

An Adaptive Learning Management System Based on Learner's Learning Style

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Abstract: *E-learning technology has been emerged to enrich learning in schools, universities and everywhere. Learners have grown up with computer and Internet and they expect to continue using them in the process of getting an education. Recently educational researchers have focused on aspects of personal characteristics such as learning styles, their impact on learning, and also how they can be incorporated in technology enhanced learning. This paper presents a system of an adaptive e-learning course including introduction, contents, assignments, Exercises. This system is developed using an open source learning management system LAMS (Learning Activity Management System) to present course materials in different ways according to learner's learning styles. Several patterns discovered where learners with different learning style showed significantly different preferences in e-learning environment. These results seem to be important in order to provide courses that include features which fit to different learning styles.*

Keywords: *E-learning, Adaptive Learning System, Adaptive e-learning, Learning Styles.*

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1. Introduction

The study of how learners learn has been a concern for researchers for many years [17]. In traditional classroom system, an instructor can control this aspect accordingly based on what he sees of his learners' reaction. For e-learning to be effective it should be adapted to the personal learning style. One of the learning style models is Myers-Briggs Type Indicator (MBTI) which is derived from psychologist Carl Jung's theory [12]. The traditional e-learning systems provide the same materials to all learners. However, Learners have individual differences. [24]. E-learning systems should be capable of adapting the content of courses to the individual characteristics of learners [28]. Adaptive e-learning systems (AES) try to solve these problems by changing the presentation of material to suit each individual learner. They use different approaches to evaluate learner's styles. [26, 20].

This paper presents a system of an adaptive e-learning system based on the learner's learning styles system diversity. The system identifies the learner's learning styles tendency through a set of questionnaire. The questionnaire scores will be used by the system as a basis to provide the learner a presentation of learning materials differently.

2. Related Work

With the advancement in educational technology and a new generation of learners has grown up using both computers and the Internet. Therefore an understanding of learners' preferences is very important [15]. E-learning tools divided into three

main types which related to learning management system, synchronous collaboration, and all other computer tools including asynchronous collaboration. E-learning challenges are categorized according to their focus which can be divided into challenges related to characteristics of the individual and technological which is concerned in this paper and challenges related to content, design and delivery [5, 2]. Learning style is an important factor that has an influence on e-learning. An unacceptable learning style can lead to learner dissatisfaction [13].

An adaptive e-Learning system gives the learner an opportunity to select learning materials or contents according to the learners' style, profile, interest, previous knowledge level. A number of researches have been conducted in the area of adaptive learning [7].

An e-learning system must be based on learner's learning style which makes e-learning more reasonable and efficiency. However, most of e-learning systems do not consider learner characteristics [18]. Many e-learning systems on the Internet provide the same content to all learners without realizing their individual differences [24]. Adaptive e-learning systems attempt to change the presentation of material to fit each learner. They collect information about learner's goals, preferences and knowledge in order to adapt the education needs of that learner [26].

One of the most desired characteristics of an e-learning system is personalization, as people with different skill sets use the system. Some people may be fast learners while some may be slow, some may need to practice more problems while others may need just

example. These preferences are in general called the learning styles of an individual [1].

Due to adaptation, there are two levels of adaptation in the adaptive e-learning system, depending on who takes the initiatives. Systems that allow the user to change certain system parameters and adapt their behaviour accordingly are called adaptable. Systems that adapt to the users automatically based on the system's assumptions about the user needs are called adaptive [23].

Learning style means that a person might prefer some preferences in learning over others but also use aspects of other preferences [14, 19]. Several learning style models were proposed to describe how different learners deal with information [9].

Learning style paradigms began to be developed in the mid to late 1970s to identify the more external and applied modes of learning styles [19]. Several learning style models were proposed to classify and characterize how learners receive and process information. They basically refer to two fundamental aspects of a learner's personal style, namely her/his cognitive style, the way she/he thinks, and her/his learning strategy, the processes she/he uses in response to a learning task. Some well known models are those proposed by Myers-Briggs, Kolb and Felder-Silverman [9]. This study adopted the MBTI model as one of the well-known source information for personalization. MBTI is one of many popular personality assessment instruments. Several researchers have used the Myers-Briggs Type Indicator to determine preferred teaching styles in distance education [21].

MBTI has four dimensions which are extraverts or introverts that refers to where learners prefer to focus their attention, sensors or intuitive refers to the way learners prefer to take information, thinkers or feelers refers to the way they prefer to make decision, judgers or perceivers refers to how they orient themselves to external world. MBTI learner profile is determined by preference for one of each of the above four dimensions. For example, INTJ means Introversion, Intuitive, Thinking, and Judger [12]

Kolb's learning Style Model defines learning as the process of being in harmony with the social and physical environment. He has proceeded to define "learning" and differentiate it from knowledge. According to Kolb, learning is a process and knowledge is the transformation of the experience. Kolb has defined four types of learning styles. These are Accommodator; they adjust to changes since they are open-minded in the learning environment. The learning occurs by doing and experiencing actively. They are always in a state of invention. Assimilator; creating conceptual models and reflective observations are their specific characteristics. Converger; they need to perceive the whole and moving from the whole to the parts. Diverger; they adjust by observing concrete situations from different angles. They construct their

ideas patiently, objectively and carefully in the learning process [16].

Felder- Silverman Learning Style Model: This model developed by Richard Felder and Linda Silverman incorporates five dimensions, two of which replicate aspects of the Myers-Briggs and Kolb models.

- Sensing/intuitive: sensing [concrete information such descriptions of physical phenomena, practical, oriented toward facts and procedures] and intuitive [conceptual, innovative, oriented toward theories and meanings]
- Visual/verbal: visual learner [prefers visual representations, pictures, diagrams, and flowchart] and verbal learners [prefer written and spoken explanations].
- Inductive/deductive: inductive learner [prefers presentations that proceed from the specific to the general] and deductive learners [prefers presentations that go from the general to the specific].
- Active/reflective: active learner [learns by trying things out, working with others] and the reflective learner [learn by thinking things through, working alone]. Active and reflective learners have difficulty taking notes hard for both learning type. Active learner will retain information better if s/he finds ways to do something with it. Writing short summaries for reflective learner will be very helpful to compensate the shortage of class time thinking about new information.
- Sequential/global: sequential learners tend to gain understanding in linear steps and the global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections. [12]
- As part of this research, the model MBTI has been examined in e-learning field,

The VARK learning style inventory was initially developed by Fleming in 1987. VARK is an acronym made from the initial letters of four sensory modal preferences that are used for learning information: visual, aural, read-write, and kinesthetic. It was the first to systematically present a series of questions for learners, teachers, and employees. The questionnaire helps instructors to find different approaches to learning that support learners who have difficulties with their studies. It was that found the kinesthetic learners try things out, touch, feel, and express their feelings physically; auditory learners talk about what to do when they learn and respond well to discussions; and visual learners learn by seeing. The instruction should be suitable for different learners [19].

3. E-Learning and Learning Styles

Learning style is the way a person perceives and organizes information [4]. Mostly online instructors

concerned with the techniques of course delivery than with the individual concerns of learners [22]. Every individual has a unique learning style that influences the ability to acquire information, to interact with others and to participate in learning experiences [3]. Adaptive e-learning systems are capable of adapting the content of courses to the individual differences of learners by using a set of questionnaire to determine learner’s learning style and then adapting their material presentation according to the learners’ styles [28].

Myers-Briggs Type Indicator (MBTI) is one of the most important learning style models which classify learners according to their preferences. The MBTI has been developed through the works of Carl G. Jung, Katherine Briggs, and Isabel Briggs Myers. The preferences are used may be influenced by environmental factors. Four dichotomies that are psychologically different rather than logical opposites underlie MBTI theory. Each dimension is represented by the letter in term used in MBTI theory to indicate a preference for one of the two dimensions of that dichotomy [10].

MBTI questionnaire was developed to measure people’s personality’s type. MBTI shows useful tips to improve learners’ communication style with learning systems [4]. MBTI personality test is used to identify one dimension of personality type (Introvert or Extravert) for each learner in a previous. MBTI was originally developed to identify people’s personality type particularly for the education domain and has been noted as an important instrument by educational psychologists. MBTI has been used to develop a better understanding of the influences of e-learners’ performance. MBTI has been used for developing different teaching methods for meeting different learners’ learning style. The results show that the personality impacts the learning performance in adaptive e-learning systems [6].

Table 1. The four MBTI personality types and preferences [27].

Personality Types	Possible preferences in e-learning
Extravert (E) vs. Introvert (I)	Video conferencing preferred by extraverted Where as the introverted learner may prefer asynchronous communication.
Sensing (S) vs. Intuitive (N)	Sensing learners need the structured framework of the course with specific guidelines. Intuitive Learners prefer the abstract contents, and learning by seeing connections.
Thinking (T) vs. Feeling (F)	Thinking learners want to see precise, cognitive, affective objective. The feeling learners may prefer group exercises and working with small groups.
Judging (J) vs. Perceiving (P)	E-learning provides judging learners with well structured instruction with clearly defined goals, while perceivers provided with more flexible course design.

Graf thesis focuses on presenting a model for supporting adaptive courses in learning management system with respect to learning styles based on Felder Silverman Model [11]. Therefore, instructors can teach

their courses in learning management systems and have the possibility to provide their learners the presented material that fit their learning style [25, 8].

4. Case Study and The Proposed System

A case study is presented to give a review on learning styles and how they are taken into account in E-learning. An assessment was developed in the form of a test aiming to gain better knowledge of how learners prefer to learn. The questionnaire was tested in action when it was addressed to learners. Furthermore, this study will provide further evidence about whether existing methods like MBTI help determine whether learning styles match what learners like to do.

In the proposed system the MBTI Learning Style model was used to analyze learners’ learning styles. All four dimensions of the MBTI model have been used to provide a personalized environment including content presentation and learning pathway using LAMS.

In this study, a random sampling method was used since the participants were university students from Egypt. They were having different specialization. The participants were 108 persons where 44 persons were male (41%) and 64 persons (59%) were female. The questionnaire learning styles results was as following 45 (42%) Persons were extravert and 63 (58%) persons was introvert. While 69 (64%) were Intuitive and 39 (36%) sensitive persons. 55 (51%) feeler and 53(49%) thinker. 81 (75%) judger and 27 (25%) perceiver.

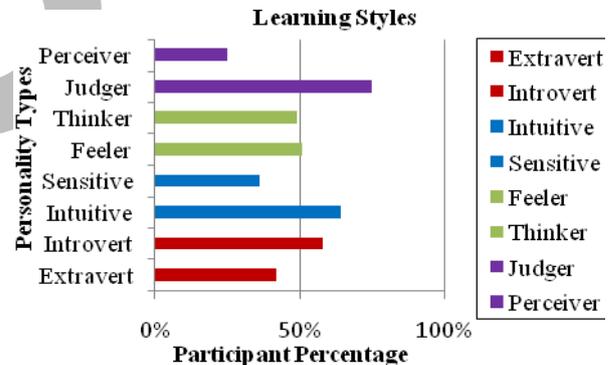


Figure1. Participants' Learning Styles.

By analyzing the questionnaire, it was concluded that several patterns were found where learners with different learning style showed different preferences in e-learning environment. The results seem to be important in order to provide courses that include features which fit different learning styles, as following:

- Extravert learner prefers synchronous and asynchronous while introvert prefers self-directed and asynchronous.

- Thinker prefers case studies and progress measure tests while feeler prefers progress measure test and interactive exercises.
- Judger prefers clear assignments and little creativity assignments while perceiver s prefer little creativity assignments and skills challenged.
- Intuitive prefers holistic while sensitive prefer sequential e-learning approach.

The proposed system identifies the learner's learning styles tendency through a set of questionnaire. The questionnaire scores will be used by the system as a basis to provide to provide the learner a presentation of learning materials differently depending on the learner's learning styles. It combines the advantages of learning management systems with those of adaptive learning systems.

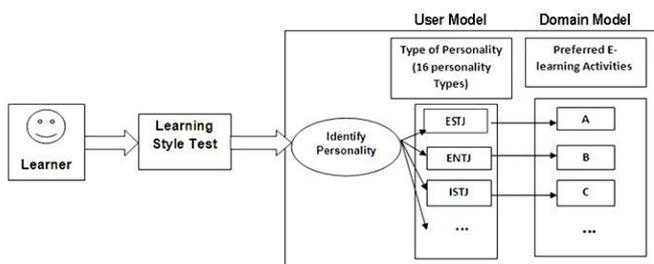


Figure 2. The proposed system with the personality type.

The proposed system is implemented using LAMS (Learning Activity Management System) tool as shown in figure 3. In LAMS, The assessment activity is used to implement the MBTI Test while the branching object is used to make the different learning paths to learners according to their learning styles.

The proposed system is implemented using LAMS (Learning Activity Management System) tool as shown in figure 3. The system uses Assessment Activity in LAMS to implement MBTI test. The test consists of four sections. Each section of the test is a group of two choice questions seeks to know one dimension of MBTI model learning style. The first test identifies Extraverted or Introverted learner. The second one categorizes learner to Intuitive or Sensitive learner. The third dimension is Thinker or feeler. The last dimension is Judger or perceiver.

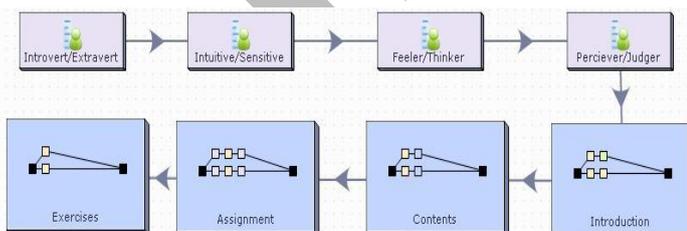


Figure 3. Implementing the proposed system in LAMS.

In Each test section there is a number of Questions which is odd number (5, 7, 9...). In each question, the 1st answer choice represents one learning style and the

2nd answer choice represent the other learning style. The more answer choices in a learning style present learners' learning style.

To calculate the results of MBTI Test using Assessment activity in LAMS, the following procedures was taken:

The 1st choice gives 1 point to learner while the 2nd choice gives 0 point to learner. For example, in the first dimension the 1st choice refers to introvert who takes point (1) for each answer while the 2nd choice refers to extraverted who takes point (0). In the second dimension the 1st choice refers to intuitive who takes point (1) for each answer while the 2nd choice refers to sensitive who takes point (0). The third dimension which identifies between feeler and thinker learner, the 1st choice refers to feeler who takes point (1) for each answer while the 2nd choice refers to thinker who takes point (0). The fourth dimension which identifies between judger and perceiver learner, the 1st choice refers to perceiver who takes point (1) for each answer while the 2nd choice refers to judger who takes point (0).

Rules:

In first test section (introvert /extravert)

- If grade \geq [(number of questions -1) | 2] + 1 then learner is introvert.
- If grade $<$ [(number of questions -1) | 2] then learner is extravert.

In second test section (intuitive /sensitive)

- If grade \geq [(number of questions -1) | 2] + 1 then learner is intuitive.
- If grade \leq [(number of questions -1) | 2] then learner is sensitive.

In third test section (feeler /thinker)

- If grade \geq [(number of questions -1) | 2] + 1 then learner is feeler.
- If grade \leq [(number of questions -1) | 2] then learner is thinker.

In fourth test section (perceiver / judger)

- If grade \geq [(number of questions -1) | 2] + 1 then learner is perceiver.
- If grade \leq [(number of questions -1) | 2] then learner is judger.

Then the system uses the branching object tool in LAMS to make the different learning paths to learners according to their learning styles.

The second part of the system includes the introduction, Contents, Assignments, and Exercises.

Figure 4 shows the course introduction in LAMS which presents the outline of the topics. The sensitive learners like sequential approach and mind map to

present the topics while the intuitive learners like holistic and multimedia.

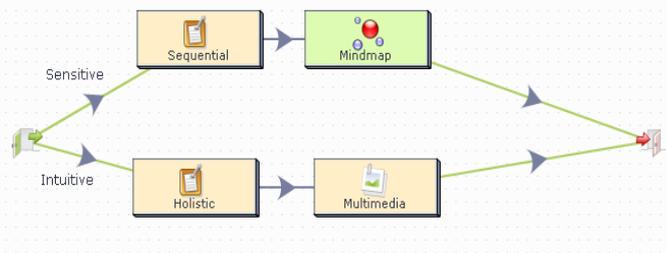


Figure 4. Creating Introduction Branching in LAMS.

Figure 5 shows the content of the course which includes the learning material. Extraverted learner prefers interactive methods and videos. Introverted prefers to work through the materials that are delivered over the internet such as e-books, videos and so on. Therefore, more videos and small number of books are provided to extravert while chatting is the communication tool for them. Less number of videos and more books are provided to introvert while forum is the way of communication.

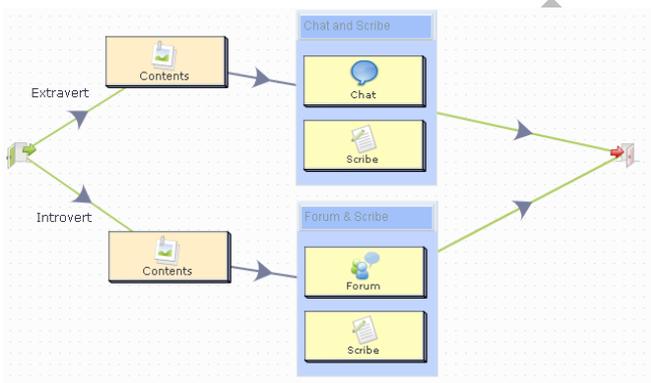


Figure 5. Creating Content Branching in LAMS.

Moreover, learner takes different assignments according to their learning style. Judger persons prefer little creativity assignments and clear assignments. Perceiver persons prefer little creativity assignments and skills challenged assignment. Different types of assignments are provided to learners due to their learning styles. (See figures 6 and 7)

Assignment

What is Computer?

What are the five basic operations of Computer?

What is the difference between Data and Information?

Define Hardware.

Define Software.

Figure 6. Text Example of Judger Assignment.

State an example of an input device, Storage device, Output device.

What is the difference between system software and application software?

Give an example on embedded computer and state what are the uses of super computer.

Give an example for operating system, web browser and search site.

Figure 7. Text Example of Perceiver Assignment.

Another element in the second part of system includes exercises which serve as practice area. Feeler prefers progress measure test and interactive exercises. Thinker prefers case studies, real situations, and detailed analyses of projects or problems. (See figures 8 and 9).

Figure 8. Example of Feeler Exercise.

Mark works in the marketing division of a company that manufactures microprocessors for computers. The head of this division has asked him to send an e-mail with predictions for the following year company sales. What the type of software is he most likely to use?

- Database
- Worksheet
- Document
- Presentation

Figure 9. Example of Thinker Exercise.

5. Conclusion and Future Work

The paper presents a proposed system of an adaptive e-learning system based on Myers Briggs Type Indicator (MBTI) learner's learning style model. The system identifies the learner's learning styles through a test. The test score is used by the system as a basis to provide the learner a presentation of learning materials differently. The proposed system is implemented using Learning Activity Management Systems (LAMS) tool. This adaptive e-learning system will present course

materials in different ways depending on the learner's learning styles.

In the case study learners were asked to fill out the learning style questionnaire for detecting their learning styles. The experiment was performed with 108 learners to show the impact of learning styles on learners' preferences. Several patterns were found where learners with different learning style showed significantly different preferences in e-learning environment. By analyzing the questionnaire, this study found statistically due to MBTI Model that:

- Extravert learner prefers synchronous and asynchronous ways while Introvert prefers self-directed and asynchronous learning style.
- Intuitive prefers holistic e-learning approach (learners focus on the big picture and miss details), multimedia approach while Sensitive prefers sequential e-learning approach (learners think logically, attend to details) and mind map approach.
- Thinker learner prefers case studies while Feeler learners prefer progress measure test and interactive exercises.
- Judger learner prefers little creativity assignments and clear assignments while Perceiver persons prefer little creativity assignments and skills challenged.

In the proposed system the MBTI learning style model was used to analyze learners' learning styles. All four dimensions of the MBTI model have been used to provide a personalized environment including introduction, contents, assignments, exercises and through the LAMS learning environment.

LAMS tool provides a variety of features to support instructors in creating, administering, and managing online courses. However, that does not consider individual differences of learners. The proposed system customizes LAMS in order to accommodate the learners' learning styles. A new adaptive course format is developed to accommodate the adaptive presentation. The use of LAMS accelerated the development of our e-learning system design and development providing enhanced capabilities and a user-friendly interface.

The paper investigates the detection of E-learner preferences within learning style dimensions and showing relationship between identifying the personality and learning materials presentation. It contributes how to develop e-learning to different learning styles and combine the advantages of learning management systems (which focus on supporting instructors in creating, administering, and managing online courses) with those of adaptive systems (support learners by providing courses that are tailored to their needs and characteristics).

This couldn't cover the learning adaptation issue. It has just shed light on some aspects. Future work will with analysis of the results with respect to different

learning style dimensions as well as the different adaptation features, measuring performance metrics for system reliability and compared with previously developed systems. It is needed to clarify the remaining and newly raised issues.

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