Chemical Technology, Control and Management

Volume 2023 | Issue 1 Article 13

2-28-2023

SYNCHRONIZATION OF THE TRAINING OF SPECIALISTS IN THE AUTOMATION OF TECHNOLOGICAL PROCESSES IN ACCORDANCE WITH THE DYNAMICS OF THE TAXONOMY OF LEARNING GOALS

Yusuf Shodievich Avazov
Tashkent State Technical University named after Islam Karimov, Address: 100095, Universitet st. 2, Tashkent city, Republic of Uzbekistan.

Kamola Abdullaeva
Tashkent State Technical University named after Islam Karimov, Address: 100095, Universitet st. 2, Tashkent city, Republic of Uzbekistan. E-mail: dinara_nandi@mail.ru., dinara_nandi@mail.ru

Recommended Citation
Avazov, Yusuf Shodievich and Abdullaeva, Kamola (2023) "SYNCHRONIZATION OF THE TRAINING OF SPECIALISTS IN THE AUTOMATION OF TECHNOLOGICAL PROCESSES IN ACCORDANCE WITH THE DYNAMICS OF THE TAXONOMY OF LEARNING GOALS," *Chemical Technology, Control and Management*: Vol. 2023: Iss. 1, Article 13.
DOI: https://doi.org/10.59048/2181-1105.1444

ISSN 1815-4840, E-ISSN 2181-1105
Himičeskaâ tehnologiâ. Kontrolʹ i upravlenie
CHEMICAL TECHNOLOGY.
CONTROL AND MANAGEMENT
2023, №1 (109) pp.94-99.
International scientific and technical journal
journal homepage: https://ijctcm.researchcommons.org/journal/
Since 2005
Article history: Received 13 January 2023; Received in revised form 27 February 2023; Accepted 28 February 2023; Available online 23 March 2023

SYNCHRONIZATION OF THE TRAINING OF SPECIALISTS IN THE AUTOMATION OF TECHNOLOGICAL PROCESSES IN ACCORDANCE WITH THE DYNAMICS OF THE TAXONOMY OF LEARNING GOALS

Yusuf Shodievich Avazov [1], Kamola Rustamovna Abdullaeva[2]

[1,2]Tashkent State Technical University named after Islam Karimov,
Address: 100095, Universitet st. 2, Tashkent city, Republic of Uzbekistan.
E-mail: dinara_nandi@mail.ru.

Abstract: *Changes in the characteristics of modern ones, reflecting them as the "digital generation", inevitably necessitate electronic interactive, mobile and mixed, machine learning, especially in the field of automation and control of technological processes and production. As a consequence of reflecting these realities, there have been parallel changes in the taxonomy of learning objectives - from the classical to the revised rethought and digital.*

In order to study the problem of synchronizing the training of future specialists in the field of automation and control of technological processes and production and funny knowledge in accordance with the dynamics of the taxonomy of learning objectives, we recommend using the following methods: clarifying the concepts of "blended learning", "e-learning", "mobile learning" and " electronic learning object"; considered, the characteristics of the digital generation; traces the evolution of the taxonomy of learning objectives; clarifies the levels of interactivity that are achieved when creating electronic learning objects for the implementation of blended learning; offers digital tools and original tools that learners master to create e-learning objects for higher cognitive levels of Bloom's digital taxonomy - assessment and creation.

The article notes the advantages of mastering the tools for creating electronic learning objects with varying degrees of interactivity and the corresponding models for their inclusion in training units of process automation in the implementation of blended learning.

Keywords: *machine learning, taxonomy of learning objectives, Bloom's digital taxonomy, assessment and creation of digital tools and blended learning.*

Аннотация: *“Рақамли авлод” каби ўзида замонавий тавсифлар ўзгаришларида электрон интерфаол, мобил ва аралаш турдаги машинали ўқитишга, айниқса технологик жараёнлар ва ишлаб чиқаришларни автоматлаштириш ва бошқариш соҳасига бўлган заруратни белгилаб беради. Бундай реалликларни акс эттириш натижасида классикдан қайта кўриб чиқилаётган ва рақамли технологияларгача бўлган ўқитиш мақсадлари таксономиясидаги параллел ўзгаришларни юзага келтирди.*

Технологик жараёнлар ва ишлаб чиқаришни автоматлаштириш ва бошқариш соҳаси ва унга турдош билимлар бўйича мутахассисларни тайёрлашни ўқитиш мақсадлари таксономияси динамикасига мувофиқ синхронлаштириш муаммоларини ўрганиш мақсадида қуйидаги усуллардан фойдаланишни таклиф этамиз: “аралаш ўқитиш”, “электрон ўқитиш” ва “ўқитишнинг электрон объекти” каби тушунчаларни аниқлаштириш; рақамли авлод тавсифларини кўриб чиқиш; ўқитиш мақсадлари таксономияси тадрижини кузатиш; аралаш ўқитишни амалга ошириш учун ўқитишнинг электрон объектларини яратишда эришиладиган интерфаоллик савиясини аниқлаштириш; Блумнинг рақамли таксономиясини юқори когнитив сатҳлари – баҳолаш ва англаш учун электрон ўқув объектларини яратишда ўқувчилар ўзлаштирадиган рақамли ва оригинал воситаларни таклиф этиш.

Ишда турли интерфаоллик даражалари ва мос моделлар билан ўқитишнинг электрон объектларини яратиш воситаларини ўзлаштиришнинг афзалликлари кўрсатилган ҳамда уларни аралаш ўқитишни амалга оширишда технологик жараёнларни автоматлаштиришнинг ўқув бирлигига киритиш кўриб чиқилган.

Таянч сўзлар*: машинали ўқитиш, ўқув мақсадлари таксономияси, Блумнинг рақамли таксономияси, рақамли воситаларни баҳолаш ва яратиш, аралаш ўқитиш.*

Аннотация: *Изменения в характеристиках современных, отражающих их как «цифровое поколение», неизбежно обусловливают необходимость в электронном интерактивном, мобильном и смешанном, машинном обучении, особенно в сфере автоматизации и управления технологическими процессами и производствами. Как* *следствие отражения этих реалий возникли параллельные изменения в таксономии целей обучения - от классической к пересмотренной переосмысленной и цифровой.*

С целью изучения проблемы синхронизации подготовки будущих специалистов в области автоматизации и управления технологическими процессами и производствами и смежных знании в соответствии с динамикой таксономии целей обучения рекомендуем использовать следующие методы: уточнения понятия «смешанное обучение», «электронное обучение», «мобильное обучение» и «электронный объект обучения»; рассматриваются, характеристики цифрового поколения; прослеживается эволюция таксономии целей обучения; уточняются уровни интерактивности, которые достигаются при создании электронных объектов обучения для реализации смешанного обучения; предлагаются цифровые инструменты и оригинальные инструменты, которые обучаемые осваивают для создания электронных учебных объектов для более высоких когнитивных уровней цифровой таксономии Блума - оценка и создание.

В работе отмечаются преимущества освоения инструментария создания электронных объектов обучения с разной степенью интерактивности и соответствующих моделей для их включения в учебные единицы автоматизации технологических процессов при реализации смешанного обучения.

***Ключевые слова**: машинное обучения, таксономия целей обучения, цифровая таксономия Блума, оценка и создание цифровых инструментов и смешенного обучения.*

Introduction

The development of information technology in the early years of the new millennium gave rise to new ways of processing and disseminating information. The introduction of information and communication technologies in education represents the largest and most significant change in the dominant educational paradigm in recent decades. These realities have changed the way young people perceive and process information, naturally led to a revolution in educational standards and to the emergence of revised digital taxonomies. In response to the new challenges of the time, modern time pedagogical psychology, including private didactics, led to the search for the most rational ways to improve pedagogy, teaching and learning in full compliance and harmony with the formed modern characteristics of students.

The training of modern highly qualified specialists in the field of automation and process control is an extremely responsible and multidisciplinary problem that requires future specialists with higher education to use modern information technologies that provide digital competence required by national and international standards; knowledge of the current and prospective characteristics of today's youth; mastering software tools for creating electronic learning objects in order to be able to create effective blended learning in accordance with generally accepted ergonomic and didactic aspects of educational psychology; apply digital teaching methods in special disciplines of industrial process automation.

The article [1] shows the effectiveness of using computer simulators for training process control operators in order to increase the efficiency of automation and process control, as well as reduce accidents in production. The role of simulation modeling in the control of the operation of various devices of technological processes and its significance for operators are described. Statistics of the damage that production may suffer due to operator errors are given. The article reveals the importance of preparing operators for various situations. In article [2] highlight important aspects of using machine learning to avoid errors in automation. It is based on the possibility of reducing systematic errors through the use of artificial intelligence methods.

The work [3] shows that training of operators on a computerized simulator is effective, but simple simulators cannot adequately present the scenario of technological events to operators without using dynamic simulation. Also, as a solution to this problem, it is necessary to add an element of "virtual reality" to the simulator. From the perspective of the chemical industry, VR simulations are believed to lead to increased productivity, reduced environmental impact, and increased safety. The article [4] proposed a method for teaching students how to operate automation systems by virtual introduction of new elements in cyber-physical laboratories. In such situations, attention is focused on eliminating the problem of direct intervention in production systems along with economic savings. The effectiveness of cyber-physical systems in teaching students about automation and control systems is described. In the article [5], taking the process of coal combustion in a furnace as a technological process, and modeling the processes of mass and heat transfer in it, the issue of training using simulation modeling is highlighted. Based on the methodology developed in the article, a dynamic computer simulator of steam boiler burners is proposed. It is based on the fact that operators will have the opportunity to fully explore the capabilities of auxiliary equipment using this simulator.

The issues of organizing online learning using automation tools, taking into account the human factor, are covered in [6]. The cases of human intervention and the development of individual tasks in online education are analyzed. Online training organized by adding a person to the automation system in online training is proposed for the railway system. In the article [7], the authors evaluated the effectiveness of computer simulators for students studying cardiac surgery. The article emphasizes that students reading on a simulator rarely encounter errors that a traditional reader might miss. Similarly, in the article [8], the authors described ten characteristics of the use of simulators in training. The decision-making procedure in the simulators is shown by the description of the model. Demonstrated the use of dynamic simulation to implement situational training in the Swedish armed forces using simulation training.

Despite the progress shown in the cited literature, none of them disclose the importance of taxonomies in the use of trainers and simulators. Pedagogical research approaches that combine methods of advanced pedagogical and digital technologies with simulators were not considered.

In order to synchronize the training of future automation specialists in accordance with the dynamics of the taxonomy of learning objectives, it is necessary: future specialists to use modern information and digital technologies, so that the necessary digital literacy and competence are provided in full and harmonious accordance with state standards; knowledge of the current and prospective characteristics of today's youth; software tools for creating electronic learning objects were mastered in order to provide the ability to create effective blended learning in accordance with generally accepted ergonomic and didactic aspects of educational psychology.

Blended learning

Blended learning is known to be a proven form of training, which is implemented by supporting traditional learning with electronic and mobile ones.

E-learning is a procedural and functional unity of learning and training activities through various electronic media and multimedia technologies. This learning is done through electronic educational resources, which can be text files, video demonstrations, simulations, assessment tests, or educational games. Blended learning takes place both in formal education at school, university, as well as outside educational institutions.

The development of computer technology and communication technologies, the emergence of mobile devices such as tablets, phablets and smartphones, have given rise to a new trend - BYOD (Bring your own devise). In their free time, modern students study, travel or have fun, constantly having their mobile devices with them. They rationally use them both for communication (including through social networks), and for the constant search for new information, games or data exchange.

Some authors define mobile learning as a natural successor to e-learning. However, mobile learning has its own terminology. For example, the concepts of multimedia, interactivity, hyperlinks, multimedia environment, etc. are included in the terminology of e-learning, and such terms as spontaneous, personal, quick search and finding, related, non-formal learning are included in the terminology of mobile learning [9].

E-learning and mobile learning require the development of appropriate learning environments, most often multimedia. According to Nokelainen, “a multimedia learning environment is an application made up of electronic didactic materials. Electronic didactic materials are created for educational purposes, published in digital form and accessible to a computer”, and the learning object is “the smallest meaningful unit of electronic didactic material” [10, 11]. A learning object is "any thing (entity), digital or non-digital, that can be used, reused, or referenced in a technology-supported learning process".

E-learning objects are suitable for stand-alone use, face-to-face learning, embedding in e-learning environments, and learning via mobile devices. Their widespread use meets the needs of the digital generation.

Characteristics of the digital generation

Current students are defined as the "digital generation" who like to get information quickly, prefer parallel processes and multitasking, prefer to receive graphic and multimedia information instead of text, work best on the network, expect immediate results and rewards.

The new generation of young people is defined as the “millennial generation”. They “want it all” and “want it now”, seek to take advantage of the present, strive for rapid career growth, work-life balance, job satisfaction, and social recognition. The new generation is team-oriented, not only a consumer of Internet content, but also engaged in the creation of content - from photos and videos to web pages and blogs.

This new generation is now entering higher education institutions. It must be educated in the expected way, on the one hand, and on the other hand, it must be prepared to educate the next generation of youth, according to its inherent characteristics. To succeed in this task, higher education institutions must provide training that prepares future automation professionals to master digital tools.

Taxonomies of learning objectives

In 1956, Benjamin Bloom proposed a cognitive taxonomy of learning objectives at six hierarchically represented cognitive levels, from lowest to highest: knowledge, understanding, application, analysis, synthesis, and evaluation [12]. Each of these cognitive levels can be represented by specific actions aimed at achieving certain learning goals. The taxonomy is hierarchical as each level is seen as a prerequisite for the next.

A revised version of Bloom's taxonomy was developed in the same way as the original, but with a number of significant changes. Although the original number of cognitive levels (six) remains the same, two of them have been renamed, two have been rearranged, and the level names have been changed to their verbal forms to match how they are used for educational purposes. The cognitive levels in the revised taxonomy include analysis, evaluation, memorization, understanding, application, and creation.

The idea of Bloom's digital taxonomy belongs to Andrew Churches, who does not rethink the content of the transformed taxonomy, but only significantly expands it by significantly supplementing the list of verbs - terms that are determined by the use of Web 2.0 technologies for each cognitive level of the hierarchy. Thus, in relation to the higher cognitive levels of the hierarchy of evaluation and creativity, new actions (verbs) were added.

Added for level assessment:

- blog / vlog, commenting and reflecting - commenting and reflecting other people's comments in blogs;
- publishing - posting your own comments on blogs and participating in discussions;
- moderation - performs the functions of a moderator (gives a reasoned assessment of publications from different points of view);
- collaboration and networking – collaboration and networking with other actors;
- testing – testing (of applications, processes and procedures);
- validation - verification of reliability (reliability of information sources).

Added for creation level:

- programming - developing your own applications - educational or gaming in a structured environment;
- filming, animation, videocasting, podcasting, mixing and remixing. Filming, animation, video casting, podcasting, mixing and remixing reflect the growing trend of using multimedia editing and editing tools;

• directing and producing (understands and integrates the components into a complete product);

• publication - publication (via the Internet author's multimedia products created by digital means).

Interest in higher cognitive levels of assessment and creativity from digital taxonomy is dictated by the fact that it is with them that it is possible to use electronic learning objects in a constructivist approach that can offer students a high degree of interactivity as an attractive component of e-learning and mobile learning.

Degrees of interactivity in e-learning

Interactivity enables teaching and learning processes to be managed as needed with a full degree of automation. The term "interactivity" came from the English language and means "interaction". If in traditional learning there is interaction between the student and the teacher, then in the context of e-learning, the wording undergoes modification, since the interaction is carried out not only in the direction of "person-to-person", but also in the direction of "person-to-person". "human" - "computer" and "human" directions "human" - "computer" - "human". The use of e-learning objects provides opportunities for these interactions. In the theory of e-learning, four levels of interactivity in the relationship "human" - "computer" are regulated:

- the first level - low interactivity: the user has little or no control over the interaction with the learning content. The interactivity of this level is primarily associated with the ability to move the user back and forth through the learning content;
- second level - moderate interactivity: includes the first level, but gives more control over the learning content. May include sound support for the presentation of educational content. In terms of navigation, back and forth, menus, branches, content map and glossaries are used;
- third level - medium interactivity: includes interaction with more complex information and allows you to increase the level of control. Operations may be illustrated with graphics, video, animation, or a combination of these. Modeling is part of the presentation of learning content. In addition, a quick response to user actions is obtained, which ensures the memorization of educational material;
- fourth level - high interactivity: includes a detailed presentation of educational information and allows you to fully control the content of training. Most tasks are demonstrated with full interaction and simulation. It includes all the interaction elements described in levels 1-3, as well as advanced branching options with multi-level menus, complex animations and videos.

A variety of digital tools and copyright tools allows you to create educational objects with different levels of interactivity necessary for their inclusion in the training blocks of automation of technological processes and production.

Conclusion

Learning objects can be used independently of each other or embedded within each other. For example, video files created with Adobe Captivate are voiced with audio files and supplemented with text files. Or, practice and assessment models created with Adobe Captivate are embedded as objects in a multimedia application created with Toolbook. This is how digital mixing and remixing activities are also carried out in practice.

Learning objects are used in the lessons of automation of technological processes with which blended learning takes place. Their inclusion in educational units depends on the current didactic task. For example, in the introductory part of the lesson blocks, at the stage of updating knowledge, infographics, tests and presentations can be used. At the exposition stage, new educational content - infographics and presentations. At the stage of skill formation - video files and simulations. When providing feedback and debriefing - mobile phone tests or electronic tests. The approach to the use of different learning objects depends on the specific topic and the creative views of the teacher.

Preparing appropriate learning objects is a lengthy process that requires great skill and effort. The result of their application is an attractive and effective blended learning process automation that meets the characteristics of digital learners.

References

1. Dozortsev, V.M., Agafonov, D.V., Nazin, V.A. et al. (2020). Computerized Operator Training: Continued Importance, New Opportunities, and the Human Factor. *Autom Remote Control*, 81, 935-954. https://doi.org/10.1134/S0005117920050124.
2. Varona, D., Lizama-Mue, Y., Suárez, J.L. (2021). Machine learning's limitations in avoiding automation of bias. *AI & Soc*, 36, 197-203. https://doi.org/10.1007/s00146-020-00996-y.
3. Patle, D.S., Manca, D., Nazir, S. et al. (2019). Operator training simulators in virtual reality environment for process operators: a review. *Virtual Reality*, 23, 293-311. https://doi.org/10.1007/s10055-018-0354-3.
4. Macías García, M.E., Cortés Pérez, A.A., Izaguirre Alegría, A.R. (2020). Cyber-Physical Labs to enhance engineering training and education. *Int J Interact Des Manuf*, 14, 1253-1269. https://doi.org/10.1007/s12008-020-00704-6.
5. Boyko, E.A., Pachkovsky, S.V., Volnev, V.N. et al. (2022). A Dynamic Training Simulator for Perfecting the Processes in Steam Boiler Furnace Devices. *Therm. Eng.*, 69, 302-312. https://doi.org/10.1134/S0040601522040012.
6. Vanderhaegen, F. (2021). Pedagogical learning supports based on human–systems inclusion applied to rail flow control. *Cogn Tech Work*, 23, 193-202. https://doi.org/10.1007/s10111-019-00602-2.
7. EL-Andari, R., Bozso, S.J., Kang, J.J.H. et al. (2021). Review of the use of simulators in learning revascularization techniques. *Gen Thorac Cardiovasc Surg*, 69, 415-424. https://doi.org/10.1007/s11748-020-01577-y.
8. Aronsson, S., Artman, H., Brynielsson, J. et al. (2021). Design of simulator training: a comparative study of Swedish dynamic decision-making training facilities. *Cogn Tech Work*, 23, 117-130. https://doi.org/10.1007/s10111-019-00605-z.
9. Gumbheer, C.P., Khedo, K.K. & Bungaleea, A. (2022). Personalized and Adaptive Context-Aware Mobile Learning: Review, challenges and future directions. *Educ Inf Technol*, 27, 7491-7517. https://doi.org/10.1007/s10639-022-10942-8.
10. Olsher, S., Cooper, J. (2021). Aspects of the teacher-textbook relationship: What can we learn about teachers when they tag didactic metadata?. *ZDM Mathematics Education*, 53, 1347-1358. https://doi.org/10.1007/s11858-021-01251-4.
11. Capone, R., Lepore, M. From Distance Learning to Integrated Digital Learning: A Fuzzy Cognitive Analysis Focused on Engagement, Motivation, and Participation During COVID-19 Pandemic. *Tech Know Learn*, 27, 1259-1289 (2022). https://doi.org/10.1007/s10758-021-09571-w.
12. Stringer, J.K., Santen, S.A., Lee, E. et al. (2021). Examining Bloom's Taxonomy in Multiple Choice Questions: Students' Approach to Questions. *Med.Sci.Educ.*, 31, 1311-1317. https://doi.org/10.1007/s40670-021-01305-y.