

ADAPTIVE E-LEARNING TECHNIQUES IN THE DEVELOPMENT OF TEACHING ELECTRONIC PORTFOLIO – A SURVEY

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Abstract :

Emerging technologies of communication and information influence the society, in particular the educational system in new directions. Media based educational systems are becoming more popular today and vast student population rely on this for learning. In the technologically emerging education system, it is necessary to have an e-learning system which can understand the learner's preferences and make attempts to deliver content accordingly. It has become a challenging task to understand the learning preferences of the learners and adapt a method to offer content to suit the learning styles of the learners. Many educationists and researchers in education have made attempts and conducted research on delivering adaptive content. The learners of today are on the look out for content that would suit them in terms of their taste, understanding level, learning curve, own preferences and their personal traits. The learning process would be more efficient if we could satisfy the above needs of the learners. This paper makes a survey of the various means of offering adaptive content in an e-learning environment and explores the possible ways of achieving adaptability in learning systems. We conduct a study on the various models of adaptive content delivery system and propose newer methods of delivering adaptive content in an e-learning environment.

Key words: *E-learning; E-portfolio; Web based education; Learning styles; Adaptive content delivery system.*

1. Introduction and Motivation

In the e-learning environment of today effort is made just to deliver the content via the electronic media. Very little attention is made to understand the personal needs of the learner. E-Portfolio based learning offers real potential for autonomous and personalized learning. The embedding of any e-learning tool provides innovation in teaching and learning process by developing collaborative learning platforms and adaptive course content that allows for creative thinking and collaboration with others. It develops an instructional design to upgrade the content for application in e-learning platforms and easy with anywhere access of course content. It also creates self development of education by providing the flexibility to select the specific content that the learners need at the moment. Teaching e-portfolios contain course materials for a particular curriculum in a digital repository. The teaching portfolio could be personalized by the learner based on his desire. It would be enhanced with facility of editing by the user and modify the content thus storing the content in his own repository. The monitoring process could be achieved by employing a learning management system(LMS).

Various researchers have analyzed and developed different e-learning models with learning styles. Individual learning styles differ, and these individual differences become even more important in the area of education. Cashdan and Victor (1971) argued that people have preferred learning styles but may switch styles depending on the problem. Learning style is an individual's inherited foundation, particular past life experience and the demands of the present environment that emphasize some learning abilities over others [Kolb *et.al.*(1974)]. Joyce Pittman *et.al.*(2006) have concluded that the learning styles could influence content type preferences among students in either environment (face-to-face or online) but this hypothesis needs more research. In this system the learners with

different learning goals are treated differently. Wall and Phillips(2008) stated that E-portfolio is the collection of authentic and diverse evidence, drawn from a larger archive, which represents what a person or an organization has learned over time, on which the person or organization has reflected, designed for presentation to one or more audiences for a particular rhetorical purpose.

Many educators pointed out the importance of interaction in high quality online education. Brusilovsky *et.al* (1998) describe an approach for developing adaptive electronic textbooks and present Inter Book, an authoring tool based on this approach that simplifies the development of adaptive electronic textbooks on the Web. Web-based education is the online education with technological change, which not only permits new activities but makes those new activities superior in many important ways over the previous method of operation, creates long lasting innovations in society [Franklin and Peat(2001)]. The adaptive hypermedia technologies used for providing adaptive Web-based course material are: adaptive presentation, and adaptive navigation support. Adaptive navigation support (ANS) is aimed to help students to find an optimal path through the hyperspace of learning material. Laura Bergström *et.al.* (2007) presents a virtual course with the topic mobile and wireless communication systems. The main didactical approach of the virtual course is a guided excursion to which students enroll. They described the task sets, consisting of exercises and study directives, that the course teacher assigns each week to the students and the concept of step-by-step skill assimilation, which lies behind the student guidance process, is also outlined together with descriptions of the different user skill levels.

Tesone and Peter (2008) conducted a relative study on the preference of students towards online learning and traditional face-to-face teaching methods and concluded that a mix of the two methods was preferred by the students. Holzinger *et.al.*(2008) found that the dynamic media can support learning when cognitive load and learners' mental representations are taken into account during the design and development of learning material containing dynamic media. Maria Dolores *et.al.* (2008) suggested that the e-learning applications are becoming increasingly important at the university; there are still some critical questions that should be solved with the objective of making use of the potential offered by current Web technologies and the creation of contents that are able of capturing the attention of interest of the students.

In this paper, we propose a system to understand the personal needs of the learner and make efforts to deliver contents accordingly. As it is needed to find the various means of offering adaptive content a broad study on the adaptive content delivery system was carried out.

The paper is organized as follows: Section 2 analyses the learning strategies used for teaching e-portfolios. Section 3 deals with the various learning style models proposed by different researchers. Section 4 discusses how the adaptive features incorporated in e-portfolio architectures and Section 5 discusses the proposed model. Finally the conclusion is given in Section 6.

2. Learning Strategies

Student learning performance is improved when students actively participate in knowledge construction and in assessment of their own learning. Environments in which students develop models, collect data, and evaluate alternative designs help them to develop vital skills. Various learning strategies have been analyzed by educational researchers to develop the learner's skills. Some of the learning strategies are analyzed below.

Inquiry-based learning [Edelson(2001)] is gaining increasing support in science education and engages students in activities that mirror methods of scientific investigation, with content interwoven with or addressed in the context of inquiry.

In problem based learning students collaboratively solve problems and reflect on their experiences. The students learn how to analyze the problem given among the students and sharing classroom knowledge into practice [Halizah and Ishak (2008)]. Afolabi Folashade and Akinyemi(2009) concluded that problem-based learning technique exposed to students more to realities of life and tend to work as scientist and acquire knowledge by themselves which the teacher only correct their miss conceptions.

When the knowledge innovations in e-learning combines with human resources, technologies and software tools, the learners can effectively share and create new knowledge and can lay their mark on the learning culture which is learner-centered, project-based, integrated [Qinglong and Chengyang(2008)]. The ways of doing and approaching projects those are shared at a significant level among the learners leads to better knowledge and providing creative forms that the collaborators to accomplish new projects.

Mind map is a way of representing information graphically using keywords, links, and key images, allowing a lot more information to be put on a page. Mind map works the way the brain works, which is non linear [Hanan and Khairuddin (2007)].

Ubiquitous learning is an emerging research field, allowing students to learn anywhere and anytime. Adaptivity and personalization issues play an important role in ubiquitous learning systems, enabling those systems not only to allow learners to learn whenever and wherever they want, but also in a personalized and adaptive way, considering the situation, characteristics, and needs of learners [Sabine Graf and Kinshuk(2008)]. Birgit Bomsdorf (2005) introduced a first notion of a comprehensive definition of 'plasticity of digital learning spaces' and stated about Ubiquitous learning in which learning environments will be accessed increasingly in various contexts and situations.

Blended learning focuses on optimizing achievement of learning objectives by applying the right learning technologies to match the right personal learning style to transfer the skills to the right person at the right time [Harvi Singh and Chris Reed(2001)].

In recent years a growing number of mobile services have been offered connecting the internet to PDAs and mobile phones. However, these innovations are hardly used in the sector of e-learning. Alimadhi (2002) discussed the need to provide gateways between web resources and mobile technology and designed a prototype to study the possibilities of making existing web resources available to mobile devices. The focus of the study by Topland (2002) was the challenge of developing multi-channel e-learning services on Internet in which the content is located at the same node. The prototype that was developed shows that older devices or browsers do not support multi-channel services. Avenoglu (2005) developed a mobile learning portal for students on web-based instruction. This portal included a mobile discussion forum and a course information system. Stefan Stieglitz *et.al.*(2007) introduced an application of a mobile e-learning network which operates totally decentralised with the help of an underlying ad hoc network architecture. In this approach, the concept of ad hoc messaging network (AMNET) is used as basis system architecture to implement a platform for pervasive mobile e-learning.

3. Learning style models

In e-learning when the learning style of the learner is not compatible with the teaching style of the teacher, difficulties in academic achievement can result. Learning style defines how learners perceive and process information in different ways. Based on how we observe and retain information, it may be of great benefit to know what our learning style may be. Thereby recognizing the individual learning styles, the quality of e-learning content can be improved to suit for learners learning styles. Several learning style models have been discussed so far by researchers [Briggs Myers(1962)]. Some of the learning styles are discussed in this paper.

Gordon Pask's work(1976) is based on the recognition of two different kinds of learning strategy: serialist and holist. Serialists tackle the subject step by step, building from the known to the unknown with the simplest possible connections between the items of knowledge. Holists, on the other hand, seek an overall framework and then explore areas within it in a less haphazard way, until they have filled in the whole.

Honey and Mumford's learning style model developed by Honey and Mumford (1982) includes four stages of learning styles: Activist, Reflector, Theorist and Pragmatist. Activists need interaction between other learners in e-learning environment and therefore group works and real-time conversations are recommended for them. Reflectors prefer standing aside and think what is happening. They learn best by observing someone else, collecting information about it and going through what was learned. Theorists prefer analytical and rational thinking over subjectivity and emotions. They like complex problems where they can use their skills and knowledge. Pragmatists are the ones who prefer hands on doing over theory.

David Kolb (1984) found that the four combinations of perceiving and processing determine the four stage learning cycle. The learning cycle stages are:

- Concrete Experience (CE) – feeling
- Reflective Observation (RO) – watching
- Abstract Conceptualization (AC) – thinking
- Active Experimentation (AE) - doing

The learning styles are: Diverging, Assimilating, Converging and Accommodating. Diverging learning style is preferred by people who are feeling and watching concrete situations from several different viewpoints. The assimilating learning style combines watching and thinking as ways to learn. These kinds of learners prefer readings, lectures and exploring analytical models. The converging learning style is learning by doing and thinking. People with converging learning style like to experiment with new ideas, to simulate and to work with practical applications. Learners who prefer accommodating learning style like to do things concretely. Accommodating learning style relies on intuition rather than logic. Kolb says that concrete experiences lead to observations and

reflections. These reflections are absorbed and translated into abstract concepts with implications for action, which a person can actively test and experiment. This enables creation of new experiences and starts a new cycle.

Felder-Silverman learning style model(1988) combines major learning style models such as the ones by Kolb (1984), Pask (1976), and Myers- Briggs [Briggs Myers (1962)] and is based on the idea that each learner has a preference on each of the four dimensions such as active/reflective, sensing/intuitive, visual/verbal, and sequential/global. Active learners prefer to work together with others, whereas reflective learners learn by thinking things through and working alone. Sensing learners prefer to learn from examples, whereas intuitive learners prefer to learn abstract material such as theories and concepts, and tend to be more innovative than sensing learners. Visual learners remember best what they have seen, whereas verbal learners get more out of words, regardless of whether they are spoken or written. Sequential learners learn in linear steps, prefer to follow linear stepwise paths, and be guided through the learning process, and whereas global learners learn in large leaps and prefer more freedom in their learning process.

The Visual-Auditory-Reading-Kinesthetic (VARK) model[Flemming(2001)] is based on a person's preference for particular types of external events to stimulate their senses to help them learn. The learning styles are divided into four categories; visual (verbal), visual (non-verbal), auditory, reading and kinesthetic. The learners who learn best through hearing (aurally) can find virtual learning useful if there are video clips, virtual lectures, and video conferences because listening and speaking are important for auditory learners. Kinesthetic learners prefer laboratory sessions or field trips over classroom lectures.

According to the Dunn and Dunn model(2003a), learning style is divided into 5 major strands: Environmental, Emotional, Sociological, Physiological and Psychological. Environmental strand incorporates individuals' preferences for the elements of sound, light, temperature, and furniture or seating design. Emotional focuses on levels of motivation, persistence, responsibility, and need for structure. Sociological addresses students' preference for learning alone, in pairs, with peers, as part of a team, with either authoritative or collegial instructors, in a variety of ways or in routine patterns. Physiological examines perceptual strengths, time-of-day energy levels, and the need for intake and mobility while learning. Psychological incorporates the information processing elements of global versus analytic and impulsive versus reflective behaviors, hemispheric elements.

4. Embedding adaptive features in teaching E-portfolio

E-Portfolios play a major role in the modern educational system. The educational system is flooded with on-line learning which could be achieved and enhanced with the e-portfolios. On-line monitoring, delivering contents, evaluation are the major functions performed by e-portfolios in the modern educational systems. As markets get focused to the consumer, Educational systems get focused to student. Hence when it has to be student centered, adaptive system becomes a necessity in the educational systems of today. Students in these days do not prefer to listen to lectures the whole day as in the traditional style of teaching. The main solution is to find the preference of the learners and offer content accordingly. Hence adaptive learning could be the only solution to the above problem. In the current scenario, researchers take huge efforts to embed adaptive features in E-learning environments. Major research is focused towards achieving adaptability using learning styles.

Valerie and Brendon(2003) concluded that adaptive e-learning provides an opportunity to dynamically order the pages so that the learner sees the right material at the right time. Christian wolf(2003), in his work of iWeaver, he proposed a model in which he categorized the learners and then the same content is delivered in different modes such as plain text, pictorial, derivative or relational and animation. He also provided different tools to switch from one mode to another mode.

Alexandros Paramythis and Susanne(2004) summarized the various e-learning techniques employing adaptability and also discussed about reusable e-learning components. Vicki and Jun (2004) reported that the integration of adaptive learning with ubiquitous computing and u-learning may offer great innovation in the delivery of education, allowing for personalisation and customisation to student needs and allowing students to access education flexibly, calmly and seamlessly. Sampson *et.al.*(2004) concluded that ontologies and semantic web technologies will influence the next generation of e-learning systems and applications. Wilson *et.al.*(2005) argues that the semantic web can contribute for the development of tools able to facilitate the construction of adaptive web-based educational systems, by using semantic web resources. Van Rosmalen *et.al.*(2006) introduced a standards-based model for adaptive e-learning and stated that adaptation requires the functionality to be able to interact with and manipulate data on the learning design, the users and the system and its contents. Danijela *et.al.*(2007) presented an adaptation scenario for tailoring instructional content towards individual learner characteristics based on learner's learning style type and subject matter motivation level. They used an ontology based student model for storing

student information. Edwards *et.al.*(2010) examined a review to determine the effectiveness and cost-effectiveness of adaptive e-Learning for improving dietary behaviours.

5. Proposed adaptive e-portfolio system

Considering the fact that not just delivering content would be sufficient, and more features would be expected from the modern learners, the proposed e-portfolio system would be embedded with adaptable features and made interactive. The E-portfolio will be flexible to the learner by implementing the need based learning styles of the learner. The learners are analyzed by offering them different questions and judge their learning styles and based on this outcome they are given variants of learning content. Some researchers [Matsuda *et.a.*,(2006) and Caryn Meissner(2008)] proposed that using the animations we can easily deliver the content to the learners and it helps them for quick understanding and also useful for simulation. So with the help of animations, visualizations and simulations we can teach the programming languages by simplifying the complex algorithms, making it interactive and remember easily. The flash animations and three-dimensional images along with audio and video can be used to make the content live. The main objective of this paper is to encourage education and training by presenting the content in the learner's preference and which often involve regular self-evaluation and feedback.

In this paper, we proposed a model which provides adaptive and interactive content for teaching programming languages where we can trace the sequence of execution of the program and the arrangement of data in the memory, which gives a clear visualization of the program. The model can be used for training learners on programming. This can be implemented for face to face teaching and also can be made online. Online chat is also provided for discussions and facility to post the doubts and clarify them immediately without disturbing the class. Depending on the topic difficulty level we will suggest the learner to switch to different content for a better understanding.

The system judges the learning style and preference of the learner and offers content accordingly. Initially the learner interacts with the system through the intelligence module. The intelligence module in order to judge the learning style of the learner puts some questions to the learners. The learner answers these questions based on his preference and analyzing the answers the intelligence system suggest a suitable content for the learner. The content delivery system based on the instruction from the intelligence system delivers the content to the learner. After a learning session the feedback and suggestions from the learner are also recorded for future modifications.

The proposed model also aims at developing an online intelligent performance prediction system based on neural networks to validate the performance of the learners when accessing the adaptive e-learning system. The intelligent teaching system uses information from a learner's database in order to determine pedagogical decisions for each learner especially to control learner's progress and to adapt the presentation of the contents to individual learner.

6. Conclusion

A detail analysis of the various adaptive techniques that could be incorporated into the e-learning system was carried out. As the new learners would not just prefer to see the content over the digital media but would demand more interactivity and adaptive features it is the right time that we take necessary steps to develop a good e-content to suit the millennium learners. To enhance learning features like interactivity, adaptively delivering content and multimedia features like sound video graphics and animations should be added. This can be achieved only through the full utilization of a computer based tutoring system. Survey states that by the year 2025 every learner on the job or off the job would be exposed to the e-learning environment in one way or the other. In the modern world learners face a lot of challenges and they are exposed to lots of media entertainment and learning on the contrary the traditional teaching which is not much entertaining does not gain attention of the learners. Hence the normal class room teaching creates much boredom and may not gain much interest. So if we could embed multimedia features in the e-learning environment and make learning more active and live the student community would enjoy learning and develop good interest in the learning process. To conclude it is going to be the digital world and learning in future will be through the media, so it will be the right time to initiate an adaptive learning environment to improve the efficiency of learning through an e-learning environment.

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