice" questions and more adaptive sequencing of instructional parts than traditional direct and separating approaches[18].When the CAI were gaining interest Jaime Carbonell suggest to develop the system which helps the computers to act like an intelligent teacher to teach the student named as "Intelligent Computer Assisted Instructions" of ITS[19].The traditional ITS system contains four components.

##### A. The Domain Model

The Domain Model or Cognitive Model is developed on a Theory of Learning such as ACT-R based on problem solving strategies. Another approach for developing domain model is based on Stellan Ohlsson's Theory of Learning from performance errors [20]. Known as "Constraint Based Modeling" [21][22].

##### B. The Student Model

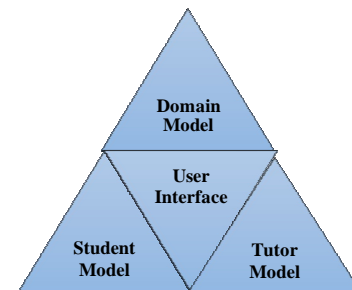
The Student Model can be considered as a covering part of domain model. In Constraint based tutors the student model is based on constraints set [23], [24].

##### C. The Tutor Model

The Tutor Model shows acknowledges data from domain and student model to make choice about pedagogic techniques and activities, consist of several rules based on learned or un-learned states,[25][26].

##### D. User Interface

User interface incorporates three kinds of information that is required to understand a speaker, domain knowledge needed for communicating content, and for communicating intent.[27].(Figure 1)



**Figure 1:** Components of Traditional (ITS)

Modern (ITS) are constructed on components such as:

##### A. Curriculum Sequencing

It allows the student to discover an "optimal path" of learning material. Curriculum sequencing was first implemented in ELM-ART [28].and CALAT [29]. ELM-ART [28] and KBS- Hyper book [29] illustrates good examples of Curriculum Sequencing.

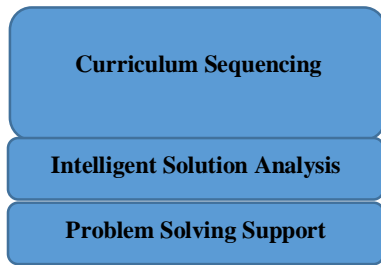
##### B. Intelligent solution analysis

This technique is used to find the solution of education issues. The non-intelligent system just inform that the answer is right or not whereas the intelligent analyzer can tell what isn't right or inadequate and which data is responsible for an error. It can give remarks and update the data of student model. The systems SQL-Tutor [30] German Tutor [31]and the latest version of ELM-ART presents the numerous methods of implementing intelligent solution analysis on WWW.

##### C. Problem Solving Support

Problem solving support helps to solve problems on each step by giving the clue for solution. Problem solving support is more popular in (ITS) as compare to the Web-based systems just because of

implementation issue, Active Math [32] implements problem solving support in Omega proof planer. (Figure 2)



**Figure 2:** Components of Modern ITS

From the beginning of (ITS) more than 20 ITS system were introduced [33]. Those authoring tools were classified on the basis of their tutoring systems. I.e. *AUTO Tutor* (Graesser, *et al* 1999) VC-Prolog-tutor (Peylo, teiken, Rollinger, & Gust, 1999)ActiveMath (Melis, *et al.*, 2001) German Tutor (Heift, *et al.*, 2001) ELM-ART (Weber, *et al.*, 2001)SQL-Tutor (Mitrovic, 2003)ZOSMAT(Keles, *et al* 2009) SMART Tutor (Cheung, *et al*)[34][35][36][14][37][38] given in Table-1

### 3.2. Personalized Educational system

The term personalized learning was used in early 1960's [39]. A decent meaning of personalized learning innovation is that it keeps up a learning profile on every learner which contains data on the best way to customize all aspects of the learning background and may enhances the learning results. Its framework is like an expert live teacher who is giving one-on-one coaching. Maybe this is the reason the National Tutors Association has dependably been a solid supporter of Personalized Learning Technology and has chosen the BrainX. In 2005, Dan Buckley introduces the personalized learning spectrum which is composed of two ends "Personalization for the learner" and "personalization by the learner". This effort was approved by the Microsoft's practical guide to envisioning and transforming education in 2006. It utilizes information and investigation to persistently adjust the learning way. Personalized Learning Systems by differentiation expect that every learner is absolutely one of a kind. While they will utilize the same authentic information and diagnostic process utilized by adaptive learning they go past this to give a larger amount of personalization. Personalized Learning empowers learning substance

to be changed in perspective of the learning pace, capacity profiles, slants of a learner. Despite the fact that the different idea of Personalized learning system a take-off from "one size fits all" education and practices of its integration. There are three core components of personalized learning system.

- A. Proficiency-based learning
- B. Customized Learning Process
- C. Learner Profile

Figure 3: shows the three components.



**Figure 3** Components of Personalized Learning System

### 4. Adaptive Educational Hypermedia System

Several Adaptive Hypermedia Systems are discussed in the literature some of which are highlighted with reference to their systems, components and technology in the Table 1:

**Table 1:** AEHS: technologies, sample system, System features are shown in bold.

| <b>Adaptive Educational Hypermedia System</b> |  |  |   |
|---|--|--|---|
| <b>AHS Technique</b>                          | <b>Sample System</b>   | <b>Components</b>  | <b>Technology used</b>  |
| Intelligent Tutoring System                   | VC-Prolog Tutor<br>AUTO Tutor<br>German Tutor<br>Active Math<br>ELM-ART<br>SQL-Tutor<br>SMART Tutor<br>ZOSMAT  | Curriculum sequencing,<br>Intelligent solution analysis,<br>Problem Solving Support.   | Adaptive navigation support,<br>Adaptive presentation,<br>Artificial Intelligence.                      |
| Personalized Learning System                  | BRAIN-X,<br>"personalization for the learner"<br>&"personalization by the learner"<br>Model to detect student from LMS<br>E-teacher Model<br>Modeling E-teachers decision for e learners | Learner's Profile,<br>Customized learning process,<br>Proficiency-based progress.<br>Learners' persona detection<br>Motivation,<br>Learning Objects dissemination as per persona | Artificial Intelligence,<br>ICT and Communication Technologies<br>Bayesian Network<br><br>Decision tree |

## 5. DISCUSSION

From this study, it is found that AEHS is being increasingly used in educational area and gives the effective learning environment. AEHS are being used in shape of personalized systems and ITS. But in early development of (ITS) they deals with pedagogic tasks only without knowing the interest of a learner. Whereas in personalized learning systems the developer's main focus is to understand learners' learning requirements, i.e. students' personal traits. Mostly the personalized systems have used students' knowledge level to meet their learning needs. Also, their cognitive level are also used. Personalized systems and ITS are open areas to work on various dimensions, i.e., from the educational dimension, technological dimension. Most recently, the learning styles are being used to understand e-learners' learning requirements on LMS and to facilitate them accordingly. But, from the study it has come to know that most studies have reported 60 to 75% accuracy in detection of learning styles from LMS also the learning style theories have also problems in theory reported by various researchers. Therefore, to develop an AHES on the basis of learning styles, cognitive theories, knowledge level is a challenge. Despite of this these systems have big drawback as the hyperspace is usually big the user becomes confused by the paths and topics available and lost his interest, to cope with this situation some other system such as hyper tutor and many other are introduced in which hypermedia and tutor components and integrated to work together.

## 6. CONCLUSION

The purposes of this study is to illustrate the techniques, Challenges, opportunities and effectiveness of AEHS in the field of education. From this research it is found that Adaptive educational hypermedia engages customized personalization of online course material and finishes all the gaps of hypermedia systems by integrating the different components, hypermedia and advanced technologies. We have exhibited how an AH system can change in accordance with various learning styles and technology now a days the AEHS are also implemented in Mobile phones so it might be the best area for the future work.

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