New Trend in Technical and Vocational Education Based on Adaptive Learning

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Abstract— This Paper Presents An Integrated Model For The Implementation Of Technical And Vocational Education Based On The Methodologies Of Adaptive Education That Is Implemented Through E-Learning. Technical Education Needs To Expand The Evaluation Circle Because The Components That Make Up This Education Are Broader Than The Components Of Theoretical Education. Therefore, The Extension Of The Idea Of Adaptive Education Depends On The Sequence Of Ideas And The Student Model Which Is The Basis Of This Methodology.

Index Terms—learning, adaptive, style, technical, standards.

1 Introduction

E-learning (e-learning) uses information and communication technologies to enhance teaching and learning in regular classrooms. Today's users are overloaded with e-learning resources, it is difficult to choose the best material for a particular topic. With maturation of the Internet technologies and lower cost of hardware platforms, more educational institutions use e-learning as an effective method in the learning process [1].

I. Adaptive Learning

Adaptive learning makes teachers enable to dynamically review and provide instructions and leaning objects to the learners according to their current progress. The latest in the art of e-learning is technique uses an automatic collection of learners' performance data using explicit testing. However, there are few existing e-learning technologies that can support automatic analysis of learners' progress in terms of the cognitive structures they have acquired. Most e-learning systems provide web-based learning so that students can access online courses over the internet without modification.

In an e-learning system, one size does not fit all. Therefore, it is a challenge to create e-learning systems that are appropriately 'adaptive'. The aim of adaptive e-learning is to provide students with theoretical and applied knowledge. The right content at the right time means that the system is able to determine the level of knowledge, track usage and rank content automatically for every student to get the best education [2].

II. Learning Styles Overview

Learning styles means the way by which the learning objects are introduced to the learner. For example, visually or verbally etc. Many of these learning styles in education have been studied by researchers, we review two of them.

- *The Basque model [3]*

  The Basque proposes a classification of learning styles and strategies that can be described and explained as follows:

 (1) The total learning style: It includes two areas of learning: The Gestalt learner, who is distinguished by his understanding of a comprehensive overview of the subject before delving into its details, while the second preferers a method of superficial learning which is called generalizations.

(2) General learning style: It is characterized by generalization from the learner style, which is a kind of learner pilots, who can choose between metacognitive learning methods.

(3) Sequential (incremental) learning method: It includes two styles of learning: the learner's action style, and the learner's uneducated style. The first is characterized as following in teaching materials step by step analytically, the learner has his own scientific methodology, while the second is the type of learner who does not see generalities, because he enters into the study of details [4].

- *The Dunn and Dunn model [5]*

  Dunn and Dunn define learning style as the way a learner begins to focus on new and challenging information, to do and to retrieve it. He considered that this interaction occurs in a way that differs from one person to another, and added that the learning style is a set of biological, evolutionary personality traits that will make learning effective for some students and ineffective for others [6]. This style provides a therapeutic and diagnostic educational framework, which is based on the theory that it is beneficial for each student to learn best in his own way, and thus calls for a choice of methods, information in instructional procedures and conditions design that fit the student's style.

  Learners are supposed to learn better if they learn in patterns that suit their learning style. For example, a visual learner may learn better when information is presented to him/her visually. This approach is called the "learning styles" [7]. Learning styles play an important role in the life of the learners. As students involve themselves to the learning method, they will be able to integrate their own learning process. As a result, the learning process will be fun, faster and more efficient. Furthermore, teachers should try to modify their teaching methods to match the learning styles of their students. Anyway, mismatching may be especially important with low-level students because they are disappointed early learning stages however, it must be done with caution, in addition [8] suggests that "teachers should strive for a balanced teaching style that does not overly favor any one teaching method, rather than trying to accommodate multiple learning styles. In the following figure 1 the role of learning styles in adaptive learning is described.
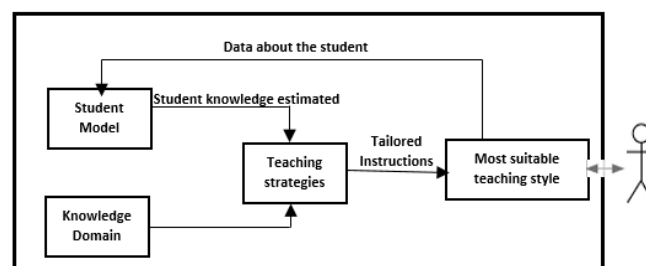

Figure 1: the role of learning style

Figure one which is described in [8] shows the integrated interaction among the components of the adaptive learning including the student model which contains every data about the student and the preferred learning style for him. Noting that there are multiple learning style and some of them are suitable for the learner. Each course has domain model which consists of learning objects and the hierarchy of the course sequencing.

Figure 2 describes the process which is done by the learning styles. The data about the student is extracted from the student model including his progress in the course, evaluation, latest evaluated learning style etc.

In adaptive learning and based on the data extracted from the student model the lecture presentation will be created and presented to the learner.
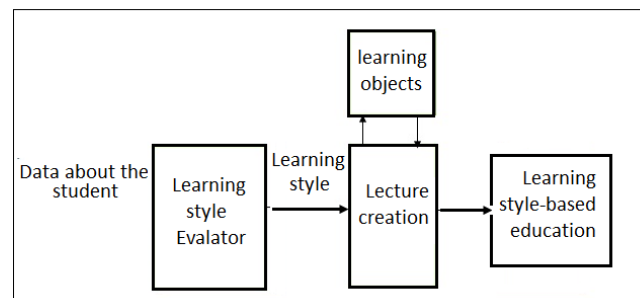
Figure 2: learning style process

Table 1 continues discussing the learning style methodology described by Dunn and Dunn, these elements should be taken in consideration when we talk about adaptive education because following the best path of learning depends on these factors

Table 1. Elements of learning styles according
to Dunn and Dunn

No	Style	Characteristics
1	Environmental patterns	Sound, Light, Temperature, Design
2	Emotional patterns	Motivation, Perseverance, Responsibility, structure
3	Social patterns	Self, Couples, The group, Maturity, Diversification
4	Physical patterns	The sweetest, Eat and drink, Time, The movement
5	Phycological patters	Holistic, analytical – Impulsive, reflective

III. Technical and vocational education

Technical and vocational education is used as a comprehensive term referring to those aspects of the educational process involved. The study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life. In the light of this, vocational and technical education is the preparation of individuals to acquire practical skills as well as basic

scientific knowledge, it provides skilled manpower, for the world of work, that is increasing the workforce in the country, individuals with specialized skill as offshoots of efficient vocational and technical education as they are trained, equipped, with workable practical/skills, knowledge, aptitude and competencies required in specific occupations [9].
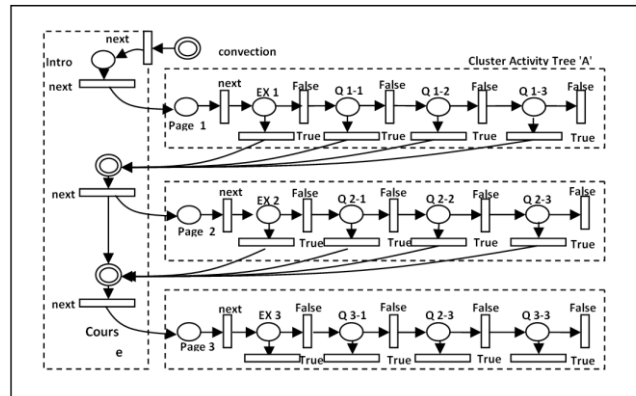
In vocational and technical education occupational competencies to do a job in a planned, prepared manner is the comprehensive term for someone being capable, responsible, and goal-oriented in order to solve complex problems or tasks in the professional family. Occupational competence includes technical, personal, social and methodological competencies. A brief discussion about these competencies is in the following points.

- Technical competence in the context of acquiring professional competence, technical competence can be described as the learner's ability and willingness to acquire and use technical knowledge and skills to solve problems and perform tasks independently, appropriately goal-oriented and assess the outcome and the ability to transfer knowledge and skills to a wide range of people within outside the professional side

- Personal Competence can be described as the ability and willingness of individuals to act and take personal responsibility in accordance with ethical values. This is due to the development of personal concepts, self-esteem, self-efficacy and commitment to values. It includes an assessment of opportunities, requirements and limitations in relation to oneself, one's work, role and participation in public and social life.

- Social competence can be described as the ability and willingness to develop positive social relationships based on social responsibility and social solidarity. With reference to the ability to cooperate, deal rationally and responsibly with conflicts, and empathize with others. The ability to understand roles, work in a team, and communicate appropriately with supervisors, colleagues, partners, and friends as part of social competence.

- Methodological competence can be described as having the ability and willingness to solve problems and the ability to perform objective-oriented, planned and organized tasks in a systematic manner. Problem-solving strategies and methods of work are independently chosen, applied and developed in order to complete assigned tasks, to ensure quality and to evaluate results. Methodological adequacy is required to obtain information through the use of language, modern information, communication and communication technologies.

IV. Cycle sequence behavior model provided by Petri net

Petri Net is a directed graph consisting of nodes representing transitions like an event. And places like adverbs expressed in circles. Directed parentheses reflect the event before or after the state [10]. Petri Net has modeling tools like other modeling standards, and provides graphical codes such as selection, operation, iteration, and concurrent execution. However, Petri Net has a mathematical definition of application as well as well-proven theorems [11]. Madjarov and Petri studied this model through a set of cascade behavior. They found that the distribution of learning materials should treat the different activities that are delivered to the learner as managed sequences. Madjarov and Petri presented a model based on Petri Net in the form of a hierarchical structure of learning activities (LOs) [11]. The learning materials are organized in the form of a clustered tree and the sequence in it depends on the learner's behavior or response to the exercises designed to determine the level of the student, which can

be determined by the examination at that stage or level. The service provided to students through LOs is more appropriate to the student's level of knowledge. This model is more dynamic in the sequencing behavior and sequence rules of the schema, which ensures more integration of different types of LOs in the sequence rules of the schema [12].

Figure 3: course cluster sequencing behavior presented by Petri Net

V. Adaptive technical and vocational education

From the previous studies that were discussed, we can rely on the Petri Net model and the educational material sequence model for the learner to start from the course, which is divided into a group of chapters. Each chapter can be divided into a group of modules, which in turn are divided into a group of topics.

It is certain that for each academic course there is a manager who manages the operations, and he is often the course teacher, who has to clarify the specifications of the course and clarify the sequence of the scientific components in the course according to the previous sequence, which is derived from the Petri Net model. He has to define the duration of the course and divide the evaluations into units and then modules and topics.

This process enables the teacher to logically sequence the educational learning objects that he wants to achieve for his students during the semester.

Since the study is related to technical and vocational education, the process becomes more complicated in terms of these divisions. Vocational education revolves around theoretical concepts and concepts that are more extensive in practical skills, and this is what makes the process of sequencing the educational material more difficult. The theoretical part of the subject may be easier to build the adaptive approach in education. Determining the learning style is easier to define. While in the practical part, it is deeper than what can be dealt with, as it was previously explained, it deals with multiple competencies that the learner must master in order to reach the required state of expertise. Therefore, the separation in adaptive education between the theoretical part and the practical part is more effective in delivering the educational learning objects to the learner. Accordingly, the adaptive education in technical education is separated into two consecutive parts, the theoretical part first, and then the practical part, which is divided into the previously explained competencies.

The theoretical part, as stated in previous research, based on Petri Net, follows course sequencing by adaptive presentation based on the learning style of the student. For each topic

in the course there are two paths, one for the adaptive learning objects presentation and for evaluation process. These two paths are for both score and accumulative learning style. The description of this process is described in figure 4:
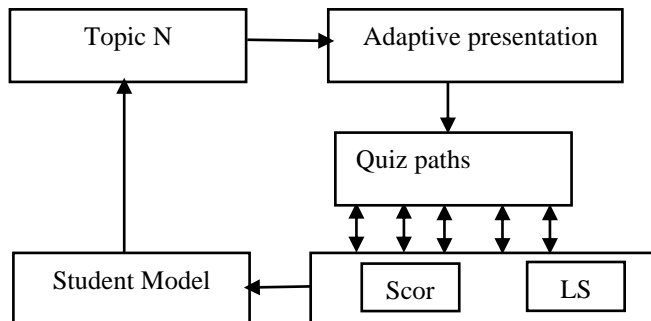
Figure 4: Theoretical part adaptive learning brief description

As we discussed before technical and vocational education, as it is known, depends to a very high degree on practical applications, and this is what makes it difficult to evaluate and find the preferred learning style for the student. Applied technical education balances technical, social, personal and professional competencies. All these competencies must be achieved through technical education, which necessitates finding a methodology for applying the mechanism of adaptive education and adaptive testing to them.

Competencies of all kinds are divided into several parts according to the training course that the student follows. For example, professional competencies in a specific subject have ten competencies which requires dealing with electronically, and the same should be applied to other competencies.
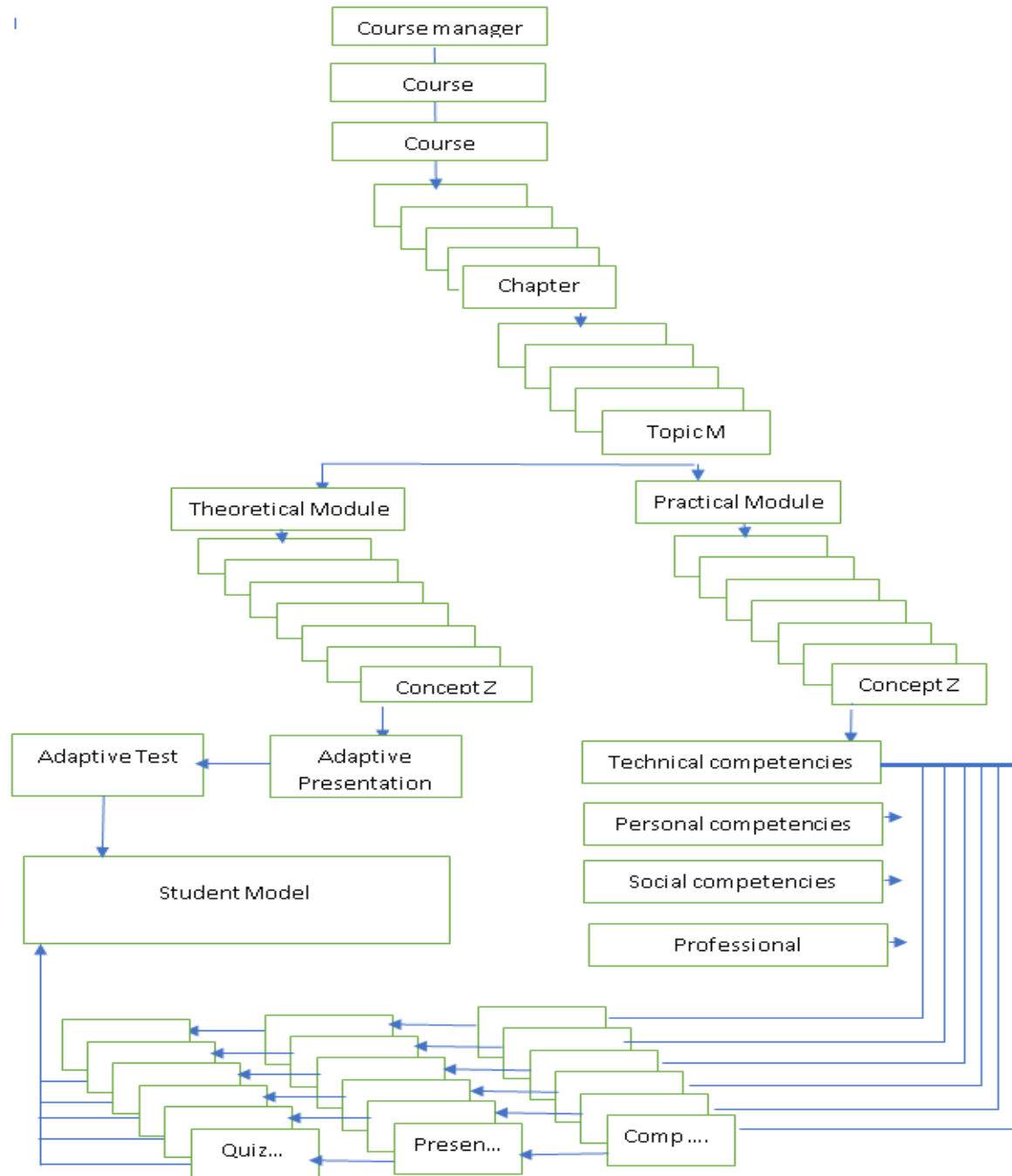
The professional hierarchy of the technical educational learning objects follows the following form described in figure 5:

VI. Discussion

According to the figure 5 which shows the complete methodology of the adaptive learning process in technical and vocational education, it is clear that for each course there is a manager who is often the course teacher. One of the tasks of the course manager is to set all the standards required to

start the course in terms of design, sequence, schedule and tests. Description of the course and its contents according to the plan developed is one of the most important things that the manager must do, in addition to uploading of all the educational materials in their various forms according to the educational patterns approved within the methodology. The course, then the units, and the unit, in turn, is divided into a group of topics. The topics here are divided into two parts, the first is related to the theoretical part and the second is related to the applied part, given that the subject of the study is technical and vocational education. The course manager is the one who determines the percentage of theoretical and practical education for the course. For each practical or theoretical part, there is a set of concepts that the student must complete. The theoretical part follows the adaptive education that has been explained in

previous studies, where the student goes through a process of adaptive presentations that match his preferred learning style based on his own student model. Then he undergoes an adaptive test that gives the student the opportunity to obtain evaluation questions with different learning styles according to the model derived from Petri Net, this method enables the system to discover the best learning style for the student.

Figure 5: The professional hierarchy of the adaptive technical and vocational education

With regard to the practical part, the matter needs to be expanded. The same method is applied, but the composition of the practical application differs. Applied education consists of a set of competencies, and these competencies must work independently. Technical competencies, for example, are dealt independently and consist of a set of standards and need adaptive presentation and adaptive testing. This situation continues with all types of competencies described in the figure 5 until we obtain a double evaluation of the student, evaluation of the mark and evaluation of the best learning style for the student in a cumulative manner, all of which are stored in the student model.

VII. Conclusion

So far, the studies concentrated on adaptive learning to serve the education process in either university and schools as an academic education. The adaptive learning not only can be applied on academic education but also it can be applied on technical and vocational education as disused above. In this direction the adaptive learning should cover all aspects of the technical education. The student should understand the nature of the technical education including the competencies he should master which are stated by the course manager.

Learning practical skills is an important factor for having expert graduates, so offering the student the training process in the suitable way he can understand by it will guarantee more effective technical education.

VIII. Acknowledgement

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