

# An Adaptive Learning Frame Work for Slow Learners In An E-Learning Environment

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**Abstract**— One of the biggest challenges that many of the 21st-century teachers face in traditional classroom teaching is the difficulty to deal with students from diverse backgrounds. Especially in the case of slow learners they find it so hard to deal with and make them learn their academic subjects. Teachers are giving instructions or delivering learning contents to learners, without understanding the learner profile parameters such as learning style, motivation, attitude, aptitude etc. They should understand the art and science of teaching. In the current education paradigm students are compelled to learn the same learning material at the same time and rate. Hence teachers are expected to adopt new methods and technologies to eliminate this problem. E-learning is an activity where learners are able to achieve their educational goals based on their skills, interest, motivation, learning style etc. Through adaptive learning learners' exact needs, their goals, preferences, etc. can be achieved during the learning process. Hence, the objective of the study is to develop a frame work of an adaptive learning system which helps the slow learners to be more active and engaged in their learning process.

**Keywords**—Adaptive learning, E-contents, Instructional Design, Learning Management System, Slow Learners

## I. INTRODUCTION

Educational institutions all over the world have become very much reliant on information technology to service their big business needs and they are moving to e-learning environment[1]. In most of the institutions teaching learning process is undergoing revolutionary changes and the students are becoming more and more technology oriented. In this 21<sup>st</sup> century teachers are expected to be worked with difficult children, poor, culturally different and special-needs populations. Hence it is essential to combine most recent technologies into the teaching and learning process to make the changing learning environment more effective and efficient so that it can provide quality education to these kinds of students.

A study by [2] explains the importance of moving to a new paradigm in the area of education. There are many studies explaining different methods to improve the performance of slow learners. Classroom performance of slow learners can be improved by adopting proper teaching method as well as by the use of materials which are suitable to their level of learning [3]. Instructional design is one method which can be used to teach, the way students could learn. In the study of Sadler-Smith (2000) and Brown et al (2001) explained about advantage of e-learning for disabled people. E-learning helps these people by giving an opportunity to advance their education from any location. The most vital characteristic, as well as the advantage of e-learning in education is the

capability of personalised learning because it centres more on learners[4]. In the study [5] author explained about learner autonomy in e-learning through the concept of adaptive e-learning. They demonstrated that adaptive web-based learning is one way to provide the ideal instruction to learners. It provides an appropriate way to deliver the right content, to the right person, at the right time. Adaptive learning is an alternative way to the traditional one for all approach. It provides a dynamic learning environment where an adaptive learning object can be provided to a learner which suits their personalized needs.

Learners in an e-learning environment have individual differences. Many are having various interests and those who are sharing these common interests may be at different levels of expertise. In the study [6] author mentioned about the importance of incorporating learning style of learners in technology enhanced learning. A study on the learning style of students suggested that information about students' learning style can be used for providing teachers with more information about their students and showing them that their students have different preferences and ways in which they learn[7]. Integration of learning styles into personalised e-learning system can solve problems in many ways. It helps to provide suitable learning material according to the needs of learners and satisfy the requests of these learners [8].

Many educational theories recommend to the incorporation of learning styles in learning activities for getting better learning

performance. It is also found that to provide support to personalized learning services, many of the intelligent learning systems use the Felder-Silverman Learning Style Model(FSLSM)[8]. According to (Felder & Silverman, 1988) different learning styles may lead to different abilities to solve problems. A detailed study on the paper [9] identified the significance of personalised learning and explored the relationship between learning styles and learning performance. They also noted that many of the researchers are taking into account learning styles as an important factor while developing educational adaptive systems.

Hence the objective of the study is to develop an adaptive e-learning system which is an instruction based e-content for slow learners. This system allows the students to move through a learning path and help them to fully engage in the learning process as they progress through each leaning contents. It will be an efficient method for teaching and helps to provide opportunities to facilitate and speed up the process of learning within learning. By considering these facts researcher has developed an adaptive e-learning system for slow learners based on learning style. It helps to improve their academic performance by providing them an adaptive learning path. In this study an instructional design based e-content has developed in a Learning Management System (LMS) Moodle. As a case study an e-content was developed for the students of graduate course in Computer Applications in the subject Computer Graphics. The topic scaling in Computer Graphics has selected to demonstrate the concept of adaptive learning, based on the understanding dimension in the FSLSM.

The structure of the paper is organized as follows. Section II surveys some relevant studies in this area. Section III explains the theoretical frame work of the study. Here we presented our approach and discussed about the method of e-content development in Moodle environment for the topic scaling, one of the geometric transformations in computer graphics. Section IV explains the method used for developing the system for slow learners. Section V explains the implementation of the adaptive e-learning system. Finally section VI concludes the study with its future scope.

## II. RELATED WORK

In the current education paradigm students are compelled to learn the same learning material at the same time and rate. It may cause some problem to slow learners because they are forced to move on to the subsequent topic before they are getting mastered into the learning content. It may cause learning deficits and make the future learning more difficult. But in the case of fast learners, they have to spend lot of time to acquire the next learning material. It causes lose of motivation, opportunity to move on to the next learning material, etc.

Following studies explaining the importance of creating a learner profile as well as designing instructional strategies to learners in an e-learning environment. A study by Commonwealth Educational Media Centre for Asia explaining the importance of understanding the learners. The main reason is that learner information would be useful in defining learning objectives. It also helps to determine the mode of communication as well as in the design of a better learning system which can support all learners. For the implementation of a personalized learning model a perfect learner profile is to be created [10]. This study also explains that a personalized learning with instructional design strategy is another method to provide the best learning path to a learner. It drives a learner towards his /her learning goal. In this process, one needs to personalize learning objects and their modules and courses, learning activities and learning environments. Again it is very much important to think about various psychometric methods to be designed for addressing the issues related with learning process and data about learners.

All these studies points to the importance of instructional strategies in the design of a course. Working together with instructional design, learning analytics, educational data mining and personalized learning can help us to learn better and use our mind and body to our maximum potential. Hence to improve the learning activities as well as academic performance of slow learners in an e-learning environment researcher has incorporated some instructional strategies and new methods of teaching. It has achieved through adaptive e-learning. Because through this learning process students can opt the method of presentation of learning material most suitable to their interests and needs [11].

Following studies explain about adaptive e-learning. Through adaptive learning, their learning materials can be explained according to the learner and to the context. An Intelligent Adaptive system is very supportive in improving the Learning environment [12]. Adaptive learning technology can be used to assess learners' knowledge, skills, and attitudes at the beginning of online training. It helps to deliver educational materials at the level most appropriate for each learner.

All these existing researches lead to the importance of developing an adaptive system which helps students to learn effectively. In the case of slow learners they always prefer to follow a step by step learning path otherwise it is difficult for them to follow topic clearly. But a fast learner tends to skip few topics which are not relevant to them. Hence it is an eye opening to all instructional designers and educators to develop and deliver courses according to the interest of learners. It is also found that adoption of various strategies like adaptive learning can cater to the need of the user and produce data best suited to the interest of the user[13]. All these studies leads to the conclusion that during the design of

an e-content at most care should be taken to provide a suitable learning material to the learners.

### III. THOERETICAL FRAME WORK

Since this study incorporates some sort of educational pedagogy it is very significant to mention about the theoretical frame work in detail.

#### A. Learning Management System

Implementation of learning strategies using pedagogical approaches supported by digital technologies like e-learning ,blended learning etc. are becoming widespread in current years. This approach can be implemented by uploading the learning resources such as lectures notes, presentations, videos, quizzes etc. on any LMS so that students can do their learning process through online [14]. Learning management systems are widely used by many educational institutions. Now a days it is used in many schools to provide smart class facility for giving better education [15].

Moodle is a widely used Learning Management System by many of the educational institutions. In this study researcher has selected Moodle as the platform for implementing the course. All learning materials are provided through the learning resources like Pages, Files (text, images, videos etc), Folders, URLs, etc. Various learning activities are like Assignments, Lesson, Quiz, etc. can be included in the course. These course activities enable the students to interact with the instructor or they can learn through system or they can interact with each other. Resources are course materials that student can read but they cannot interact with, such as presentations, graphics and PDFs. Different kinds of resources are available in learning management system Moodle .Some examples are Book, File ,Folder, Label, Page, URL, etc.

As part of the study a course on Computer Graphics has designed in this free and open source LMS, Moodle. Moodle can be deployed on a private server allowing access to the data for data mining. In the design process many activities and resources were included. Videos, quizzes, etc are some of the resources provided through the course. Since this study is especially meant for slow learners, lot of factors to be considered in the course design. Proper planning is needed for the inclusion of sufficient resources and activities for the effective learning of these kinds of learners.

In order to make the course more adaptive and interactive researcher has incorporated some features of Moodle during the process of designing a course. In this work for the benefit of slow learners, researcher has included a lesson activity in Moodle for the process of designing a course.

The major difference between a Lesson and other activity modules in Moodle is its adaptive ability. Using lesson it is possible to create student's choices to provide self-directed

lesson. The Lesson activity helps to build structured pathways through learning materials and test knowledge, as students make progress. A Lesson consists of a series of web pages and it can be made up of with text, images, videos, etc. Students can do the learning process through these pages in a linear path ways or they can select any branching paths. Since a lesson activity is having the capability of including questions, students can perform a self- assessment about their learning. In this learning process, students are automatically directed to further questions, feedback pages or other content pages depending on the responses. For a slow learner this feature is very useful. Because in a lesson there may be small amounts of informational text, followed by a question that can be graded, with branches to retake the question if wrong or move on if right. It helps them to do any number of retake for a particular topic.

According to FSLSM, during the process of learning sequential learners are expecting more details. If we leave out steps or skip over work it can confuse the sequential learners, who tend to think very linearly. Sequential learners give more attention on organizing information in a linear way and dealing with logic and followed steps. In this study researcher would like to create an e-content for slow learners based on these concepts.

#### B. Adaptive learning for slow learners

In order to provide the best form of learning students should always be kept engaged while providing education to them. In a study regarding the guiding principles for developing an e-content for a subject, explaining the importance of including interactive elements in a course for making an online learning session so effective and to make it an immersive learning. These interactive elements help the students to engage with as they progress through the learning contents, or it can be a full-fledged simulation that test both understanding and skills within the context.

Adaptive e-learning plays a vital role in the performance of student. In the following Figure 1 concept of adaptive learning is explained through a block diagram.

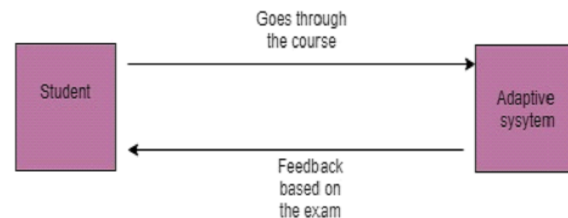


Figure 2. Block diagram of adaptive learning

Adaptive learning means adapting, modifying and varying content, pedagogy and course delivery to improve student learning and the mastery of learning outcomes through the use of analytical tools. Adaptive e-learning technology personalizes learning. It is an individualized learning for a learner's style and ability. It provides continuous learner

feedback on performance. It modifies learning path-ways in real time based on learner performance. It will be helpful for both learner and instructor to know a learner's knowledge state in real-time. Another advantage is the possibility of teaching by understanding the strengths and weakness of each learner. It is focusing on the evidence of knowledge and demonstrating competency.

#### IV. METHODOLOGY

A review on various studies showed that in e-learning there is a need to transform the traditional method of teaching. The process of creating web-based instructions and make use of learning objects require lot of care and it is becoming a demanding area. Some of the subjects like Computer Graphics can be taught by using web-based instructions.

##### A. About Computer Graphics Course

By considering these factors, researcher would like to develop an e-content for a Small Learning Object (SLO) 'Rotation', one of the basic geometric transformations in Computer Graphics Course.

The study of Computer Graphics mention about the creation and manipulation of images on computer, including animated images [16]. In computer graphics there are certain situations where there is a need for altering or manipulating the displays. Changes in orientation, size and shape of an object is accomplished by geometric transformations. For example, in animation, an object is to be rotated, translated and scaled at each increment of motion. Translation, rotation and scaling are the basic geometric transformations. In this study researcher is explaining about one of the basic geometric transformations called scaling.

##### B. Small Learning Object (SLO) –Scaling

Scaling is a geometric transformation used for changing the size of an object. Like translation, it is a simple transformation which just scales the coordinates of an object. This is not a rigid body transformation. This operation is applied for polygons. We use scaling factors  $S_x$  and  $S_y$ . Here  $S_x$  scales objects in the x direction.  $S_y$  scales objects in the y direction.

##### C. Lesson Activity in Moodle

In the process of creating an e-content for slow learners the concept of scaling is explained with lesson activity. Lesson module presents a series of HTML pages. There are two types of lesson pages-content pages and question pages. Lesson is designed to be adaptive and to use a student's choices to create a self-directed lesson. Difference between lesson and other activity modules is its adaptive capability. This work included lessons to create web pages and iterative questions for providing adaptive learning capability.

In this section Lesson activity, its significance, adaptivity concept etc are explained. Lesson is one activity we have used

for e-content development in Moodle. In order to explain the concept of adaptive e-learning best method used is the lesson activity in Moodle. It provides adaptive learning path to the learners. One advantage with this lesson activity is the feedback mechanism used. After explaining the content to learners a test is conducted to evaluate it. Immediately the score of the test is obtained and if the answer is wrong they have to attend a remedial course before moving to the next step. Hence the test conducting at different levels will help to identify the learning deficiencies of each student. Figure2 shows the learning path designed for explaining the concept of 'scaling' in computer Graphics using lesson activity.

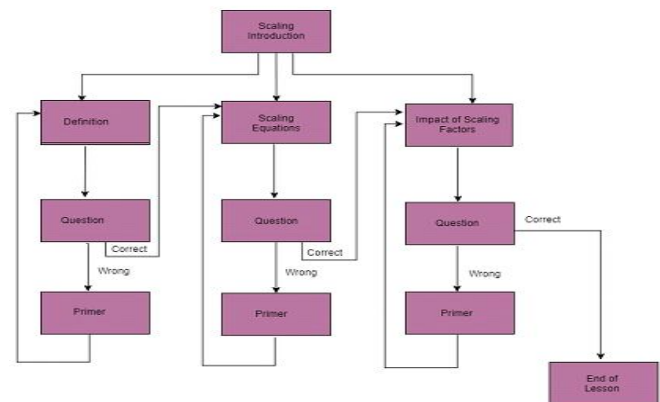


Figure 2. Learning path of lesson activity for scaling

The above figure explains the learning path designed for explaining the concept of scaling in different levels. It explains the way of proceeding the course of study. At each step, student could learn certain learning content by choosing a suitable learning method. At Level-0 an introduction about the concept of scaling is explained. In level-1 details about the scaling such as definition, scaling equations and scaling factors are explained. Level-2 contains questions corresponding to the previous topic. In this level evaluation of the learner is happened. If a student can answer all questions correctly then they can move to the next topic which is explained in Level-1. Otherwise they have to move to Level-3, the primer page. This primer page is meant for some remedial learning content. In this page we can include more learning materials based on the result of questions answered.

#### V. IMPLEMENTATION

In this study researcher has prepared a learning material based on the characteristic of slow learners. A slow learner always wants to refer the learning material many times. This study can be considered as adaptive learning because we have given options to refer the topic many times, while preparing course content. Figure 3 explains how scaling is implemented with lesson activity. Through this activity students can move from one page to next page.

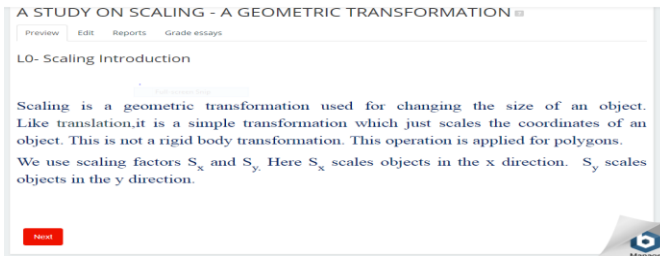


Figure 3. Implementaion of Scaling using lesson activity

Adaptive E-learning refers to adapting the way of presentation of educational material according to the student’s needs. This method uses the technology to assess the knowledge of learners, their skills, and attitudes at the beginning of online training. This knowledge can be used to deliver educational materials at the level most appropriate for each learner [17]. Using this method student can move back to the course using the feedback mechanism. To achieve this, at the end of each explanation a quiz is conducted.

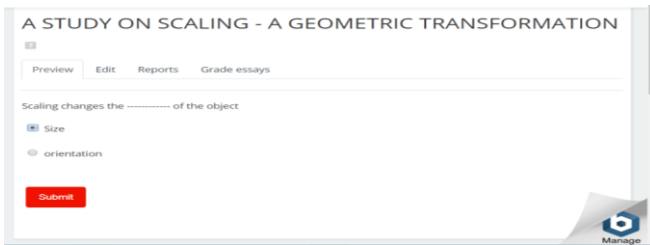


Figure 4. Example of a quiz

It helps to understand the learning level of students. If they answer it correctly they can move to next topic, otherwise they have to go back to the same topic again. This allows a learner to learn the topic one more time and help them to acquire a thorough knowledge. Implementation of quiz is illustrated through the figure 4 in this study.

During the course of study if a learner can answer the quiz correctly, they can move to the next page. In this study the initial page was explaining the introduction about scaling. After the successful completion of the quiz they can move to the next page, ie Definition of scaling. If they answer it incorrectly, they are directed to move to the previous page in the course. Figure5 shows the navigation towards the next page.

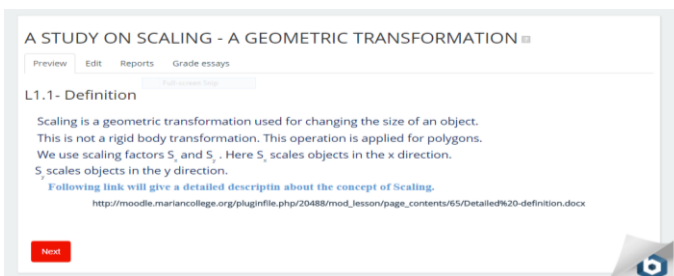


Figure 5. Lesson activity for scaling

Using lesson activity it is possible to include more pages for any types of learners. In the study [18] the concept of translation is explained for visual learners using FSLSM and in this study scaling concept is explained for slow learners. Using lesson activity in Moodle it is possible to accommodate all these types of learners. Figure 6 shows how pictures, power point presentations, etc.can be included in the lesson activity for the slow learners.

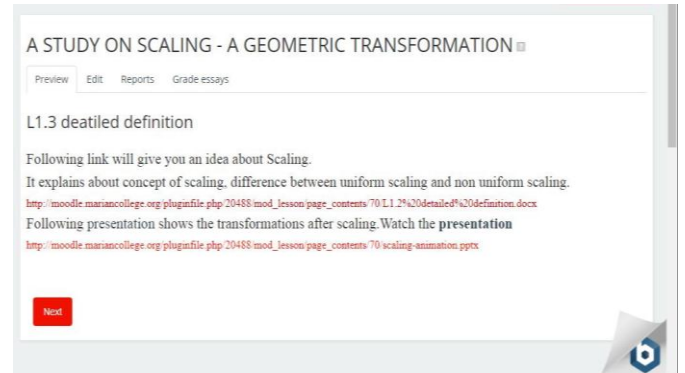


Figure 6. Visual aids for slow learners

Since in the study of graphics students have to learn equations, definitions etc. we can include more pictures and examples. These types of learning materials can support a slow learner who seeks visual aids. Figure 7 is an example of the use of pictures.

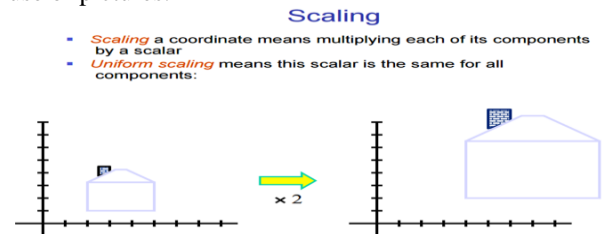


Figure 7. Explanation with pictures

This method of learning will benefit the slow learners in some extent. After the completion of the learning process an analysis of the log data will help to identify difficulty level of a particular student. Again the impact of successive path through a series of quizzes helps them to learn the subject thoroughly. The student appears for the quiz during process of learning the course and gives the answers according to the knowledge gathered. Based upon the answers, the system evaluates whether that particular topic needs to be improved or not and provides it as a feedback to the student. It also describes various ways that needs to be adapted in order to improve on those particular areas. By this technique a student gets a chance to analyze his weaknesses, using a tutor like experience digitally. All the above diagrams restate these facts through the lesson activity designed for Scaling.



## VI. CONCLUSION

Providing personalized learning contents to all learners has become a popular trend in e-learning. It helps to communicate relevant knowledge to a recipient in the learning process. Development of suitable methods for providing such personalized learning contents to all learners is important in e-learning. In this study images, videos, power point presentations, hyperlink to web resources etc. were incorporated during the e-content creation. It will be very much supportive during their process of learning. In this study researchers have developed a small learning object (SLO) scaling for slow learners. As a future study, with the help of knowledge discovery and data mining techniques it is possible to understand more about slow learners and their educational behaviors. As a further step an analysis on the log data collected from Moodle will be used for identifying the learning path of the learners. Many algorithms are used to solve machine learning problems. The study [19] explains the application a machine learning algorithm for the prediction of the status of the institutions. Hence in this study, some machine learning techniques will be used for predicting the academic performance of the students.

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