E-Content Presentation based on Learning Styles

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*Abstract-*The design and development of electronic contents has become a major area of concern in today's modern distance education system. It has opened up many opportunities, at the same time, facing challenges in a localized distant learning environment. These challenges demand to address the needs of local learners by taking into consideration their profiles and learning styles. This paper presents a model of content presentation based on learning styles. The model proposes a combination of multimedia electronic courseware tailored using visual, auditory, and kinesthetic learning style theory. Three formats of contents are proposed to fulfill the dynamic needs of learners. The dimensions of visual, auditory and kinesthetic are selected in the light of perceptual modalities. The survey module investigates the profiles and learning styles of students and learning algorithm presents the specialized contents based on their learning styles. The survey and content presentation modules are integrated with delivery tools of an open source Learning Management System. The model is implemented on a course offered at Allama Iqbal Open University, Pakistan. The result of the course offered with the supplement of specialized contents is made with the same course offered in previous semesters when traditional materials were provided to students. The test results highlight the improved performance of students using e-content as compared to the previous results. The satisfaction of students about content presentation and navigation control is also analyzed. The analysis reveals positive feedback of students about specially prepared e-contents.

*Keywords-*Learning Style, E-learning, Pedagogy, Content Presentation

I. INTRODUCTION

Distance education is a non-traditional mode of education in which teacher and student are not physically present at the same location. It is not constrained by the geographical separation and therefore can provide more engaging educational experience [i]. It offers opportunities where traditional educational setup is difficult to manage [ii]. However with the availability of opportunities, it is also facing many issues and challenges [iii]. The needs of distance learners have changed significantly with the advancement in technology [iv]. The technological transformations have changed the norms of distance education from postal correspondence to Internet based communication and from print media to web based materials, which are omnipresent digitally [v]. The development of quality content with effective delivery sequence is a real challenge for today's modern distance learning system.

The new modes have revolutionized distance learning in the form of e-learning or online learning [vi]. E-learning is the use of Information and Communication Technology (ICT) for teaching and learning [vii]. It is as an instructional process comprising of knowledge, communication, education and skill which is delivered electronically [viii]. The content is the basic building block of e-learning which facilitates the learning needs of distance learners [ix]. It requires novelty and creativity in the format and design of digital and electronic contents [x]. It can be made more convenient for learners if developed keeping in view their preferences and learning styles [xi].

There are many different insights and views of learning styles because they are affected by several aspects of processing and observing information by different people [xii]. Many different ways have been introduced for defining and classifying learning style. Li highlights learning style as process through which students interact, perceive and react to learning environments [xiii]. Felder & Silverman describe learning style in a way in which an individual acquires, retains and retrieves information [xiv]. Herod describes learning style as an approach in which learners process information and select the required knowledge from it [xv].

In a distance learning environment, the traditional contents cannot fullfill the academic needs due to the geographical separation between the learner and the tutor. Each learner has individual needs and

characteristics which are reflected through their learning styles. There is a need to tailor specialized contents matching with the learning styles of distance learners. Therefore, the design and development of specially prepared e-contents can play a vital role in a localized distance learning environment. The objective of this paper is to present a model of e-content presentation matching with the learning styles of the distance learners. This paper also discusses the impact of content presentation on the student's learning. The important contribution of this research is the content presentation model based on learning styles which is in compliance with International standards and also fullfills the needs of the localized environment.

II. LEARNING STYLE

Learning Styles have been divided into idiosyncratic classes and families by many researchers. Coffield, Moseley &Ecclestone have made a comprehensive classification of learning styles [xvi]. They have distinguished the learning styles into five categories covering seventy one (71) different styles. The classification is based on theoretical importance and use of learning styles in research and development. The subsequent section looks into important learning style theories and impact of these styles in e-learning.

A. Felder Silverman Learning Style (FSLM)

Felder & Silverman presented a well-known learning style model for engineering students. Their theory focused on the learning preferences and associated teaching methods that suit different learning styles of the students enrolled in engineering discipline [xiv]. There are four dimensions of FSLM: active&reflective, sensing&intuitive, visual&verbal and sequential&global [xvii]. Active learners process information by making discussions and implementing it in a practical scenario. Reflective learners use their intellectual abilities and process information before applying it. They prefer to work alone to understand concepts. Sensing learners adopt a practical approach to absorb facts and figures. They like data and information to understand the notions. Intuitive learners like theoretical concepts and prefer to take in hidden information that is abstract and conceptual. Visual learners like textual and pictorial representations of contents in shape of words, diagrams and charts. Verbal learners like auditory contents and get more information from what they listen. Sequential learners arrange information in a chronological way where information comes one after another in a sequence. Global learners prefer large amount of information without any logical sequence. They like random arrangement of data and information.

The learning styles presented by Felder and Silverman are important due to couple of reasons. Firstly, they observed the differences among learning styles of science students. Secondly, they proposed alternative methods of teaching strategies like allocation of learning resources in a logical sequence [xviii]. This theory founded a new area of research in learning styles and strategies for science and engineering students.

B. Kolb Learning Style

David Kolb presented one of the most influential learning style model called Kolb learning style. According to Kolb, learning is a process where knowledge is created through conversion of experience [xix]. Kolb shows that learning style could be perceived from four activities: concrete experience by passing through a new experience, reflective observation by watching others doing their work, abstract conceptualization by thinking and forming theories and active experimentation by solving problems and making decisions. The theory also portraits that learning is a cyclic process where experience leads towards observation and reflection. These reflections are further engaged and converted into concepts with consequences of action. These actions result in the creation of new experiences and initiate new cycles which continue till the learning process completes. This cyclic process is extended and four learning styles are proposed, where each style represents a combination of two preferred activities: diverging (concrete experience&reflective observation), assimilating (abstract conceptualization & reflective observation), converging (abstract conceptualization & active experimentation) and accommodating (concrete experience & active experimentation). Smith argued that Kolb learning Style theory has weak practical evidence for different phases of learning [xx]. It does not fully endorse the social and cultural aspect of learning. However, this model provides an association between theoretical models and practical approaches where feedback can be obtained to improve the teaching and learning process. The model can be used by an individual, teams or entire class in all subject areas [xxi]. The style provides a direction to combine different learning activities into one learning style. The combination helps to reduce the perception of learners being held back by only one learning style. The theory opens up the idea that learning styles of learners might evolve over time and they might adapt different approaches for learning.

C. VAK Learning Style

The Visual Auditory Kinesthetic (VAK) is based on observation ways and means of human being. The idea was first presented in 1920's by psychologists Fernald, Keller and Orton [xxii]. The model has presented different styles of behavior, evaluation and learning.It focuses on human manifestation modalities that intermingle with observation and memory and

therefore provides open method to investigate the learning style. VAK sensory receivers are composed of vision, auditory, and kinesthetic perceptions. A large proportion of learners use all these three styles [xxiii], however one of the styles is dominant which is favorite way of obtaining knowledge. The visual learners learn by using their ability to see. They use their seeing and reading skills to acquire knowledge from observations. The favorite material of learning includes text, images, notes, graphics and charts. The auditory learners use their ability to hear and listen. They prefer spoken lectures, debates and listening lessons. They have strong auditory skills and feel comfortable using multimedia contents. The localized voice ascent and modulation help auditory learners to maintain interest and concentration. The kinesthetic learners use muscular movement and contraction to absorb knowledge [xxiv]. They feel comfortable by doing movement and learn by doing and touching. They have strong athletic ability and use their body language to engage themselvesin learning activity. They are fond of doing hands on exercises and lessons. Due to diverse nature of VAK, different learning style theories like Dunn and Dunn, Kolb and Felder Silverman make use of VAK to define attributes of their proposed learning patterns.

Despite, a lot of research studies in learning style have been conducted; there is not a single theory available that could have elaborated all the concepts. This might be due to the fact that each researcher has tried to elaborate learning style in the context of one's own domain. However, from literature survey it may be deduced that the concept of learning styles is dependent on three major areas: perceptual modality, information processing and instructional preferences [xiv]. The perceptual modality is the way of extracting information from the surrounding environment. It includes the visual, auditory and kinesthetic preferences. The information processing is managed by human brain through which learners code, encode, process and retrieve information. The instructional preferences deal with the teaching and learning scenarios of physical, sensory and perceptive conditions. The perceptual modality is the most important because it is the first step of interaction during the start of learning activity. In case of e-learning, there is a broad spectrum from technology to pedagogy, therefore the determination of learning styles may play an important role in handling issues and challenges faced by the e-learners.

D. *Learning Styles in E-learning*

During e-learning process, the learners and the teachers are not present at the same place. As a result, the e-learners have to participate in the distant activities using the available technology. The evaluation of their preferred way of learning may help to design and develop allied materials that suit to their learning choice [xv]. Both the students and the teachers may benefit by knowing the outcomes of their learning styles. Students may analyze their strengths and weaknesses by knowing about their style of learning. They may use this information to select the right material for the right topic at the right time. They may grasp difficult topics by selecting their favorite format of contents from text, audio, multimedia and video resources. Teachers may improve their teaching methods by recommending suitable contents to their students. They may define logical sequence in the content presentation to improve the knowledge level of learners. They may develop a variety of contents as per needs of a particular batch of students. It may also help to map the learning preferences with e-learning contents. The literature review provides this mapping of learning paradigm as shown in table I [xxv]:

TABLE I
LEARNING STYLES, PREFERENCES AND E-LEARNING ACTIVITY

Learning Style	Learning Preferences	E-learning Content/Activity
Visual	Graphics,Text	Tutorials, slides, multimedia animations, e-books
Auditory	Sound	Audio and video Lectures, Multimedia tutorials
Kinesthetic	Home-work	Activities, assignments, tests

The visual learners prefer to study materials with embedded text and graphics. The suitable lessons for visual learners may be composed of text based lectures having combination of graphics, Figures, Tables and multimedia animations. The auditory learners make use of their hearing sense rather than visualizing items. They can be provided with video, audio and multimedia lectures. The kinesthetic learners are comparatively different type of learners. They like to work on homework and may be engaged by giving assignments and tests.

Numerous research studies [xxvi-xxvii] have validated that learning styles is an important consideration for the arrangement and presentation of learning objects in a distance/e-learning environment. It has also been proved significant to enhance the learning level of students. Due to such importance, this confirmatory research was conducted in a localized environment. The research was not only interesting but also challenging because it involved the investigation of learning styles of local learners and presentation of e-contents in a localized e-learning environment.

III. CONTENT PRESENTATION MODEL

The perceptual modality and VAK styles form the basis for other learning styles and associated theories. Therefore, the proposed model has adopted VAK

theory to develop the format of electronic contents as per specific needs of the learners. Table I has described the learning preferences and types of electronic contents for VAK learners. Following this approach the conceptual model is proposed and applied on standard course structure at Allama Iqbal Open University (AIOU), Pakistan. A course is considered as a coherent concept of knowledge and divided into chapters. Each chapter is composed of topics and sub-topics depending upon the depth and breadth of knowledge according to the university criteria. The course structure is shown in Fig. 1.
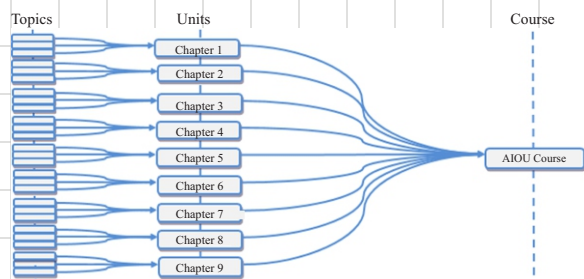

Fig. 1. Course Structure

The conceptual model adds the granularity level on the format of e-content corresponding to VAK learning styles. These formats include three types of contents i.e. tutorial, multimedia instructions and activities as shown in Fig. 2:
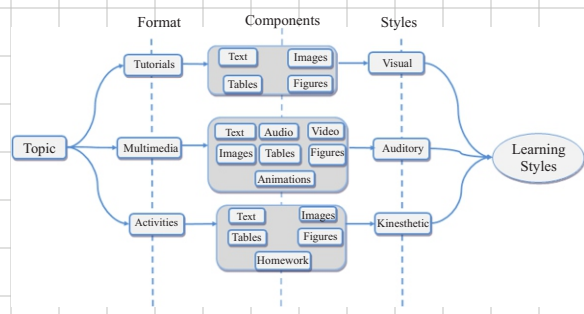

Fig. 2. Format of Contents and Learning Styles

Tutorial is a self-explanatory content that teaches a topic and related concepts. It is developed in the form of webpages that takes a learner through concept building steps in a logical manner. It makes use of text, shapes, diagrams, and graphics to elaborate a concept. The webpages are connected with each other via hyperlinks. The composition of tutorial is made to suit the students with visual learning style. Multimedia is a specially designed content which is developed with a combination of text, graphics, sound and animations. The different formats of contents and their combination make it a hypermedia content to suit the learners having visual and auditory learning styles. Activities are also specially designed contents which comprise of self-learning exercises and assigned homework presented at the end of each lesson. It allows students to solve a

problem by applying their knowledge and skills in a manner which suits kinesthetic learners' attitude.

A. Algorithm for E-content Presentation

The proposed algorithm for e-content presentation is shown in figure 3. The algorithm starts with the initialization of student information. The administrator enrolls students and creates their login credentials. An email is generated to the students to intimate them, their login credentials. After login, students are required to complete a survey questionnaire. There are two parts of the survey: profiles and learning styles. First part collects data about students' general profile, age and location and second part is used to investigate their learning styles. After the completion of the survey, the system evaluates the survey results and divides students into three groups based on their learning styles as shown in Fig. 3.
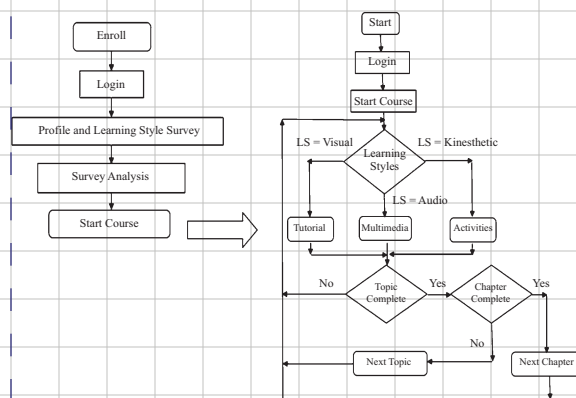

Fig. 3. Algorithm for E-content Presentation

Three formats of contents i.e. tutorials, multimedia and activities are prepared for each topic as discussed in the previous section. Tutorials are the text based self-learning materials developed using Hyper Text Markup Language (HTML) in the form of web pages. Multimedia animations are developed using flash macromedia and the activities are knowledge building concepts through activity webpages. The link hiding and the link enabling conditions are used to automate the e-content presentation. The students with visual learning style are presented tutorials, auditory learners get multimedia and kinesthetic are provided with activities as shown in figure 3. After completing the topics the students move to next topic and after completing the unit the students move to next unit. The process continues till the completion of all units as defined by the teacher.

B. System Architecture

The proposed system is implemented as three-tier web based application as shown in Fig. 4. The layer 1 is the repository layer which stores media objects and student data. The layer 2 is composed of the application program for e-content presentation, survey module and

delivery & communication tools of LMS. The layer 3 provides the delivery and communication modules via graphical user interface for interaction of students, teachers and administrator.
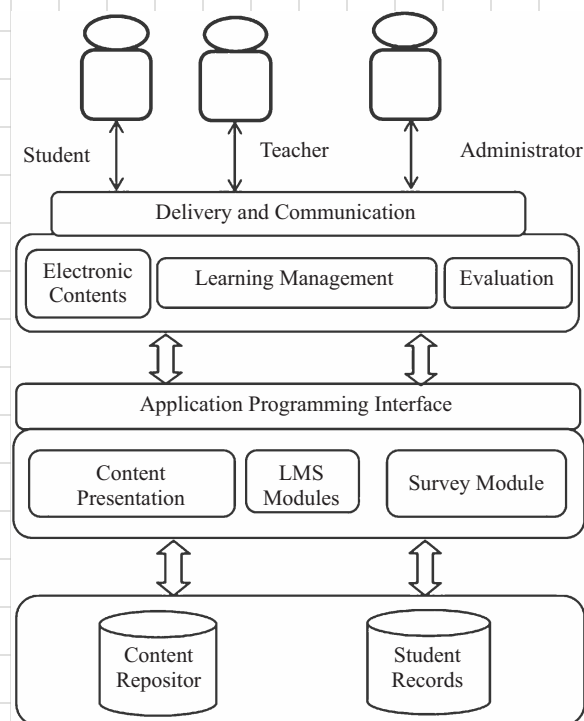

Fig. 4. System Architecture

The client side contains the user interfaces for teacher, students and administrator as shown in layer 1 of the architecture. The other two layers reside on the server side. The e-content presentation and survey applications are programmed using open source server side scripting language PHP with My Sql database at the back end. The functionality of MOODLE Open source LMS is customized by adding the survey and content presentation modules. The survey module is based on an instrument designed to investigate profiles and learning styles. The student interface is personalized to manage the content presentation based on learning styles. The teacher interface is tailored for content authoring and flow of presentations according to the algorithm discussed in section III.

C. Design of Instrument

On the basis of literature review and research design a questionnaire was developed to investigate the profiles and styles of the local learners. There were two parts of the instrument: part 1 contained profile data and included questions from demographics, part II comprised of questions about the learning styles adapted from VAK test by Chislett & Chapman (2005). The questions were scaled on the likert scale 1-5.

D. Sampling and Population

The convenience sampling method was followed and students from Post Graduate Diploma in Computer Science were selected. The reason to select computer science students was their competency to use computers and their capacity to absorb new trends and technologies.

IV. IMPLEMENTATION AND RESULTS

The adaptive contents were developed for a course of Visual Basic & Database Interface offered at Computer Science diploma level program. The course was divided into nine chapters and each chapter comprised of topics as per format of the university as shown in figure 1. Sixty three students were enrolled in that online course. The survey results are discussed in subsequent section.

A. Demographics

Table II presents the demographic analysis of the sample. The results show that the female students have significant percentage of 30.2 % as compared to male students 69.8 %. The location of study is also balanced with substantial proportions from urban, semi-urban and rural areas. The age group of 21 – 30 is dominant but a small yet noticeable number of senior age students also sought admission as shown in the results:

TABLE II
STUDENTS' DEMOGRAPHIC PROFILE

Variable	Frequency	% Frequency
Gender		
Male	44	69.8
Female	19	30.2
Total	*63*	*100*
Age Group		
Less than 21	12	19.1
21 – 30	39	61.9
31 – 40	08	12.7
More than 40	4	6.3
Total	*63*	*100*
Location		
Urban	36	57.1
Semi-urban	16	25.4
Rural	11	17.5
Total	*63*	*100*

B. Learning Style

The Learning Style section was designed to investigate preferred way of learning. The results are shown in Fig. 5:
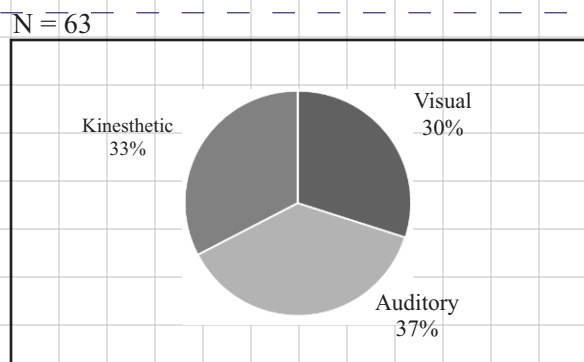
N = 63

Fig. 5. Learning Styles

It is interesting to find that the majority of students have auditory learning style and they like multimedia format of instructions. The second majority is of kinesthetic learners who like hands on exercises and activities. The other students are found to have visual learning style which requires tutorials and lectures (web-based). Therefore, the adaptive content presentation is identified as a preferred way of learning where majority of students want different formats of learning contents matching with their learning styles.

C.   Screenshot
These materials were compiled with the help of subject experts and uploaded using delivery mechanisms of an open source LMS MOODLE. The selected screen shot is shown in Fig. 6:
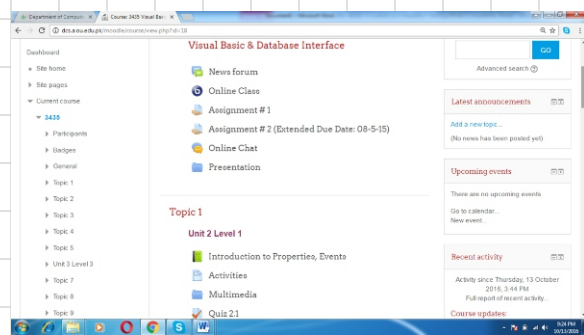

Fig. 6. Screenshot of E-content Presentation

D.   Result Comparison
The students were presented the contents in a sequence according to the learning algorithm discussed in the previous section. The other semester activities were completed as per usual university criteria. After browsing the contents and completing the scheduled activities, students appeared in the examination. The comparison of course grades obtained by students enrolled in current batch (with LS contents) was made with the same course offered in the previous semesters as shown in Fig. 7:
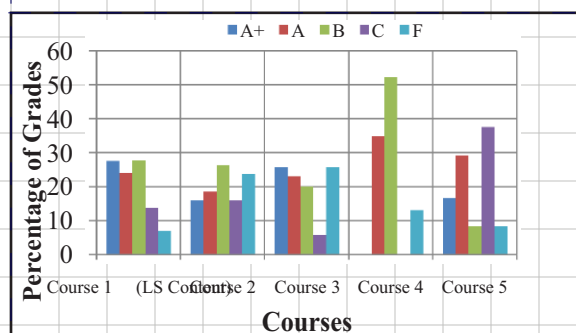

Fig. 7. Result comparison

The Fig. shows performance of the students enrolled in the current batch (with specially prepared e-contents) is far better than the same course offered in the previous semesters when traditional books were provided to students. The percentages of higher grades (A+) and (A) has significantly improved and absence rate is reduced significantly. The students have played and replayed their favorite format of contents, which enabled them to earn good grades. The teachers have utilized the contents to deliver the lessons in a better way. The results indicate the improvement in class performance by using adaptive contents based on their learning styles.

E.   Evaluation of Content Presentation Model
Evaluation of proposed model was performed to investigate the students' feedback about the content presentation and the navigation control. A survey questionnaire was prepared and validated through the education and technology experts. The likert scale was used to measure students' perception about different aspects of using adaptive content based on their learning styles. The SPSS tool was used to analyze the results. The analysis of responses is shown in Table III.

TABLE III
EVALUATION OF CONTENT PRESENTATION

Feedback	Mean	SD
The contents matched with your course curricula?	3.7	0.7
The contents matched with your learning style?	3.6	0.8
How you rate different formats of contents?	3.6	0.8
The page design was uniform	3.8	0.8
The size of text was appropriate	3.8	0.8
Animations were good	3.7	0.7
Use of graphics was suitable	3.8	0.7
The navigation controls were easy to use	3.6	1.0
The sequence of instructions helped in getting knowledge	3.6	1.0
The link disabling (until attainment of required knowledge level) was suitable	3.2	0.8
The hyperlinks were logically connected	3.6	0.8
The model helped to improve your learning?	3.6	0.8

The analysis of table highlights a positive response of the students as mean value calculated is higher than three. The students are satisfied with the content presentation which matched with their course curricula. The students with different learning styles have highly rated the ingredients of specialized contents including page design, text size, graphics, and animations. The combination and proportion of multimedia components have matched with their desired format of learning object. The navigation control and disabling of link was appropriate for their learning. It was arranged in a logical manner which helped to improve their knowledge. The overall satisfaction level of students was high as reflected in the feedback survey results.

V. CONCLUSION AND FUTURE WORK

A model of content presentation based on learning styles has been presented in this paper. The contents are tailored using VAK learning style theory. The recipe comprises of tutorial for visual, multimedia for auditory and activities for kinesthetic learners. A course of Computer Science was selected for the preparation of VAK contents. The presentation algorithm and survey modules have been devised and customized with an open source LMS MOODLE. The survey module analyzes the profiles and the learning styles of the local learners. The content presentation algorithm tailors a learning path based on their learning styles. After browsing the contents, the students appeared in a test. The test results were compared with the same course offered in the previous semesters when students had the traditional books and routine allied materials. The analysis of test results depicts the improved results of whole batch. Overall, the number of students securing A and A+ grades increased while on the other side the number of absent students also significantly decreased. The satisfaction survey was conducted from the enrolled students. The results show positive response from the students. They are satisfied with the adaptive content presentation and navigation controls. The interface is user friendly as they are satisfied with the composition of text, graphics, animations and the learning sequence. The model has helped to improve their performance.

The research reveals that the learning style is important consideration for the design of learning contents in a distance/e-learning environment. The geographical distance between the learner and the teacher can be accommodated by developing specialized e-contents for the learners. It can reduce the burden on teachers by tailoring a learning path for an individual and group of learners. The research opens up an idea for the development of the specialized contents for other courses in a distance learning environment. The future work in this discipline may involve the development of learning and assessment object

repository as per International e-learning standards.

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