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TENDENCIES IN FUTURE EDUCATION DEVELOPMENT – PERSONALIZED AND ADAPTIVE E-LEARNING**

Abstract: An approach founded on belief that one learning system suits each and every students results in a great many problems that can be summarized as a lack of personalization. Adaptive e-learning systems try to solve these problems by shifting the presentation of material to suit each individual student. The paper discuss need for a paradigm shift – from teacher-centric to a student-centric learning model – by leveraging technology. The use of ICT (information and communication technologies) powered adaptive and personalized learning holds great promise as a cost-effective and egalitarian means to help greater numbers of students accelerate their learning, graduate, and meet challenges in a competitive world.

Keywords: *Adaptive e-learning, Personalized learning, LMS, Education.*

INTRODUCTION

Contemporary and rapid technological expansion has led to a change in fundamental everyday and business activities, and the establishment of a new social and economic constitution. This without doubt leads to major changes in the education system. However, the education system tends to be rather slower transformations, especially when it comes to the formal education system, since the implementation of reforms is a very long-lasting process.

Presently, the educational process is adjusted to an average student. But does average student really exist? Due to the require to educate numerous students, we have developed and adopted educational methods that ignore and overlook individual needs and put the focus on what should suit the educational needs of a student with an average competences in all areas. However, the reality is different and this approach leads to the denial of advanced or students with lower abilities. Students who are advanced in a particular field are not suitably stimulated, while

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students who are not interested or talented in a particular field are overloaded. Insisting on average actually leads to a lack of interest at most students. This education system seeks to develop individuals who are average in everything, while the society and the labour market need an individual who is gifted and involved in a particular field. The educational system must be changed in accordance with the modernization of contemporary society and its requirements, as well as to requirements of present-day students.

TRADITIONAL VS. CONTEMPORARY APPROACH TO EDUCATION

The domain of traditional education and learning has been teacher-centric. The approach, perhaps, is attributable to social hierarchy that dictates learning has to be driven from the “top” by a teacher or mentor. While this may well be effective, besides being tried and tested, it often fails on one count – it’s assumption that one size fits all. Teacher-centric models traditionally assumes that the student group is a homogenous entity with similar learning styles, levels of competence and prior knowledge, learning needs and motivation levels. This way of delivering education results in the following:

- no variation in content,
- learning restricted to a select group,
- lower motivation,
- lower return on investment (whether they are monetary investments or the effort of teachers and pupils that is involved).

It is necessary to change the paradigm and to make educational system shift to a student-centric model, by leveraging technology (Murray & Pérez, 2015). Although a student-centric model may not be the solution for all disadvantages of traditional teacher-centric approach, it achieves the following:

- have more diversity in content,
- make content more accessible to learners,
- allow learners to determine their learning path,
- account for different skill/competence levels among learners.

Despite the growing acceptance that “teaching to the middle” is no longer an effective instructional or design strategy, we continue to deliver instruction and learning solutions that were designed to provide an equitable education for all by providing the same lock step, uniform educational experiences for all students. Traditional teacher-centric educational systems were designed to support the common perception that most people learn in similar ways, and embracing a paradigm shift of this magnitude will take time (Murray & Pérez, 2015).

Therefore the rapid development of information and communication technologies (ICT) enables us to develop new methods of work in the teaching process and education. It will also come to the process of personalization and adaptivity that will increasingly respect the real needs of student and enabling development in a direction that is characteristic of student personally, and not in artificially created direction of average (Murray & Pérez, 2015). Idea of learning suitable and customized to students is not new, but there are different approach to adjustment of the learning and teaching process to the student's needs. Hill (2013) distinguishes between types of teaching deals with the adaptive learning and points to some differences between the concepts of adaptivity and personalization:

- differentiated learning – is a kind of learning with a number of ways in which students approach a new curriculum. Students are divided into categories, with each category being different in the way of learning and approaching new information.
- personalized learning – is a kind of learning where each student takes different paths to achieve their educational goals. Before the start of Instruction, the student takes a pretest, which determines their individual “path”.
- adaptive learning – takes into account the student's results during the entire time of instruction. It is a dynamic process as the student's “path” can be changing all the time.

PERSONALIZED LEARNING

The philosophy of personalized learning is not new to education. ELI's “7 Things You Should Know About Personalized Learning” provides a useful definition of personalized learning as a starting point: “Personalized learning provides a unique, highly focused learning path for each student. Individual attention from instructors isn't feasible in traditional educational models with large numbers of students, and personalized learning is intended to use ICT systems and tools to tailor learning experiences based on student strengths, weaknesses, and pace of learning” (ELI, 2017a). Technologies including analytics, adaptive learning, digital courseware, and others underlie personalized learning, which builds a profile of each student and makes continual adjustments to learning paths based on student performance.

Many different approaches exist to personalize learning across diverse educational institutions and programs. By using a personalized learning philosophy, technology has the potential to provide learning tools that emphasize good areas and provide support to weak areas, providing useful information to allow teachers to target their instruction and resources to individual students (Cavanagh, 2016). Web-based personalized learning platforms also provide paths to equity and access, supporting students who need flexible or self-timed learning schedules.

Despite the fact that a focus is on ICT tools and other technologies as providers of personalized learning, Feldstein and Hill (2016) explained that personalized learning is not a product you can buy. According to the mentioned authors (Feldstein & Hill, 2016) personalized learning is a strategy that good teachers can implement. Without good teachers and good strategy, even a great product designed for personalized learning applications has limited value. Personalized learning should be conceptualized as a practice. As a complement to the practice of personalized learning, digital courseware technologies provide one method to support students based on their unique learning needs (Feldstein, 2010). As a practice, personalized learning solutions can be designed to align with the learning goals of different disciplines, degrees, institutions, and missions (Feldstein & Hill, 2016). Besides educational technologies, a comprehensive practice of personalized learning can be designed to include many other complementary educational practices. For example, in an effort to create a more comprehensive approach to learning, some educational institutions are implementing 21st century classroom redesigns: competency-based education, Universal Design for Learning (UDL), “flipped” learning, and other student-centric practices that can be supported by digital courseware (UDL, 2018).

Used individually, each of these personalized learning solutions can be of little use (and can lead to wasted resources and time). However, when these practices are integrated and harmonized with the curriculum and instructional design, institutional policies and planning, and the professional development of faculties and staff, the potential benefits of personalized learning can even be successfully evaluated to benefit a large number of students. It is impossible to redesign students to fit into a system, but a system could be redesigned for students. This can be the difference between success or failure for successful student learning.

ADAPTIVE LEARNING

Adaptive learning is one of many possible approaches to personalized, highly targeted education to large numbers of students, through various technology systems and tools. It can be said that adaptive learning is a method for providing personalized learning, which aims to make available efficient, effective, and customized learning paths to employ each student. Adaptive learning systems use a data-driven and, sometimes, nonlinear approach to instruction and remediation. Such systems dynamically adjust to student interactions and performances, delivering the types of educational content in an appropriate sequence that individual students need at specific moment to make progress (ELI, 2017b). These systems use algorithms, assessments, student feedback, teacher adjustments/interventions, and different media to deliver appropriate educational objects to students, whether there are new learning materials or remediation, depending on the progress of students (ELI, 2017b).

Paramythis' description (2004) captures the essence of adaptive learning. He argues that “a learning environment is considered adaptive if it is capable of: monitoring the activities of its users; interpreting these on the basis of domain-specific models; inferring user requirements and preferences out of the interpreted activities, appropriately representing these in associated models; and, finally, acting upon the available knowledge on its users and the subject matter at hand, to dynamically facilitate the learning process”. According to Paramythis, there are four categories in the adaptive learning environment:

- Adaptive interaction – the first category refers to modifications intended to facilitate or support the user's interaction with the learning environment. Examples of modifications at this level include the use of alternative graphical and color schemes, font sizes, etc. to accommodate the user's requirements.
- Adaptive course delivery – the second category constitutes adaptation techniques aimed at the adaptation of the course/instruction to the individual users. The intention is to optimize the fit between the course contents and user characteristics.
- Content discovery and assembly – the third category refers to the creation of an adaptive study material based on adaptive techniques and knowledge about users derived from previous “sessions”.
- Adaptive collaboration support – the fourth and final category captures communication between people (so-called social interaction) and collaboration toward common goals. It is important to support communication, collaboration and cooperation as the individualist approach to learning can lead to complete isolation (Paramythis, 2004).

Adaptive learning technologies support three general systems, which differ in the way of implementation, control of configuration, and adjustment of content and its sequencing. Within the adaptive learning system, learning modules are designed so that the content, sequencing of concepts, and assessments are aligned with the learning objectives for the course.

There are numerous benefits from adaptive learning systems. Considered from the perspective of students, adaptive learning respects their prior knowledge, responds to their characteristic learning needs and preferences, and reduces gaps in their understanding (ELI, 2017b). Adaptive learning systems can provide tailored support and guidance to all students. The role of the teacher changes from content provider to learning facilitator. Teachers can more easily observe progress of students, measure curriculum performance, and maximize learning outcomes. Teachers can have a better insight into areas where students are in difficulty, and system metrics allow proper reaction before there is a possibility of withdrawal or failure of individual students. For the education institution, adaptive learning system contributing to greater levels of academic success for more students in a

cost-efficient manner (ELI, 2017b). Main benefit of adaptive learning systems is their potential to improve the efficiency of learning, and thereby instruction.

On the other hand adaptive learning systems can be expensive and require plenty of time to implement. Also, their implementation requires detailed mapping of the curriculum and the development of content that supports the learning objectives (Griff & Matter, 2013). The content requires a specific, well defined design – it has to be designed at the lesson and objective level, and concept interconnections must be determined across the course or across connected courses (Griff & Matter, 2013). Preparation of such educational materials requires additional time for preparation and possible teacher training for its creation, uploading and maintenance on the system.

E-LEARNING AND ADAPTIVITY

ICT, when used appropriately, can enable teachers to provide opportunities for both personalized and adaptive learning. Digital learning, namely e-learning, has the potential to support the wide variety of background knowledge and experiences, academic preparation, learning styles and learning schedules of today's students. Adaptive learning strategies must be integrated into a comprehensive personalized learning system that is supported institutionally by faculty and staff training and designated resources. Adaptive e-learning system (AES) is a recently established area of research integrating technologies of CAI (Computer Assisted Instruction – CAI), ITS (Intelligent Tutoring System) and hypermedia systems. Learning management systems (LMS) are commonly used in e-learning, but most of them provide none or very low level of adaptivity (De Bra et al., 2003). Existing adaptive web-based educational systems like AHA, APeLS, 3DE provide variable degrees of adaptivity (Dagger et al., 2003). Moreover, they have some strict limitations like: supporting a small amount of e-learning functions, deficient in integration, not reusable courses' learning content etc (Del Corso et al., 2005). These are one of the greatest reasons for low usage of such systems. On the other hand, typical LMS such as Blackboard, WebCT or Moodle, which are frequently and effectively used in e-learning (because they provide numerous features supporting teachers to generate and handle their online courses) provide low level or no adaptivity at all (Murray & Pérez, 2015). In order to provide a personalized/adaptive approach to instruction and teaching, an adaptive LMS model has to be developed. Most LMSs are open source, i.e. they allow the implementation of software add-ons that enable the LMS adaptivity.

The basic components of adaptive LMS are:

- the domain model,
- the student model and
- the adaptation model (Cannataro et al., 2002).

The domain model is a domain or subject matter for which LMS is intended as a source. The student model is a set of preferences and characteristics for which certain values are recorded for each user. The adaptation model is basically a description of what parts of the e-learning can be adapted and under what circumstances this adaptation is to occur.

The main factor that provides adaptivity in LMS is the student model that represents significant aspects of the students (learning preferences, prior knowledge, learning style and interests, etc.). The student model maintains information about each student (knowledge, preferences, etc.) which the system collects through the observing of applications' use (by presenting series of questionnaires or feedback forms) (Cannataro et al., 2002). The more accurate the student model is, the more sophisticated adaptivity can be provided. There are numerous characteristics of student that are related to the learning process. Among others, these are: prior knowledge, intelligence, learning habits, learning style, age, gender, level of motivation, level of cognitive development, level of socio-emotional development, level of moral and character development. Therefore, the student model should take into account at least some of these factors, in order to provide adaptive LMS accordingly with students' needs and preferences (Kay, 2001).

The creation and development of an adaptive LMS is in some respects different from the development of other software. According to Koch (2000), this difference is mainly concerned with navigational facilities, the role of the user, and dynamic adaptation of learning materials, presentations and navigation. The first step in the process of development of adaptive LMS model is the analysis. The analysis involves generating a description of system requirements, describing the system functions and the main characteristics of the system that is expected. The next step that the author takes is the decision on the parameters according to which the adaptation is done. It is possible to choose one, but also several adaptation parameters. And these parameters are some of the students' characteristics (the most common learning style and/or pre-knowledge, etc.). Adaptive LMS is expected to provide a presentation of learning materials which vary according to the chosen parameters. Thus, the system must be able to identify the differences (e.g. different types or some kind of levels) within the selected students' parameter and use student data as considerations for deliver presentations (Arsović, 2011). An adaptivity mechanism that is used to decide whether a student will get a certain learning mode is most often based on the results of questionnaires that a student completes when applying for an e-learning course. The questionnaire contains questions that ask the tendency of the selected adaptation parameter. Based on the results of the questionnaire, students are divided into specific groups, where students of one group share the same characteristic and/or preference depending on the chosen adaptation parameter (Arsović, 2011). The next step is design that produces a system architecture based on a summary of the functional systems and features of adaptive e-learning systems. The implementation is next step, that would be the realization of the system design through a programming work. Some of the existing open source LMS platforms can be selected for implementation (e.g Moodle). Since a standard

LMS, like Moodle, does not consider individual differences of learners and treat all learners equally, in order to accommodate the learners' characteristic accordingly to chosen adaptation parameter, it needs to be customized. Adapting Moodle to implement system design involves the creation of some modules, blocks, and formats of a course within Moodle. The higher the number of educational and learning materials that corresponds to the characteristics of each of the recognized group of students, and therefore the adaptive courses, allows for a higher level of personalization of instruction and learning (Arsović, 2011). Teachers are responsible for creating and editing all learning materials. And the adaptive LMS requires the creation of a large number of additional learning materials, which is an additional job and obligation for teachers. Reusability of learning materials and objects is another great property and request of adaptive LMSs, which makes it easier to create new learning materials.

CONCLUSION

It is obvious that modern trends in the development of education will affect many changes in schools and universities, professional educational institutions that will have to find their place in the recently created educational environment. These trends will necessarily influence finding new teaching methods and educational strategies in order to offer effective and high quality educational experiences in the future.

The traditional model of the “one-size-fits-all” education system has shown its weaknesses over time. Contemporary society requires modernization and change of such an approach to learning and teaching, as well as shifting the focus of learning from teacher to student. Most students are either ahead or behind the average learning rate. Since personalized learning facilitates instructors in trying to adjust the content to each student rather than learning the average, the time of educational institutions can be efficiently and effectively spent on the instruction. Modern ICT, properly used, can be an appropriate tool for personalization and adaptation of learning.

In a comprehensive context of the learning process, adaptive LMS can support changes in the role of faculties and schools, enable innovative teaching practices, and incorporate different educational content formats in order to support students according to their learning needs. At the same time, these tools can provide new evidence of the relative effectiveness of different sequences and learning approaches.

To sum up, the main goal of the adaptive e-learning systems is the possibility for learning personalization to be assured for each learner in respect to students' necessities, preferences, needs, performance, and progress.

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ТЕНДЕНЦИЈЕ БУДУЋЕГ РАЗВОЈА ОБРАЗОВАЊА – ПЕРСОНАЛИЗОВАНО И АДАПТИВНО Е-УЧЕЊЕ

Резиме

Приступ заснован на веровању да један систем учења одговара сваком ученику, производи много проблема који се могу сумирати као недостатак персонализованости. Адаптивни системи е-учења покушавају да реше ове проблеме померајући презентацију градива тако да одговара сваком ученику појединачно. Рад разматра потребу за померањем парадигме – од модела учења усмереног на учитеља до оног усмереног на ученика – уз помоћ ефикасније технологије. Употреба ИТ-ем потпомогнутог адаптивног и персонализованог учења пуно обећава као исплативо и егалитаристичко средство које може помоћи већем броју ученика да убрзају своје учење, заврше студије и сусретну се са изазовима света у којем влада конкуренција.

Кључне речи: *адаптивно е-учење, персонализовано учење, СМУ, образовање.*