

## INNOVATIVE PRACTICES IN EDUCATIONAL TECHNOLOGY

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**Abstract:** *To gain a competitive advantage universities have to improve continuously the learning they offer to students and to renew their product offerings. In this paper, we discuss innovations in educational technology and their influence to form a highly connected, interactive and engaging environment within the classroom. We concentrate on the efforts of New Bulgarian University to modernize the learning process and to foster novelties in. We present educational innovations at our university where both the full-time and distance forms of education are enhanced by e-learning.*

**Key words:** *innovations, higher education*

### Introduction

Nowadays modern digital age influences deeply the way we perceive life and the way we acquire knowledge. The development of ICT and the use of Internet has led to significant changes in the overall educational process. Innovative technologies in the educational field permit the educators to form highly connected, interactive and engaging environment within the classroom. In reality classroom is the place where the effect of modern technology is observed. Advanced educational technology-based devices, tools and systems that enhance student-learning experience have been introduced. The result is remarkable benefits such as more collaboration, independence, and flexibility in the classroom environment. More and more traditional learning tasks are delivered online. Students have the flexibility to study “anytime and anywhere”. They can choose the way of their learning as well. Learning management systems facilitate instructors’ work significantly. Summarizing innovative information technologies change the social environment completely. Not surprisingly, investments for new information technologies are growing continuously.

Today it is important to foresee how innovation and digital technologies will integrate in the current Educational Systems as they serve the needs of the society. “It is widely believed that countries’ social and economic well-being will depend to an ever greater extent on the quality of their citizens’ education: the emergence of the so-called ‘knowledge society’, the transformation of information and the media, and increasing specialization on the part of organizations all call for high skill profiles and levels of knowledge. Today’s education systems are required to be both effective and efficient, or in other words, to reach the goals set for them while making the best use of available resources” [1]. According to an Organization for Economic Cooperation

and Development (OECD) report, “the pressure to increase equity and improve educational outcomes for students is growing around the world” [2].

The purpose of this paper is twofold. First, we try to systematize the innovative trends in educational technology. Our study is based on a literature survey and author research. Innovation is defined as “the successful introduction of a new thing or method” [3]. In education, innovation has many facets ranging from a new pedagogic theory to teaching techniques. It can appear as an institutional framework that if implemented gives rise to visible transformation in teaching and learning. The outcome is better students' learning i.e. an improved learning quality. All the participants in the educational process e.g. university professors, administrators, researchers, and policy makers are expected to be deeply involved in these innovative practices.

Next we present educational innovations at New Bulgarian University where both the full-time and distance forms of education are enhanced by e-learning. New Bulgarian University has formally adopted three types of delivery models for its courses: in-class, online and blended. The Moodle NBU platform provides access to e-learning content for each course and supports active communications among instructors and students in all forms of study.

The paper is organized as follows. Section 2 concentrates on the innovative trends in educational technology. Today's classrooms illustrate the actual influence of modern technology. At present, unfortunately some innovative practices have not yet found their application in education. In Section 3 we share our university experience of implementing some innovations in the learning process. We have the proper institutional framework – the Moodle NBU platform. In addition, university management supports the application of innovative approaches that are included in the regulations of the university. In the conclusion, we point out on some effective innovations that can help produce high quality learning outcomes for all students across the system.

## **Innovative trends in education**

Education and educational innovations are systematically analyzed and classified in [4]. They quickly generate scalable effects but the human element, - the learner and teacher, remains a driving force. Therefore, the potential applicability and benefits of innovations should be taken into account to develop successful practices.

In our opinion, the following trends in educational technology will shape the present learners.

### **1. Virtual/Augmented Reality**

Virtual and augmented reality are artificial surroundings that are created with software program. When supplied to the users they believe in the reality of

this environment. The Global virtual reality Market is expected to exceed more than US\$ 43 billion by 2024 [5].

Over the last year, the application of Virtual Reality (VR) in education exhibits an explosive growth. VR gives access to complex data within a three dimensional environment to large groups of trainees. Students can interact with the objects in this immersive environment and learn more about their characteristics. Specific audio and video equipment engage two major senses namely awareness of sound and sight at once. You need just a headset and a Google Cardboard. Interactivity of VR applications permits of a more impressive education experience. In addition, VR is location independent and universities have started to implement it into their global classroom curriculum. Despite that books remain a significant part of integral educational process. Organizations are also investing in cognitive learning products especially for children and people with special needs.

Augmented Reality (AR) enriches the existing content via interesting overlays of graphics and images that can pop out and draws learners' attention. In this way, learners can concentrate on the content better. AR appears to be very useful for natural sciences because it facilitates the comprehension about size, ratio, temporal relationships, etc. among objects. Recently there is a trend to combine VR and AR – the so-called Mixed Reality – to achieve great effect in the educational process.

## 2. Artificial Intelligence

It is believed that the achievements in the field of artificial intelligence (AI) will change largely the ways of learning, teaching tools and access to knowledge. First AI can facilitate grading that, in the case of large courses, requires a significant amount of time. Certainly human grading activities could not be fully automated; however, plenty of test elements such as multiple choice or fill-in the-blanks can be easily checked. This will permit trainers to concentrate more on in-class activities and communications with students.

AI helps adapt educational software to individual student's needs. Adaptive learning systems generally help students work at their own pace, whatever that may be and concentrate on topics that trainees have not mastered. Custom-tailored education could be a machine-assisted solution to helping students at different levels work together in one classroom, with teachers facilitating the learning and offering help and support when needed. Moreover it appears possible to develop AI tutoring systems that act as a tutor and help to the students when needed.

AI changes the role of teachers towards facilitators, i.e. persons who provide human interaction and hands-on experiences for students when they

need to find out information or ask questions. The use of AI in today's classrooms really transforms the quality of education.

By applying AI techniques learning content could be improved. Instructors may not always be aware of gaps in their lectures and educational materials that can leave students confused about certain concepts. For example when a large number of learners make the same type of mistakes they can receive some suggestions to the correct solution. Coursera, a massive open online course provider, implements this practice.

### 3. Gamification and Game-Based Learning

Gamification is defined [6], as the use of game design elements in non-game context and it is a new and rapidly growing field. According to Gartner, gamification, combined with other technologies, will have a significant impact on the globalization of higher education. Despite the considerable efforts made by the trainers, problems with students' motivation and engagement in learning activities are observed [7]. The use of educational games such as learning tools appears to be promising because skills as problem solving, collaboration, and communication can be reinforced. Creatively engaging students in learning is one of the smartest means of getting their attention for a longer time.

The development of institutional games is a difficult, expensive and a time-consuming activity [8]. An appropriate pedagogical integration and technical infrastructure is also required to adopt games effectively in the classrooms.

### 4. Microlearning via Wearable Devices

Microlearning [9] is an innovative learning approach where learning content forming one lesson is delivered to trainees in small portions via specialized platforms e.g. Talent Cards. The main characteristics of a microlearning course are:

- the focus on a specific concept, skill, idea, or topic;
- short in duration no more than 20 minutes
- a variety of content such as presentations, infographics, video, audio, and even interactive games;
- mobile.

Investigations show that learners achieve better information retention as learning in small portions conforms to the brain's working memory activity. Students also benefit as they get through the modules quickly and can repeat the learning many times as well.

Microlearning can be used during all stages of the learning cycle but it is especially useful in cases where repetition and memorization are involved. As approach, it seems to be very helpful when introducing basic concepts in a subject like mathematics, science, and engineering. Learning through small teaching units permits the trainees to engage with the material instead of feeling

confused. Microlearning is one of the most effective approaches to learning languages. By using audio, video and other types of microlearning content, learners can practice a new language and repeat the same material as many times as necessary.

#### 5. Innovative e-resources

Modern training is related to the vast array of educational resources available online. These include digital textbooks, paintings, music, 3D models of different artifacts, etc. The selection of a proper set of teaching materials is very important. Today's technology allows for a refined examination of the content to be useful and to conform to the learning objectives. In addition, it is expected that resources can be used on different kind of hardware ranging from computers to mobile devices.

Videos play an integral part in disseminating information and they are decisively used in training. Investigations show that video-based learning is preferred and video represents a primary channel for learning delivery. The focus is on decreasing the load time and the size of videos using various tools. Video needs to be very short and engaging following principles of microlearning. Most learners will not watch videos longer than a few minutes. Videos also are to be interactive and available on different devices. Educational video comes in many different forms e.g. simulations, animations, lecture recording, presentations, etc. Today, YouTube is the default source of videos for many teachers.

#### 6. Deep analysis of learning data

Learning Analytics is defined as “the selection, capture and processing of data that will be helpful for students and instructors at the course or individual level.” [10]. It concerns collection, analysis and reporting of data about learners in order to understand learning outcomes and to improve the educational environment. Learning analytics is important because it:

- facilitates institutional decisions;
- enables students to change their behavior so as to positively affects their learning;
- influences students' outcomes;
- supports faculty teaching and pedagogy.

The state of learning analytics adoption is summarized in [11]. Learning analytics can improve learning practice by transforming the ways we support learning processes. It allows programs refinement and adaptation based on results.

#### 7. Blockchain technology

Widespread adoption of electronic grade records needs to be a secure, trusted and efficient solution to the problem of being unable to share data

among students, schools, universities and authorities. All this have to be done with respect to personal privacy.

A possible solution to these (and many other) issues [12] is the implementation of a students controlled, blockchain-based system for grading record maintenance and sharing.

To implement a blockchain-based grading record system, all record keeping systems would encrypt and send a transaction containing students' data – exams taken, grades, etc. – into the public grading blockchain. The transaction would include a digital signature from the contributor to trace provenance and the students' blockchain ID as the recipient of the transaction.

After the documents are stored in the blockchain, students would use a web-based or mobile application to view their blockchain contents and to grant or revoke access to specific parties.

This type of system has a number of advantages over current methods of record keeping.

- students become part of the platform, they own and control access to their grading data;
- because data is stored on a decentralized network, there is no single institution that can be robbed or hacked to obtain a large number of students' records;
- data is encrypted in the blockchain and can only be decrypted with the students' private key;
- the infrastructure itself provides auditing and non-repudiation capabilities.

A blockchain-based method of storing grading data includes all the expected criteria of a grading record keeping system, and it goes beyond what a traditional, centralized system can do because it improves students' access to their records and strengthens security against data breaches.

Bundled in the learning process, blockchain technology can track progress in training and be the basis for a personalized education.

## **Innovations in the learning process at NBU**

Basis for the application of innovative methods in education at our university is the implemented learning management system Moodle NBU. It provides instructors with resources to create and deliver content, to monitor students' participation, and to assess students' performance. The platform offers content curation as an important method of sharing information, and provides the right experience to the learners. It represents an easy-to-navigate environment with a simple design where learners can use their own tools and have the ability to deliver their course work. Meanwhile Moodle is far more intuitive and permits good housekeeping when the course tends

to become disordered. Moodle's single page unit based structure facilitates a modular design that permits to improve the overall functionality by adding new components. It handles interactive content such as videos, audio, and websites. Moodle has an assortment of plugins that can assure additional functionality. We work in order to support students and frequently see the use of Moodle. Students are able to login to the portal, find assignments, and from there plan and manage their time. The system allows for a clear communication of information and an open dialogue with the student.

At NBU several new developments in e learning can be pointed out:

### 1. Virtual Classrooms

Distant students benefit from the use of virtual classrooms. They represent online spaces designed for learning and usually are part of a learning management system. Virtual classrooms facilitate live teaching by providing live video and audio streaming capabilities, an interactive whiteboard set-up, file repositories for sharing additional resources and text chat options.

Within Moodle NBU real-time on-line classrooms are created using BigBlueButton, an open source web conferencing system for distance education. BigBlueButton supports real-time sharing of slides (PDF and any document readable by OpenOffice), webcams, whiteboard, chat, voice over IP (using FreeSWITCH), and presenter's desktop. It can record and playback sessions (slides, audio, and chat), runs on Mac, Unix, and PC clients. Sessions can be recorded and stored for further usage.

For face-to-face education at NBU virtual classrooms support collaborative work on the same project. In this way, active students' participation in the learning process is stimulated.

### 2. Video content

NBU fits in with the tendency to use video in the educational process. There are visual learners who better understand and retain information when ideas, words and concepts are associated with images and videos. A typical video consists of moving images, sound, and text. Video content engages students because learning is performed through two or more senses. The platform Moodle NBU assists lecturers to add videos of lectures and consultations with students. All of these supports students' self-training. In addition, they can give links to publicly available video lessons. Thus, videos with engaging content created by industry professionals become available.

### 3. Use of AI techniques in foreign language education.

An experimental pilot training with use of AI achievements is offered in English language education for distance learning students. Chatbots are computer programs built of the latest technology that simulate real conversations and interact like humans. Language learning chatbots help NBU

students to achieve the language conversation practice or to brush up on their linguistic skills. In addition, they can activate different voices through which to discover the differences in pronunciation between people of various nationalities.

#### 4. Game-based testing

The platform NBU Moodle mostly offers opportunities to test students' knowledge and competence via online testing. Although setting up the question bank is a time consuming activity the possibility to give any student individual test for self-assessment or evaluation is appealing. Online exams permit more scheduling flexibility for both students and faculty, test elements can be reused and students' exams are automatically graded.

Online testing facilitates the generation of primitive game situations. Game-based assessments are gathering significant advantages as next generation psychometric measures.

#### 5. Learning data

There are several ways to track student progress in Moodle. A number of Course reports are available to the teachers in their course to help them track the progress of their students.

Moodle also implements open source, transparent learning analytics based on machine learning techniques. These analytics go beyond simple descriptive analytics to provide predictions of learner success, and ultimate diagnosis and prescriptions to learners and lecturers. Two critical situations can be monitored:

- students at risk of dropping out
- no teaching activity.

The definition of "dropping out" is "no student activity in the last quarter of the course."

This model predicts students who are at risk of non-completion (dropping out) of a Moodle course, based on low student engagement.

## Conclusion

In this paper, we discuss innovative trends in educational technology. We briefly describe the institutional framework namely the Moodle NBU platform that aids the visible transformation in teaching and learning at our university. We concentrate on some innovative practices being applied in the adopted delivery models of program courses. We share our experience in the use of virtual class rooms, chatbots and video-enabled content.

Further developments in e-learning include microlearning. Some investments will be made to build a VR environment.

## References

1. Cornali, F. (2012). Effectiveness and efficiency of educational measures. Evaluation Practices, Indicators and Rhetoric. Vol. 2 No. 3, pp. 255-260, available at: [www.SciRP.org/journal/sm](http://www.SciRP.org/journal/sm), accessed on April 10, 2019.
2. Vieluf, S., Kaplan, D., Klieme, E., Bayer, S. (2012). Teaching Practices and Pedagogical Innovation: Evidence from TALIS. OECD Publishing, Paris, available at: [www.oecd.org/edu/school/TalisCeri%202012%20\(tppi\)-Ebook.pdf](http://www.oecd.org/edu/school/TalisCeri%202012%20(tppi)-Ebook.pdf), accessed on April 11, 2019.
3. Brewer D., Tierney, W. (2012). Barriers to innovation in the US education. In Wildavsky, B., Kelly, A. and Carey, K. (Eds), Reinventing Higher Education: The Promise of Innovation, Harvard Education Press, Cambridge, MA, pp. 11-40.
4. Serdyukov P. (2017). Innovation in education: what works, what doesn't, and what to do about it? Journal of Research in Innovative Teaching & Learning, Vol. 10 Issue: 1, pp.4-33, <https://doi.org/10.1108/JRIT-10-2016-0007>, accessed on April 7, 2019.
5. John Bay. (2018). Virtual Reality Market Size. Market Research Engine. <https://www.marketresearchengine.com/>, accessed on April 1, 2019.
6. Deterding S. et al. (2011). From Game Design Elements to Gamefulness: Defining "Gamification". In A. Lugmayr et al. (Ed.), MindTrek, Tampere, Finland: ACM, pp. 9-15.
7. Lee J., Hammer, J. (2011). Gamification in Education: What, How, Why Bother? Academic Exchange Quarterly, 15(2), 146.
8. Kapp K. (2012). Games, Gamification, and the Quest for Learner Engagement. T and D magazine, 66(6), 64–68.
9. Kasenberg T. (2018) Just One Thing – Microlearning, a Practitioner's Guide. Raptivity available at <https://www.raptivity.com/microlearning-ebook.html>, accessed on April 13, 2019.
10. Elias T. (2011). Learning Analytics: The Definitions, the Processes, and the Potential. <http://learninganalytics.net/LearningAnalyticsDefinitionsProcessesPotential.pdf>
11. Tsai Y., Gasevic D. (2017). Learning Analytics in Higher Education –Challenges and Policies: A Review of Eight Learning Analytics Policies. In proceedings of Seventh International Learning Analytics & Knowledge Conference Canada. ACM. ISBN 978–1-4503-4870-6, DOI:10.1145/3027385.3027400.
12. Grech A., Camilleri A. (2017). Blockchain in Education. Joint Research Centre Policy Report. Inamorato dos Santos, A. (ed.) EUR 28778 EN, ISBN 978-92-79-73497-7, ISSN 1831-9424, doi:10.2760/60649.

## ИНОВАТИВНИ ПРАКТИКИ В ОБРАЗОВАТЕЛНИТЕ ТЕХНОЛОГИИ

Юлиана Пенева, Венцислав Джамбазов, Делян Керемедчиев

**Резюме:** За да получат конкурентно предимство, университетите трябва непрекъснато да подобряват подготовката, която предлагат на своите обучаеми, и да обновяват предлаганите от тях образователни продукти. В тази статия се обсъждат иновациите в образователните технологии и тяхното влияние с оглед изграждането на силно свързана, интерактивна и ангажираща среда в класната

*стая. Дискутират се предприетите от Нов български университет инициативи за модернизиране на учебния процес и насърчаване на нововъведенията. Представени са образователните иновации в университета, където електронното обучение подпомага различните форми на обучение: редовна, дистанционна и хибридна.*