Educational digital tools for university level under climate change and COVID-19

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Abstract. Paper considers educational digital tools development results for university level within geo-information management paradigm during Industry 4.0 era under climate change and COVID-19. While research, authors used modern web-technologies for educational platforms design. Recently, the ways of geo-information support for environmental economics have distinct features of digitalization with new concepts in data obtaining and presenting. In paper, preference is given to the use of open online platforms, which integrate heterogeneous hardware and software resources with the use of web-technologies in distributed networks and wide application of cloud services. There are considered examples of presented digital tools using. The presented research results have significant scientific novelty can be used in training and educational purposes at university level, including the preparation of Master's programs.

1. Introduction

In recent years, there has been an urgent need to ensure the search for new technologies for the educational activities of university students. This is due to new trends in education, the widespread use of digital and information technologies, as well as the pandemic that came in 2020, which, objectively, required the transition of education to a distance format. It is quite difficult for technical and engineering universities to ensure the transition to distance and digital technologies, since their programs include subjects that cannot be studied using digital technologies, such as, for example, physics, electrical engineering, chemistry, electric power, electrical machines and other technical disciplines, that require setting up experiments and various experiments for the successful mastering of the discipline. At the same time, subjects that are studied using information technology have successfully switched to distance learning, among them subjects of a technical orientation that study the ecological system through the prism of geo-information and digital tools.

Recently, development of educational digital tools (EDT) for university level have to be made on Industry 4.0 principles under climate change and COVID-19 with taking into account information technologies, which are realized within geo-information management (GIM) for global environmental economics (GEE) tasks [1]. Because of COVID-19 pandemic, serious information technological changes in university education would be implemented with attention to reducing total cost of learning process [2-3]. Note, that Industry 4.0 leads to digital transformation in geo-information support systems (GISS) and managerial support systems (MSS) for GEE, including geo-ecological support systems (GESS) [4] and natural risk management (NRM) [5]. Within GEE, special attention has to be
paid to environmental safety (ES) [6-7] and compensation measures (CM) [8-10]. All of the above should be taken into account when developing a new EDT for the university level [11-12].

Within the framework of the existing paradigms of teaching students of technical specialties, we believe it is necessary to form an educational system for teaching students of environmental specialties, which would include the existing trends in education - this is the use of information and digital technologies, distance learning and training in conditions of unforeseen changes in the external environment, to which it is possible include epidemics, emergencies, disasters, etc.

2. Methods and Data
The purpose of this study is to form a digital educational system for teaching students of technical specialties. To achieve this goal, the study set the following tasks:

- To analyze the experience of using educational technologies for students of technical specialties;
- To formulate recommendations for the transition of technical training to distance educational technologies.

The main base of the research was the data of open information sources, as well as methods of comparison, logic and analysis [13-16].

3. Results
Currently, EDT development for university level in the area of NRM, ES and CM under climate change and COVID-19 is important task area within GEE, because traditional university education has significant difficulties due to COVID-19. We claim, that new EDT have to be implemented in traditional university education with attention to reducing total cost of learning process. As result for this tusk, we propose to use open educational digital platforms (OEDPs), for example, Google Classroom, because of its main advantages like ease of use, universal access, flexible feedback system and its free of charge.

In research, we paid essential attention to university education in Earth sciences, where climate change and COVID-19 have especial importance. As main result for digital learning content development, we propose to use aggregative EDT on basement of Google Sites environment with using of GIDOPs OSCAR [15] and Ocean-OPS [16], as modules, which give open access to huge volumes of meteorological and oceanographic data for usage in university practical works while COVID-19.

In figures 1 and 2, we present examples of educational digital online platform (EDOP) “Climate Change - RSHU” using, while practical learning operations in Russian State Hydrometeorological University. In figure 1, we show hydrometeorological stations positions visualisation within EDOP “Climate Change - RSHU” by GIDOPs OSCAR.

In research, special attention was paid to the databases creation for Argo floats in the Arctic Ocean. These databases are used online by students when performing practical work on the study of climate change in the Arctic. In figure 2, we present visualisation of Argo float #6902729 metadata within EDOP “Climate Change - RSHU” by GIDOP Ocean-OPS.

Thus, during practical learning students can train online with EDOP “Climate Change - RSHU”, using data bases and tools of GIDOPs OSCAR [15] and Ocean-OPS [16]. Note, decoding of figures 1 and 2 and discussion of data using for NRM, ES and CM s is not task of this article.

The analysis showed that the experience of the Russian State Hydrometeorological University may indicate that the use of digital technologies in educational activities allows students of technical specialties to gain additional competencies and knowledge in their professional field, which allows the student to analyze the environment in the prism of several dependencies and with taking into account the information flow coming from different sources.
4. Discussion

It is obvious that with the help of proposed in the article EDT for university level in the area of NRM, ES and CM within GEE under climate change and COVID-19, students get access to a huge amount of complex data and learn to work with such data in solving practical problems in various areas of geo-information management at the global, regional and local levels. Especially useful proposed EDT will be for Master’s programs in GIM for GEE. In some cases, real practical work in special GIS laboratory can be undergoes with virtual reality (VR) technologies [10-12], that can reduce total cost of learning process.

Thus, we believe that such a practice should be used to teach students of technical specialties, which will allow them to learn how to work with new digital information systems, while they can do this both independently and with the advice of a teacher.

5. Conclusion

Of course, in a period of changing conditions for the existence of the educational environment in a physical, technical and engineering university, namely, the transition to innovative and digital technologies, the introduction of distance learning into the educational process, the emergence of new external factors, requires the educational system to ensure a qualitative transition to new technologies. Information and digital technologies, which were used in educational institutions before the 2020 pandemic, are extremely rare today reaching a new level, which requires the educational organization, teachers and students to be ready for such changes. In the presented material, we analyzed the existing educational technologies that are used at the Russian State Hydrometeorological University and help improve the quality of the educational process, gain additional skills and competencies of students and have current information about climate change. The paper also proposed to use the presented experience in technical and engineering universities, which must be implemented taking into account
the existing global information systems that allow you to receive, analyze, process and store the obtained data. The research results presented in this article has significant scientific novelty and can be useful for educational organizations.

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Platform https://www.researchgate.net/profile/Valery_Abramov2/ was used while this research.

References
[1] Abate C et al 2021 J. Phys.: Conf. Ser. 1960 012009
[2] Zhichkin K A, Starikov P V, Zhichkina L N, Mamaev O A, Artemova E I and Levochkina N A 2020 The applied software role in the training of economic specialties students. Journal of Physics: Conference Series 1691 012111
[3] Burlov V G, Fokicheva A A, Sokolov A G, Abramov V M and Istomin E P 2018 The methodological basis for the strategic management of territory development. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 18 (2.2) 483
[4] Karlin L N, Lednova J A, Malakhova J A, Abramov V M, Gogoiberidze G G and Berboushi S V 2014 Variability of particulate matter in Saint-Petersburg megacity air within climatic time scale. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2(4) 599-606
[5] Khaimina O, Karlin L, Gogoiberidze G, Lednova J, Abramov V M, and Isaev A 2014 Main results of summer oceanographic surveys in the eastern Gulf of Finland in the framework of the Topcons project. International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management, SGEM 2(3) 645-652
[6] Lukyanov S V, Abramov V M, Averkiev A S, Rybalko A E, Tatarenko Yu A, Frolova N S and Shevchuk O I 2019 Innovative technologies for geoinformation management while hydraulic structures survey. Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020 712-712
[7] Eremina T, Ershova A, Martin G and Shilin M 2019 Marine litter monitoring: Review for the Gulf of Finland coast. 2018 IEEE/OES Baltic International Symposium, BALTIC 2018 8634860
[8] Kouzov S, Chusov A, Lednova J, Zhigulsky V, Shilin M and Ershova A 2017 Nature protected area as compensation action. 13th International MEDCOAST Congress on Coastal and Marine Sciences, Engineering, Management and Conservation, MEDCOAST 2017 1 257-268
[9] Lednova J, Chusov A, Shilin M and Gogoiberidze G 2019 Integrated Indicator Approach for Economic-Environmental Assessment of Coastal Local Municipalities. 2018 IEEE/OES Baltic International Symposium, BALTIC 2018 8634848
[10] Fokicheva A, Sokolov A, Abramov V, Istomin E, Goloskovskaya E and Levina A. 2019 Machine learning with digital generators for training sets including proteins modeling in the context of big data and blockchain technologies. Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020 8638-8642
[11] Popov N, Abramov V, Istomin E, Tatarnikova T, Baykov E and Zavgorodniy V 2020 Development of digital transformation technologies for university practical learning in industrial area. IOP Conference Series: Materials Science and Engineering 940(1) 012013
[12] Kolokolov Yu and Monovskaya A 2016 Guess-work and reasonings on centennial evolution of surface air temperature in Russia. Part IV: Towards economic estimations of climate-related damages from the bifurcation analysis viewpoint. Int. J. of Bifurcation and Chaos 26 1630033
[13] Gnatyuk V I, Kivchun O R and Lutsenko D V 2021 Digital platform for management of the regional power grid consumption. *IOP Conference Series: Earth and Environmental Science* 689 012022

[14] Google sites Retrieved from: https://sites.google.com/

[15] World Meteorological Organization's Retrieved from: https://oscar.wmo.int/surface/#/

[16] Ocean-OPS Retrieved from: https://www.ocean-ops.org/board