REVISTA INCLUSIONES

UNIVERSIDAD E INVESTIGACIÓN: AL SERVICIO DEL ORBE

Revista de Humanidades y Ciencias Sociales

Volumen 7 . Número Especial
Octubre / Diciembre
2020
ISSN 0719-4706

REVISTA
INCLUSIONES M.R.
REVISTA DE HUMANIDADES
Y CIENCIAS SOCIALES

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Revista Inclusiones, se encuentra indizada en:

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BIBLIOTECA UNIVERSIDAD DE CONCEPCIÓN

REVISTA INCLUSIONES M.R.
REVISTA DE HUMANIDADES Y CIENCIAS SOCIALES

CUADERNOS DE SOFÍA EDITORIAL

ISSN 0719-4706 - Volumen 7 / Número Especial / Octubre – Diciembre 2020 pp. 301-314

DIGITALIZATION OF EDUCATIONAL CONTENT IN THE CONTEXT OF DISTANCE LEARNING: THE READINESS OF STUDENTS AND TEACHERS

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Fecha de Recepción: 10 de junio de 2020 – **Fecha Revisión**: 26 de junio de 2020

Fecha de Aceptación: 23 de septiembre 2020 – **Fecha de Publicación**: 01 de octubre de 2020

Abstract

Digitalization of all sectors of the economy, the implementation of digital technologies in all spheres of life open up unsurpassed opportunities for economic development and, as a result, improve the quality of citizens' life. Digital technologies provide an opportunity to intensify the educational process, improve the level and quality of perception, understanding, and assimilation of knowledge. The article provides a theoretical analysis of the problems and prospects of the digitalization of educational content in the context of distance learning. Based on an expert survey, the main types of digital educational content used in distance learning were identified. In the course of empirical research, the authors performed diagnostics of readiness of students to distance learning using digital learning resources, as well as the teachers' readiness for professional self-improvement in the implementation of digital educational content (DEC) in the learning process.

Keywords

Digitalization – Digital educational content (DEC) – Distance learning – ICT – Educational process

Para Citar este Artículo:

Khramtsov, Ivan Igorevich; Askarova, Gulnara Beisenovna; Sabekia, Raushna Beisenovna; Goncharov, Vitaly V. y Bodrova, Tatyana Yuryevna. Digitalization of educational content in the context of distance learning: the readiness of students and teachers. Revista Inclusiones Vol: 7 num Especial (2020): 301-314.

Introduction

In the modern era of global informatization of society, fierce competition, and rapid changes, many countries are directing their state policy towards modernizing educational activities, namely, training a new generation of specialists, who can compete in the contemporary labor market, act in nonstandard situations, and adapt to the current conditions[1]. In this context, Russia also faces the problem of finding effective ways and innovative approaches that will contribute to the quality training of future specialists in different industries[2]. One of the possible ways to solve this problem is to digitalize the educational process of higher education institutions since it is universities that are the centers of designing the latest technologies and serve as launch sites for implementing innovations that generally ensures the development of any spheres of human activity and contributes to socio-economic growth[3].

Digital educational content (DEC) is an integral part of the educational process digitalization, has an educational and methodological purpose, is used to ensure the educational activities of students, and is considered one of the main elements of the information and educational environment (IEE).

The purpose of creating the DEC is to modernize education, to ensure the content of the educational space, providing equal access of the educational process participants to the created ICT-based quality learning and teaching resources, regardless of their place of residence and forms of education[4].

According to Diederen J. et al.[5], DEC is a type of educational activity tools that exist in electronic form, is placed and submitted in educational systems on electronic data storage devices, and represents a set of electronic information objects (documents, documented information, and instructions, information materials, procedural models, etc.).

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[1] O. V. Glinkina; S. A. Ganina; A. V. Maslennikova; T. A. Solostina y M. V. Soloveva, “Digital Changes In The Economy: Advanced Opportunities For Digital Innovation”, International Journal of Management Vol: 11 num 3 (2020): 457–466 y G. M. Gogiberidze; V. A. Isakov; T. V. Ershova y O. V. Shulgina, “Development of innovations in the educational environment: inclusive education and digital technologies”, Revista Inclusiones Vol: 7 (2020): 147-158.

[2] V. D. Sekerin; M. N. Dudin; A. E. Gorokhova; T. P. Danko y N. I. Nikolaykin, “Applying interactive marketing methods to improve the quality of university educational services”, Quality - Access to Success Vol: 19 num 163 (2018): 37-42 y V. D. Sekerin; M. N. Dudin; A. E. Gorokhova; V. I. Gayduk y V. I. Volkov, “Creation of a virtual image: Digital technology of the 21st century”, Amazonia Investiga Vol: 8 num 20 (2019): 340- 348.

[3] M. N. Dudin; J. S. Shishalova; E. A. Pogrebinskaya; V. N. Sidorenko; E. I. Sukhova y N. Y. Zubenko, “Cross-cultural management in the system of harmonization of interests in the multi-confessional educational environment”, European Journal of Science and Theology Vol: 15 num 3 (2019): 191-199 y Z. I. Latysheva; E. V. Skripkina; T. Y. Kramarova; N. A. Gracheva y M. M. Istomina, “Digitalization as a factor of development of world Economy”, Revista Turismo Estudos & Práticas num 3 (2020).

[4] F. Van Acker; H. van Buuren; K. Kreijns y M. Vermeulen, “Why teachers use digital learning materials: The role of self-efficacy, subjective norm, and attitude”, The Journal of Education and Information Technologies num 18 (2013): 495-514 y K. Kostolányová y J. Šarmanová, “Use of adaptive study material in education in the E-learning environment”, The Electronic Journal of e-Learning Vol: 12 num 2 (2014): 172-182.

[5] J. Diederen; H. Gruppen; R. Hartog y A. G. J. Voragen, “Evaluation of computer-based learning material for food chemistry education”, Chemistry Education: Research and Practice Vol: 6 num 2 (2005): 64-82.

In the context of distance learning, P. Nokelainen[6] understands under DEC educational, scientific, informational, reference resources and tools developed in electronic form and placed in computer networks, which are reproduced through electronic digital technical means and are necessary for filling the educational process with high-quality educational and methodological materials. Moallem M.[7] notes that the modern didactic system requires, first of all, active learning from students, as well as active teaching offered by academic staff, using a variety of resources in the educational process (multimedia, interactive videos, virtual laboratories, and mass media). The teacher can independently create methodological materials repositories based on the scientific principles, differentiation of training, individual approach, and other principles of didactics.

According to researchers, contemporary DEC is characterized by the following features:

- it reflects the content and technological components of educational methodological systems that form the subject-information components of the educational environment (of closed and open type)[8];
- it ensures the content of educational electronic information systems[9];
- it is intended for versatile purposeful use by the educational process participants aimed at providing information and procedural support of educational, scientific, and managerial activities, information support of educational systems functioning, and development[10].

Defining the requirements for the DEC, Ardito C. et al.[11] mention educational and methodological, design-ergonomic, and technical requirements. The authors also emphasize that the design, ergonomic, and technical requirements for the DEC are based on the requirements for educational software.

Demir I. et al.[12] define the quality criteria of the DEC and propose to combine it into four groups: efficiency, methodological properties, quality of screen design, and economic validity.

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[6] P. Nokelainen, “An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students”, Educational Technology and Society Vol: 9 num 2 (2006): 178-197.

[7] M. Moallem, “An interactive online course: A collaborative design model”, Educational Technology Research and Development Vol: 51 num 4 (2003): 85-103.

[8] L. Yang; T. Weng; D. Yang y P. Wu, The effectiveness of digital teaching materials on introduction statistics. Proceedings of the International Conference on Education Reform and Modern Management. 2014.

[9] D. P. Zwart; J. E. H. Van Luit; O. Noroozi y S. L. Goei, “The effects of digital learning material on students’ mathematics learning in vocational education”, Cogent Education num 4 (2017).

[10] O. Noroozi; A. Weinberger; H. J. A. Biemans; M. Mulder y M. Chizari, “Argumentation-based computer-supported collaborative learning (ABCSCL): A synthesis of 15 years of research”, Educational Research Review num 7 (2012): 79-106.

[11] C. Ardito; M. Costabile; M. Marsico; R. Lanzilotti; S. Levialdi; T. Roselli y V. Rossano, “An approach to usability evaluation of e-learning applications”, Universal Access in the Information Society Vol: 4 num 3 (2006): 270- 283.

[12] I. Demir; H. Ünal y S. Kiliç, “The effect of quality of educational resources on mathematics achievement: Turkish case from PISA-2006”, Procedia Social and Behavioral Sciences num 2 (2010): 1855-1859.

Kazaine I.[13] developed methodological recommendations for evaluating the quality of DEC when using it in the educational process. Researchers have identified several groups of requirements for the quality of educational achievements of students who use ICT in learning: mastering the knowledge, reproductive skills, creative abilities, educating certain personal qualities in students, as well as the ability to interact with society.

The purpose of the article is to investigate the readiness of students and teachers to digitalize educational content in the context of distance learning.

Research hypothesis is as follows: the development of information and communication pedagogical environment is an integral part of the digital transformation of management and educational processes at the university.

Based on the research results, it can be concluded that the goal set in the study was achieved.

Methods

To achieve the goal set in the study, a combination of theoretical and empirical research methods was used which included theoretical methods (analysis, synthesis, comparison, generalization) when studying the scientific literature on the problems and prospects of digitalization of educational content in the context of distance learning; as well as empirical methods (expert survey method, diagnostic methods, i.e. a survey of students and teachers).

The research method included:

- conducting an expert survey to determine the types of DEC required for distance learning.

- studying of students' readiness to learn remotely using a DEC;

- surveying teachers to identify their readiness for professional self-improvement in the context of the implementation of the DEC in the distance learning process.

The survey was attended by 25 experts, university employees (administrative staff, technical staff, and academic staff) with at least 10 years of experience in higher education. All survey participants were warned about the purpose of the survey and the intention of the study organizers to publish the results of the study in a generalized form in the future.

To diagnose the readiness of students (2nd and 3rd-year students in the number of 84 people) to study remotely with the use of DEC, the methods of questionnaires, conversations, and observations during training were used. The experiment was aimed at determining the students' attitude to distance learning using information technology and DEC (a motivational component of readiness), as well as the level of knowledge, skills, and abilities in the application of information technologies and computer equipment, as well as working independently remotely from the university and the teacher (cognitive and operational components).

[13] I. Kazaine, Evaluating the quality of E-learning. Proceedings of the 11th International Scientific and Practical Conference num 2 (2017): 74-77.

Based on the criteria for determining the level of readiness to learn remotely using DEC, the authors have conditionally determined three levels of such preparedness:

- *low level,* characterized by a lack of motivation, interest in distance learning, and DEC, as well as skills of independent work, including use of DEC, unwillingness to use IT, and DEC tools in their educational and research activities. Such students' unreadiness to study remotely with the use of DEC is conditioned by a certain psychological barrier;

- *average level,* characterized by unstable positive motivation, episodic interest in distance learning technologies, and the use of DEC in the educational process. Such students are aware of the need to use DEC, but they also have doubts about the effectiveness of their application. At that, skills needed for independent work in the new conditions are underdeveloped;

- *high level*, characterized by stable positive motivation, strong interest in IT technology and the use of DEC, the desire to use DEC to apply them in the educational, research, and later in professional activity; the aspiration to self-extraction of knowledge, skills, and abilities of independent work.

A survey of teachers (17 people) to identify their readiness for professional self-improvement in the context of the implementation of DEC in the learning process included questions about the possession of the following aspects of the teacher's activity: developing digital educational-methodical complex; creating tools for the content management of digital educational-methodical complex; developing digital methodical recommendations necessary for students to perform laboratory and practical works, prepare for seminars and lectures, studying the distance learning courses; developing digital guidelines for organizing online consultations; creating a repository of test tasks of various forms, developing tests; and organizing remote monitoring of educational and cognitive activities of students.

Results

According to experts, it is advisable to develop the following DEC for full-fledged distance learning (Table 1).

No	DEC	Characteristics
1	Digital equivalent of a printed publication	Digital edition (in pdf, doc, jpg, etc. formats), which mainly reproduces the corresponding printed edition
2	Digital demonstration materials	Digital materials (presentations, diagrams, video, and audio recordings, etc.) intended to supplement the educational process
3	Computer test	Standardized tasks in digital form for incoming, intermediate and final control of the level of student's educational achievements, as well as self-control and/or providing measurements of psychophysiological and personal characteristics of the testee
4	Digital learning objects library	A set of digital resources that provides (based on hardware, and software) capabilities for creating, searching, and using information. Contains information objects in various formats

5	Digital educational and methodical complex	This is a set of components of the educational direction that supports most types of classes and includes the following items: an abstract; the curriculum of the discipline (course, subject); a multilevel digital textbook for students in the form of a user-controlled computer program (programs), a web document; additional information and reference and/or methodological materials; diagnostic materials (tests, practical and creative tasks, task completing criteria); tasks for independent work; audio-visual aids; glossary; reference list, Internet resources; and methodological recommendations for teachers concerning the use of the complex
6	Digital teaching aids	Publications that contain material on the methodology of teaching and studying the discipline; performing practical and laboratory work; performing tasks; solving problems, completing term papers and theses; conducting research; organizing and conducting business games, etc.

Note: compiled based on an expert survey

Table 1

DEC in the context of distance learning

According to experts, all the above-mentioned types of DEC can be developed at the universities by organizing project groups that should include teachers, methodologists, IT specialists, and students.

The analysis of the results of the students' survey allows speaking about the presence of a certain interest in distance learning with the use of DEC in the majority of students. However, the same data show that not all students believe in the effectiveness of learning remotely using DEC. Thus, only 48% of respondents reported their constant interest in using the DEC. Almost 46% of respondents experienced positive emotions when working with DEC. However, almost half of the students doubted concerning the possibility of using the DEC in the study of certain subjects or even denied it. When asked the question of how DEC affected the learning process, 25% of respondents indicated that DEC increased the learning load and volume of educational content, 59% noted that DEC saved time and allowed working more efficiently, while 66% mentioned that DEC increased access to information.

At that, 84% of respondents had regular experience of working with DEC before starting their studies at the university, 12% of students described this experience as episodic, while 4% had no experience of working with DEC.

The results of the survey evidence that the majority of students had sufficient skills in using IT and computers (67%). Only 10% of students noted that they did not have enough knowledge and skills, but wanted to improve them, 52% of students considered distance learning to be as effective as traditional learning, 26% considered it more effective because they could learn at their own pace and schedule, as well as combine study with work. The remaining 22% of students had chosen distance learning only because they did not have the opportunity to attend classes regularly, or because the tuition fee was less than that for full-time or part-time modes of education.

Besides, 75% of students tended to continue their studies in case of arising difficult circumstances (discomfort due to the inability to see and communicate with the teacher and students in person; lack of emotional interaction between students, students, and the

teacher; a sense of isolation, frustration, panic; inability to study independently, without pressure from the outside, dissatisfaction with the results of their studies, etc.). Among respondents, 15% were not sure or could not answer this question, and 10% probably would not continue their studies if difficult circumstances arose.

The results of the experiment also evidence that the reason for students' difficulties during their studies, as well as the decrease in interest in learning, is largely due to the inability to organize and implement independent learning, to manage time correctly, select the key issues in the digital content provided for study, as well as process and master a large amount of information.

Although 68% of students did not feel discomfort from not being able to see and communicate directly with the teacher and other students, the main reason for the loss of interest and motivation in distant learning was that they did not always receive timely assistance from the teacher if necessary or a response to a completed task. Thus, 83% of students would like to be able to get assistance from a teacher throughout the entire learning process in case of arising difficulties. At that, 11% of students needed such assistance or explanations at the beginning of the educational process, while the rest of the students (6%) needed assistance at the end of training before the test, credit, or exam.

When students were asked the question as to what in their opinion could improve the learning process, 68% answered that they would like to have better quality DEC, 62% would like to receive an analysis and explanation of their mistakes within a week after sending the completed work, 56% preferred more discussions and debates on complex issues, while 45% wanted to have more interaction with colleagues and peers.

After taking into account the motivational, cognitive, and operational components, the authors conditionally characterized 27% of students as those having a low level of readiness to learn remotely, 65% of students – as having the average level, and 8% of students – as having the high level.

Thus, the results of the experiment testify that the majority of students have a positive attitude towards distance learning with the use of DEC, they are psychologically ready to learn without the ability to see and directly communicate with the teacher; mainly, they have formed skills and abilities to work independently using IT and DEC. Besides, they consider DEC an effective means of learning. However, most students believe that the available educational and methodological support is not always effective for self-study of the educational material.

To identify the readiness of teachers for professional self-improvement in the context of the implementation of the DEC in the distance learning process, a special survey was conducted involving teachers (Table 2).

Content of the teacher's activity	**Perfect skill level, %**	**Imperfect skill level, %**	**Lack of skill, %**
Developing a digital academic and methodological complex	6	41	53
Creating content management tools for a digital academic and methodological complex	6	41	53

Developing digital guidelines for the implementation of laboratory, practical, seminar classes, and the study of the distance course lectures	6	47	47
Developing digital guidelines for organizing online consultations	6	47	47
Developing tests and creating a repository of various test cases	6	53	41
Organizing remote monitoring of educational and cognitive activities of students	6	59	35

Table 2
Results of the teacher survey

According to the analysis of the survey results, teachers have an insufficient level of formedness of this readiness. Thus, the following two indicators were characterized by minimal values: "Developing a digital academic and methodological complex" and "Creating content management tools for a digital academic and methodological complex". The best indicators were received concerning "Organizing remote monitoring of educational and cognitive activities of students".

Given the fact that today those who can apply and combine their knowledge and skills in pedagogy and special disciplines with ICTs can adapt to the new role of a teacher in distance learning, it is necessary to provide targeted assistance to academic staff in teaching them how to create DEC.

Discussion

According to the researchers[14], when creating DEC in a distance learning environment, it is advisable to adhere to the following basic principles:

- ensuring cognitive visualization which contributes to the formation of concepts, the development of critical and creative thinking of the educational process participants;

- providing information richness of data, which implies a compact presentation of educational content to give students basic or necessary information that would be clear, accessible and easily perceived in a visually accessible form;

- ensuring clarity of data, which increases the effectiveness of classes with students, as well as helps to overcome formalism in learning, and contributes to the development of students' learning efforts, creative cognitive activity, and independence;

[14] C. Callahan; J. Saye y T. Brush, "Designing web-based educative curriculum materials for social studies", Contemporary Issues in Technology and Teacher Education Vol: 13 num 2 (2013): 126-155; L. Carswell; P. Thomas; M. Petre; B. Price y M. Richards, "Distance education via the Internet: The student experience", British Journal of Educational Technology Vol: 31 num 1 (2000): 29-46; A. Cohen; S. Kalimi y R. Nachmias, "The use of digital repositories for enhancing teacher pedagogical performance", Interdisciplinary Journal of E-Learning and Learning Objects num 9 (2013): 201-218; M. C. W. Yip, "Using WebCT to teach courses online", British Journal of Educational Technology Vol: 35 num 4 (2004): 497-501 y L. J. Ausburn, "Course design elements most valued by adult learners in blended online education environments: An American perspective", Educational Media International Vol: 41 num 4 (2004): 327-337.

- compressing (compacting, folding) of data as a knowledge reconstruction process to make complex and incomprehensible simple and clear, represent bulky in a compact concise form, to transform fragmentary information into complete knowledge;

- providing completeness of data, which characterizes their quality and determines the sufficiency of data for decision-making;

- providing the integrity of perception of data presented in a certain form, which is always perceived as a whole in the unity of all qualities and features, appears conditionally-reflexively through the preliminary existing connection between visual, auditory, tactile stimuli that come from objects;

- ensuring reliability and relevance of the data which should display real objects with the necessary accuracy in constantly changing conditions;

- providing accuracy of data that determines the degree of their similarity with the actual state of the object, process, phenomenon, etc.

Researchers believe that DEC, precisely as the content of a university IEE, becomes a determining factor of the contemporary learning system, and its application, as a rule, becomes an essential condition for the transformation of the pedagogical activity, which includes cognitive, constructive, organizational, and communicative components[15].

At that, cognitive activity is aimed at studying the possibilities, forms, and methods of including the DEC in the educational process, and determines all further components of the teacher's activity, provided that they are used[16].

The constructive activity involves the selection and design of educational material based on the curriculum, academic program, taking into account the theoretical and practical tasks and conditions of training using the DEC, as well as the capabilities of the teacher and individual qualities of students. The use of DEC requires more thorough approach to design, which should combine organizational, pedagogical, and methodological components of pedagogical activity[17].

Researchers of the article[18] note that organizational and pedagogical activity involves analyzing all the topics of the subject being studied and determining the place and role of the DEC. The methodological component consists in the development of a certain modern methodological system for the use of DEC.

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[15] N. Arman, “E-learning materials development: Applying and implementing software reuse principles and granularity levels in the small”, International Journal of u-and e-Service, Science and Technology Service, Science and Technology Vol: 3 num 2 (2010): 31-42.

[16] Y.-C. Chang; W.-Y. Kao; C.-P. Chu y C.-H. Chiu, “A learning style classification mechanism for E-learning”, Computers and Education num 53 (2009): 273-285.

[17] N. A. Buzzetto-More, “Student perceptions of various e-learning components”, Interdisciplinary Journal of E-Learning and Learning Objects num 4 (2008): 113-135; I. A. Rudskaya y E. A. Konnikov, “Digital transformation of the labor market”, Revista Inclusiones Vol: 7 num 3 (2020): 188-199 y I. A. Skripak; S. N. Aynazarova; E. V. Ukhanova; A. E. Tkachenko y L. S. Erina, “Digital Virtualization Technologies in Distance Learning”, International Journal of Advanced Trends in Computer Science and Engineering Vol: 9 num 2 (2020): 1808 – 1813.

[18] M. Lister, “Trends in the design of e-learning and online learning”, MERLOT Journal of Online Learning and Teaching Vol: 10 num 4 (2014): 671-680.

It is individual for each teacher but must be based on the general principles of using information technologies in the educational process of the university.

According to researchers[19], the organizational activity provides for the organization of teachers' and students' own activities. Changes in the organization of students' activities are determined by the fact that the use of information technologies allows applying various modes of learning (collective, group, and individual), achieving a high level of learning individualization, and thus, it is desirable to build it according to the capabilities and abilities of each individual student.

Conclusion

Digitalization of society and education, as well as changes in academic programs, require changing approaches to creating methods for using DEC promoting the development of IEEs in which both authors and users collaborate and create high-quality educational content. It is important to create conditions for the implementation of high-quality DEC in universities that would meet the needs of modern education. The solution to this problem will both improve the effectiveness of education and also overcome the biased attitude of many teachers to the involvement of information technologies in the educational process.

Summarizing up, one can formulate the following basic requirements for the content and organization of DEC:

- the learning tools that are components of the learning DEC should be designed and created taking into account the hierarchy of mental actions and operations of the learning subject;

- the structuring of learning material and its presentation in the DEC must not contradict the requirements of systematic knowledge and systematic presentation;

- the DEC components should fit seamlessly into the learning process, be used as a means of collective and independent activity of participants of this process; software tools should be accompanied by appropriate methodological support.

Thus, the results of the study have confirmed the hypothesis that it is necessary to conduct activities in universities aimed at familiarizing teachers with the special didactic requirements which are associated with the use of DEC in training. These can be seminars and masterclasses, where students and teachers explore various requirements needed to use information technologies in the educational process, such as psychological, pedagogical, technical, ergonomic, design, etc.

The development of a program of such events, which must take into account the different level of preparedness of both teachers and students, as well as the administrative component of the university to implement the methodological foundations for the development of the DEC as the content of the university IEE, can become a problem for further research.

[19] K. Swan; S. Day; L. Bogle y D. Matthews, "A collaborative, design-based approach to improving an online program", The Internet and Higher Education num 21 (2014): 74-81.

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