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ADAPTABILITY OF EDUCATIONAL PROGRAMS' CONTENT TO DISTANCE LEARNING TECHNOLOGIES IN HIGHER EDUCATION INSTITUTIONS OF KAZAKHSTAN

The purpose of the article is to determine the level of adaptability of the of higher education institution educational programs' content to distance learning technologies based on the application of the principles of synergy and coherence.

A comprehensive analysis of the disciplines of educational programs of all levels of training in the specialty «Chemistry» was carried out. According to the results of the analysis, the disciplines that can be transferred to online format and distance learning technologies without discussion and the disciplines that require additional digital and resource support are identified. During the transition to online format and distance learning technologies it is necessary to keep in mind the specifics of each direction of training and the peculiarities of the organization of the learning process. From the perspective of synergetics and connectivism principles, the reorientation of the educational process from the traditional form to distance and online learning has revealed a number of problems associated with the failure to prepare the education system for the new realities.

Key words: educational programs, adaptability of educational programs, inter-discipline connection, distance educational technologies and online learning.

Introduction

In the context of globalization and the transition to a digital economy, the ways of learning in the educational system are changing. This situation also affects higher education institutions. The new paradigm of higher education is characterized by a shift from the traditional form to distance and online learning. Due to the COVID 2019 pandemic lockdown in mid-April 2020, 1.5 billion students were affected by school closures in 195 countries, from preschool to higher education institutions (UNESCO, 2020b).

In Kazakhstan, 131 institutions of higher education have switched to distance/online learning (Information and Analysis Center, 2020). In the United States, more than 80 percent of major institutions of higher education, that is, 4.6 million students, are enrolled in online courses.

Online enrollment has also increased by 17% (Allen and Sailor, 2010). This situation, meaning the massive shift to distance learning, has raised serious questions about the quality of online learning.

In recent years, online learning has been widely used throughout the world (Beck et al., 2013 ; Culp et al., 2005). To some extent, the proliferation of online learning is limited by access to the Internet, community infrastructure, and community/individual technology resources; in areas where these factors are not available, learners have difficulty participating in online education programs (Rideout & Katz, 2016).

Pandemic has identified several problems associated with the inability of Kazakhstan's education system to switch smoothly to online/distance education (Bokayev, B., et al., 2021). The strongest impact is the lack of material and technological resources. The transition to distance / online education in a pandemic requires improvement in technological and pedagogical terms. Expanding access to high-speed Internet for quality online education is especially important.

Some foreign scholars like Nissenbaum, Walker, Trinkle are concerned that distance education threatens the quality of education (Nissenbaum, & Walker, 1998; Trinkle, 1999). According to them, distance technology will make traditional education cheap and destroy the special relations of teachers and their students. The same emphasis is put on the fact that some distance courses are impersonal, superficial, misdirected, and potentially inhumane and oppressive, which disrupts the interaction that a learning community creates. In this situation, the verification of educational programs and behavior of the subjects of learning is a major component of the adaptation of the higher education system to the digital space.

The question whether the higher education system is ready to the new realities is quite relevant. The President of the Republic of Kazakhstan K. Tokayev notes the importance of the need for the forced introduction of modern distance technologies in Kazakhstan's universities and on the other levels of education. «It is necessary to revise the content of educational programs, to make them accessible and interactive» (Tokayev, 2020). Kazakhstan realities have shown both positive and negative sides of the urgent transition to the distance and online learning system. In Kazakhstan, the difference in educational and information-technological levels of universities requires the study of methodological, organizational, psychological, content, practical and regional aspects of distance learning functioning. This is caused by the fact that Internet connections across the country are not available everywhere, and this is acutely felt especially in remote areas. The reorientation of the educational process in training areas and educational programs by supplementing the database of information and content resources of distance learning requires the application of synergetic theory and connectivism principles.

Literature review

The article is based on the leading methodological approaches to verification of social programs, including educational programs of higher educational institutions.

With the impact of the pandemic on changes in educational services and the shift to distance learning, institutions of higher education have been forced to switch to online learning, integrate their non-academic staff to be a supportive part of the online platform to better implement the initiative (Pushkar Dubey, Deepak Pandey, 2020).

The transition to distance learning does not diminish the role of the traditional form of learning. Each way of learning, traditional and online learning, and the two forms of knowledge transfer should offer some strong elements for education, but by no means should be seen as one above the other. Obviously, face-to-face learning can be useful and enriched with elements of online education in any case (Karalis, & Raikou, 2020).

Researchers publish the results of a study examining the current challenges of distance education in higher education under pandemic conditions. Students' adaptability to online learning in a pandemic environment and the transition to online learning revealed that many students are not accustomed to learning effectively on their own (Owusu-Fordjour, Koomson, Hanson, 2020).

Siemens and Downs have developed clear principles of connectivism that apply to distance and online learning. Connectivism is based on individual ideas and opinions, appreciating the diversity of others' perspectives, lifelong learning, relationship building, interdisciplinary connections, current information and risk accepting.

The practical application of connectivism can best be seen in distance learning with the development of massive open online courses. Connectivism theorists suggest that cognitive tasks between people and technology are performed in networks that represent connections between «people, groups, systems, domains, ideas, or communities. As Siemens suggests, formal learning as we know it, lectures, traditional textbooks, and classroom structures no longer make up much of learning, but are replaced by informal experiences that can take place in online learning environments (Siemens, 2005b., 2018).

Russian scientists Yu.V., Gorbunkova, E.S. Polat, F.L. Ratner and others have studied organizational and pedagogical aspects of distance learning, problems of distance learning, principles of distance education, problems of implementing distance learning technology in universities. They raise the question of developing electronic educational resources based on foreign experience. They argue that this form of learning leads to superficial, merely practice-oriented learning, does not allow high-quality and meaningful learning and research activities (Gorbunkova, 2001; Polat, 2005; Ratner, 2008).

Kazakhstani scientists in their studies have touched upon the issues of social policy in the implementation of the program «Information Society-2030», distance education, innovative technologies, the formation of the information educational space. In particular, E.K. Balafanov, B. Buribayev, A.B. Dauletkulov study the problems of new information technologies (Balafanov, Buribayev & Dauletkulov, 2009). S.K. Omarova's work is devoted to the modern trends of education in the era of informational technologies (Omarova, 2018). The peculiarities of technology and methods of distance education in Kazakhstan have been analyzed in the work of A.K. Kusainov and A.A. Sharipbai. In particular, they characterized the subsystems of distance learning, justified the importance of distance technologies in modern society, defined the features of distance learning in Kazakhstan (Kusainov and Sharipbai, 2019).

Compiling indicators of the difference between traditional and innovative forms of learning, considering the particularities of the areas of training will improve the effectiveness of training adapted to the new conditions of educational programs.

The transformation of the traditional form of learning is part of the process of formation of the digital economy in Kazakhstan and the policy on the organization of training using distance learning technologies. Kazakhstan is focused on the introduction of modern distance technologies and revision of the content of educational programs to make them accessible and interactive.

In the state program of development of education and science of RK for 2020-2025 in order to increase the global competitiveness of Kazakhstan education and science, upbringing and educating personality on the basis of universal values the problem of modernization of the content of education is emphasized (State Program of the Republic of Kazakhstan).

Consequently, the preparation and functioning of new educational programs are focused on the formation of flexible and professional skills (soft skills, hard skills) required in the rapidly changing world of VUCA, involving lifelong learning.

Nevertheless, the problems and mechanisms of adapting educational programs and textbooks for specialties and subjects of education to the transition to distance and online education, one might say, have not yet fully become the object of study.

Materials and methods

To solve the tasks set in the article the following research methods were used:

– Review of scientific literature concerning the online format and distance learning technologies, adaptation of educational programs accordingly;

–The comparative method was used to analyze the interdisciplinary structure of educational programs in the specialty «Chemistry» at all levels of training for the transition to online format and distance learning technologies;

The method of collecting primary information is a content analysis of educational programs in the studied specialty. The sources of primary information are educational and methodical documents, curricula, teaching materials, SPOC and MEP base, digital resources.

Results and Discussion

Comprehensive and comparative analysis of educational programs, educational-methodical complex of disciplines and MEP in modern educational conditions, where the time requires reorientation of the educational process to the distance learning format, will offer a differentiated approach in the implementation of distance learning technologies in combination with traditional forms of learning.

In the context of modern challenges it is necessary to study not only the objective indicators of the transition to distance and online learning formats, but also to identify hidden factors in the application of educational programs for specialties, the interaction of subjects of the educational process with the new realities.

DL (distance learning) programs are based on the modular principle. Each separate discipline (course), which is being mastered by a student, is relevant to a particular subject area. This leads to the creation of a curriculum consisting of several independent courses that meet the individual or group needs.

While writing the article we analyzed the curricula (Table 1) of educational programs in the field of «Chemistry» at three levels of training (bachelor, master, PhD).

Table 1 – Curriculum of educational programs
6B053011 Chemistry

Code	Names of disciplines/other educational activities	practice. (hour)	lab (hour)
M-1 Module of social and cultural development			
SIK 1101	Modern history of Kazakhstan	30	0
FiL 2102	Philosophy	30	0
MSPZ 2103	Module of socio-political knowledge (Sociology, Political science, Culture, Psychology)	20	0
M-2 Instrumental module			
IKT2104	Information and Communication Technologies (in English)	0	**30***
IYa 1105	Foreign Language	90	0
K(R)Ya 2106	Kazakh (Russian) Language	90	0
M-3 Module Physical Training			

Continuation of table 1

FK 1107	Physical Training	75	0
M-4 Physics and Mathematics Module			
Mat 1201	Mathematics1	30	0
Mat 1202	Mathematics2	30	0
Fiz 1203	Physics1	0	**60**
Fiz 1204	Physics2	0	**60**
M-5 General chemistry			
OH 1205	General chemistry	15	**30**
POH 1206	General Chemistry Practical Work	15	**60**
PP 1207	Professional (educational) practice	12	
M-6 Analytical chemistry			
AH 2208	Analytical chemistry 1	15	**60**
AH 2209	Analytical chemistry 2	15	**60**
PP 2210	Professional (industrial) practice	30	0
M-7 Chemical thermodynamics and kinetics of equilibrium and nonequilibrium processes			
FH 2211	Physical chemistry 1	15	**60**
FH 2212	Physical chemistry 2	15	**60**
HF 3213	Chemical physics	15	**60**
KH 3214	Colloid chemistry	0	**60**
PP 3215	Professional (industrial) practice	36	0
M-8 Organic chemistry			
OH 3216	Organic chemistry 1	15	**60**
OH 3217	Organic chemistry 2	15	**60**
M-9 Measurement of parameters of the physico-chemical process and its modelling			
HTT 2218	Chemistry of solid body	30	0
MS 3219	Metrology and standardization	30	0
PMMHP 3220	Using Matlab for chemical process modeling	15	**30***
M-9 The role of experiment and mathematical modelling in chemistry			
OM 2218	Fundamentals of materials science	30	0
MMOFE 3219	Methodology and metrological support of physico-chemical experiments	30	0
MMHP 3220	Mathematical modeling of chemical processes	15	**30***
M-10 Chemistry of high molecular and biochemical systems			
HVS 3221	Chemistry of macromolecular compounds	0	**60**
Bio 4222	Biochemistry	0	**60**
M-10 Kinetics and mechanism of the reactions involving biomolecules			
HP 3221	Polymer Chemistry	0	**60**
BH 4222	Bioorganic chemistry	0	**60**
M-11 Structure and properties of substances			
NH 1301	Inorganic chemistry	0	**60**
SV 3302	Structure of matter	15	30
M-12 Study and obtaining of substances and materials			
FMI 3303	Physical methods of research	0	**60**
OHT 4304	Basis of Chemical Technology	15	**60**
PP 4305	Professional (industrial) practice	72	0
PP 4306	Professional (pre-diploma) practice	36	0
M-13 Chemical Expertise (Expert Chemist)			
AKOOS 4307	Analytical control of environmental objects	0	**60**
HEPP 4308	Chemical expertise of food	0	**60**
HESM 4309	Chemistry and expertise of silicate materials	0	**60**
ETBH 4310	Expertise of household chemical goods	0	**60**
AMS 4311	Analysis of metals and alloys	0	**60**
M-13 Theoretical and Applied Chemistry (Research Chemist)			
ORRE . 4307	Fundamentals of radiochemistry and radiation ecology	0	**60**

Continuation of table 1

HKS 4308	Chemistry of coordination compounds	30	0
PE 4309	Applied Electrochemistry	0	**60**
KSP 4310	Kinetics of complex processes	30	0
TR 4311	The theory of solutions	0	**60**
M-13 Chemistry of organic compounds (Research Chemist)			
HGS 4307	The chemistry of heterocyclic compounds	0	**60**
FMAOV M 4308	Physico-chemical methods of analysis of organic substances and materials	0	**60**
SOM 4309	Stereochemistry of organic molecules	30	0
SRSV 4310	Structure and reactivity of compounds	30	0
TOSFP 4311	Theoretical basis for synthesis of functional polymers	30	0
M-13 Green Chemistry (Research Chemist)			
HOS 4307	Chemistry of environmental	0	**60**
VZH 4308	Introduction to green chemistry	30	0
NN 4309	Nanochemistry and Nanotoxicology	30	0
ZAH 4310	Green analytical chemistry	30	0
BM 4311	Biodegradable materials	0	**60**
M-13 Nanochemistry and Nanomaterials (Research Chemist)			
MNM 4307	Mechanochemistry of inorganic materials	15	**30**
VN 4308	Introduction to nanochemistry	0	**60**
SMAN 4309	Modern methods of analysis of nanomaterials	0	**60**
BN 4310	Bioengineering in Nanotechnology	30	**0**
KHN 4311	Colloid chemistry of nanoparticles	0	**60**
M-13 Obtaining and design of materials (Research Chemist)			
FHPAV 4307	Physico chemistry of surfactants	0	**60**
HTRE 4308	Chemistry and technology of rare elements	15	**30****
KHMT 4309	Quantum-chemical methods in thermochemistry	15	**30***
NFPM 4310	New functional polymeric materials	0	**60**
HPS 4311	Chemistry of natural compounds	0	**60**
M-17(ДВО)			
M-12 Study and obtaining of substances and materials			

**For these disciplines, certain conditions are necessary to transfer them to online or distance learning;*
*** For this discipline laboratory classes can be transferred to online or distance learning based on the Internet and digital resources.*

According to the results of the analysis, it can be noted that the curriculum is based on the modular approach and corresponds in content to the direction «Chemistry» research and teaching on the master's degree. The number of modules depending on the level of training varies from 3 to 17 (Table 2), and their number in Bachelor's degree is much more than in Master's and PhD degrees.

Table 2 – Curriculum of the educational program of the Bachelor's degree 6B053011 «Chemistry»

№	Educational programs	Module (number)	Practice (number)	Practice (hour)	Lab (number)	Lab (hour)
1.	6B053011 Chemistry	17	42	1211	34	2400
2*.	7M01503 Chemistry	5	31	921	0	0
2.	7M05301 Chemistry	9	56	1722	0	0
3.	8D05301 Chemistry	3	26	780	0	0

** Master's degree in pedagogical direction. KazNU is not preparing specialists in bachelor's degree in pedagogical directions.*

The comparative analysis shows that in the educational programs of Bachelor's degree in Chemistry 42 disciplines out of the total number (76) have 1211 hours of practical studies, 34 disciplines have only 2400 hours of laboratory studies. This specialty involves more laboratory research, that is conducting chemical experiments with the use of various equipment and chemical reagents. Consequently, the number of laboratory classes and, accordingly, the number of hours allocated for them in the bachelor's degree is higher. For Master's and PhD programs there are no laboratory classes, and the number and hours of practical classes are 56 (1,722) and 26 (780), respectively. There is a comparatively higher number of practical classes in the master's program. And there are no laboratory classes for both master's and doctoral programs, which implies their automatic transfer to online format and distance learning. In general, practical classes involve solving practical and typical problems, we think it is possible to transfer these classes completely to online format and distance learning.

We have studied the possibility of transferring the disciplines of the curriculum to the online format, and it was discovered that 34 disciplines with laboratory classes have their own specifics, which require their detailed study. For the discipline «Chemistry and technology of rare elements» the limited number of chemical reagents in the laboratory classes allows to transfer this discipline to the online format or distance learning based on the Internet and digital resources.

At the same time, it was revealed that there are disciplines such as «Application of Matlab for modeling chemical processes», «Mathematical modeling of chemical processes», «Quantum chemical methods in thermochemistry» in the curriculum. These disciplines require the use of paid specialized licensed software, which is not available to students because of its high cost . Usually such software is purchased for one or two computer classes for the entire department. Accordingly, distance learning in these disciplines is possible only with an extended collective license available to students. This issue needs to be addressed at the university management level.

In this regard, it should be noted that to ensure the quality of education it is necessary to create a good base of interactive and digital resources. Moreover, these resources should be available to both teaching staff and students. In order to investigate the digital resources for the educational program «Chemistry», the analysis of digital resources available at the faculty of chemistry and chemical technology was carried out.

As an additional resource, online courses in the basic disciplines were launched: Analytical Chemistry (SPOC), Selective Problems of Inorganic Chemistry (MOOC), Physical Chemistry (SPOC), Theory of Chemical Applications in Oil Production. Organochlorine compounds (MOOC), Organic chemistry of aliphatic compounds (MOOC), Fundamental of nanotechnology (SPOC).

At the moment a total of 74 online courses have been developed in KazNU, and the growth rate of online courses reached 30%. In general, the work is aimed at creating high-quality online courses, rather than increasing their number. In this regard, there is a question of training teachers in the process of developing and launching MOOCs. To solve this problem, systematic upgrading courses «Massive Open Online Courses: Development, Promotion and Application» are held for the university teaching staff.

In order to accept in the development and implementation of online courses of faculties for 2021 the university held a competition of scripts of online courses and their public defense. As a result of the competition, pedagogical scenarios for 19 MOOCs and 21 SPOCs were selected for publication on the platform:

1) MOOCs of Al-Farabi Kazakh National University;
2) Moodle distance learning system of Al-Farabi Kazakh National University;
3) National Platform for Open Education of Kazakhstan (NPOK);
4) Coursera – an open online course for the development of lifelong learning for children and adults.

The works of the Faculty of Chemistry and Chemical Technology in Kazakh, Russian and English languages: Theory of chemical reagents application in oil production. Organochlorine compounds; Organic chemistry of aliphatic compounds and Organic chemistry of cyclic compounds; Fundamental of nanotechnology – also passed through the competition.

On January 2, 2021 the first public open online course of the Al-Farabi Kazakh National University – Methods of molecular biology – was published on the international educational platform Coursera https://www.coursera.org/learn/methods-of-molecular-biology.

The analysis conducted by the Institute of New Educational Technologies shows that a large proportion of enrolled students, as well as those who successfully completed a program make for the course «Agylshyn tili» – 3 487, «Information and Communication Technologies» – 5 926, this is explained by the introduction of these online courses in the educational process, and the course «Methods of molecular biology» – 3 932, which is explained by the publication of the course on the international educational platform Coursera – the world leader in online education.

In the university MOOCs of the cycle «Ruhani zhangyru»: «Psychology», «Sociology», «Pedagogy of Higher Education», «Cultural Studies», «Political Science», «Philosophy» in Kazakh language were transferred from the MOOC platform of Al-Farabi Kazakh National University to Moodle distance learning system and launched with integration into the educational process. These online courses in Chemistry are studied as supplementary material to the discipline.

KazNU continues cooperation with the international educational platform Coursera on the project Coursera for Campus.

Before October 1, 2020, access to all Coursera MOOCs was unlimited and free. Students and teachers could study any MOOC of their choice and receive a certificate of successful completion. Later, Coursera automatically switched all entities participating in the no-cost promotion, which began in March 2020, to the basic package. In this case, a student or university employee can study free online courses from the catalog of the Coursera for Campus project (about 3800 titles) and receive a certificate of successful completion of only one MOOC during the calendar year. And as of June 4, 2021 about 3,200 KazNU students were enrolled in more than 10,000 Coursera courses. The most frequent choices are MOOCs in Computer Programming, English, and Management.

In this connection, Coursera suggested that the university consider switching to a paid package where students could receive certificates for an unlimited number of MOOCs studied and instructors could publish their MOOCs on Coursera. Not openly, but in SPOC format, giving access to the course only to their students.

Al-Farabi Kazakh National University also implements online courses on the National Platform for Open Education of Kazakhstan (SPOC).

In addition, there are online courses integrated into the educational process on the Coursera and OpenKazNU platforms: Distance Learning Technologies (MOOCs), Learn Distantly (MOOCs 1, 2 and 3), Theory and Practice of Creating Online Courses, Distance Learning Technologies (MOOC), Distance Learning (MOOC), Distance Learning (MOOC), Physical Chemistry, Metrology and standardization (MOOC), Probability Theory, Statistics and Exploratory Data Analysis (MOOC), Standardization and Technology (MOOC), Statistics for application (MIT open course wave), Selected problems of inorganic chemistry (MOOC), Physical chemistry (SPOC). These MOOCs create an additional base of interactive resources that are necessary to provide a quality learning process in an online format.

During the 2020-2021 academic year, 288 disciplines were studied with the integration of online courses in the educational process. For example, in the Department of Chemistry and Chemical Technology: 1) Inorganic Chemistry. Chemistry; 2) Nanochemistry. Nanomaterials. 1.Nanotechnology: a Maker's course; 3) Colloid-chemical bases of environmental protection.1. Global Environmental Management 2. Air Pollution – a Global Threat toour Health; 3) Physical Chemistry; 4) Physical Chemistry 2.1. Introduction to Physical Chemistry; 2. Introduction to battery-management systems; 5. Structure of matter. 1. Introduction to solid state chemistry 2. Principles of Inorganic Chemistry 3. Symmetry, Structure, and Tensor Properties of Materials 4. Principles of Chemical Science.

Thus, Al-Farabi Kazakh National University students are given the opportunity to choose a Massive Open Online Course (MOOC) as an alternative to the discipline they are studying as part of their chosen educational program.

Also during both spring and fall semesters of the academic year 2020-2021, 126 exams were held in the alternative form, where students were re-credited with certificates from online courses upon successful completion of the course. In Chemistry, the number of retakes was 20 and the number of alternative exams was 2.

Digital tools were introduced in the educational process for several disciplines Kahoot: General and inorganic chemistry; Physical chemistry, catalysis and petrochemistry; Kahoot and Quizizz: General and inorganic chemistry; Miro: Chemistry and technology of organic substances, natural compounds and polymers; Kahoot and Miro: Analytical chemistry.

Also a video lecture by visiting foreign professor Yitzhak Mastai was recorded, which is available to students majoring in Chemistry.

Despite the focus of this curriculum on the training of a research chemist and expert chemist, the specialty «Chemistry» creates the basis on which the necessary digital resources for the transfer of a number of curriculum disciplines to online format or distance learning technologies are provided.

Conclusion

Based on the analysis we can make appropriate conclusions regarding the partial transfer of disciplines to the online format or distance learning technologies. The need for such a study is explained by the fact that in the conditions of the lockdown associated with the COVID-19 pandemic we were convinced that despite the unexpected situations, the educational process cannot be interrupted, and universities must be ready for such a force majeure at any moment. Moreover, global trends and modern challenges set the task of digitalization of the educational process.

In the context of the transition to distance learning technologies, higher education institutions should do the following:

– conduct an analysis of the material, technical, technological capacity and qualitative composition of teachers, which will help assess the real potential and preparedness of faculties for the transition to distance learning technologies;

– to identify problems of objective and subjective nature in the implementation of educational programs in humanities, science and technical specialties in the transition to distance learning technologies by conducting quantitative and qualitative studies of effective management of education, considering the motivational structure of the subjects of learning;

– to identify key indicators of difference between traditional and innovative forms of learning and make a proper list on it;

– to determine the specifics of traditional and distance learning technologies, including online learning format, by studying the results of scientific research and sociological surveys in the form of questionnaires, interviews and focus groups among management, lecturers and students;

– to check the content of programs and teaching materials of universities of different profiles and statuses in order to identify the compliance of educational programs in the humanities, scientific and technical specialties and their level of adaptability to the transition to distance learning technologies.

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