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Custom-Tailored Programs Development and Realization for Professional Skills in Synchrotron and Neutron Investigation during Pandemics

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Abstract

The paper presents the experience of National Research Tomsk Polytechnic University (TPU) and its partner-organizations in development and realization of academic programme that comprises online school for early-career researchers and custom-tailored programs for vocational training and competences enhancement within the topic «In situ techniques for synchrotron investigation for multilayered functional structures with unique parameters and properties developed with plasma and beam surface engineering». The academic programme is unique presentation of experience of re-search and training organizations. The specifics of the academic programme include its realization via hybrid and blended format in the new novel, the situation of pandemics. The academic programme was implemented within Federal research and engineering programme for development of synchrotron and neutron investigations and research infrastructure for 2019 – 2027 – federal grant subsidy to develop and enhance the professional skills of specialists from academic and research institutions. The academic programme was an interactive e-learning experience that allowed for hybrid and blended teaching and learning for organizing institutions and academic events participants. The knowledge, skills and competences addressed were developed. The teaching goals successfully met the learning outcomes. The recommendations to boost teaching and learning in the new novel for academic and research

institutions specialists are underway including academic solutions through interactive tutorials and exercises, a facilitated online discussion, and individual work; also, requirements are developed for successful completion of the academic events within the academic programme.

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Keywords

Custom-tailored programs, blended learning, pandemics, synchrotron and neutron radiation, education.

Context

The paper presents the experience of National Research Tomsk Polytechnic University (TPU) and its partner-organizations in development and realization of academic programme that comprises online school for early-career researchers and custom-tailored programs for vocational training and competences enhancement within the topic «In situ techniques for synchrotron investigation for multilayered functional structures with unique parameters and properties developed with plasma and beam surface engineering». The academic programme is unique presentation of experience of research and training organizations. The specifics of the academic programme include its realization via hybrid and blended format in the new novel, the situation of pandemics. The academic program was implemented within Federal research and engineering programme for development of synchrotron and neutron investigations and research infra-structure for 2019 – 2027 – federal grant subsidy to develop and enhance the professional skills of specialists from academic and research institutions.

Purpose

The academic programme embraces the development and realization of online school for early-career researchers for synchrotron and neutron research and development works; development and realization of the custom-tailored programs for vocational training and competences enhancement; including development and realization of lecture series, laboratory sessions and practicals as teaching aids and assessment materials. The academic programme target audience is senior students, postgraduate and PhD students of universities majoring in Physics, Theoretical Physics and Material Studies and students of other neighboring majors; as well as research and teaching staff of higher education institutions, research fellows of research and academic institutions. The realization of such academic programme is conditioned by continuous demand in highly trained specialists who possess professional skills for academic and research institutions. The research question is in enhancement of professional skills via vocational training enabling synchrotron and neutron radiation, beam and plasma engineering, implementation of X-ray and neutron optics. This paper discusses objectives and skills and competences for professional performance demonstrated by the programs participants within custom-tailored vocational training and competences enhancement programs designed and implemented. The custom-tailored programs for vocational training are «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»; «Generating

synchrotron and neutron radiation for investigation of materials properties». The training programs were realized for early-career specialists. There was developed and realized online school in the field of synchrotron and neutron investigation (and developments) for early-career researchers entitled as «Online school for early-career researchers on using synchrotron and ionizing radiation». The academic programme with above mentioned academic events (training programs and online school) was delivered via hybrid and blended format during pandemics. The teaching methods and formats suggested for the delivery of lecture series, laboratory sessions and practicals as well as assessment materials and methods prove to be efficient.

Approach

Programs Description

Based on the plan developed there are two custom-tailored programs for vocational training and competences enhancement designed; these are «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»; and «Generating synchrotron and neutron radiation for investigation of materials properties».

Training of early-career researchers within the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» was delivered. «Online school for early-career researchers on using synchrotron and ionizing radiation» was realized for early-career researchers. The training programs within the framework of the supported by federal subsidy academic programme comprises lecture series, practicals, laboratory sessions and independent studies hours. The programs (including online school) were delivered via hybrid and blended format that is via zoom, online and face-to-face meetings, see Table 1 below.

Table 1 - Delivery methods suggested for the teaching formats

Teaching formats	Delivery method
lecture series	online (synchronous lectures; zoom meetings)
practicals	online and face-to-face meetings
laboratory sessions	online and face-to-face meetings
independent studies	online and face-to-face meetings

The custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties» was developed jointly by National Research Tomsk Poly-technic University (TPU), National Research Tomsk State University (TSU), Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences, and Institute of Strength Physics and Materials Science of Siberian Branch of Russian Academy of Sciences (ISPMS SB RAS).

The custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties» comprises 108 delivery hours and was realized in the peri-od of November-December 2021. Its target audience is senior students, postgraduate and PhD students, university research and teaching staff. The main learning objective is to form professional competences in the field of using sources of synchrotron and neutron radiation to study materials properties. Upon the program completion the participants developed thorough understanding of the synchrotron and neutron radiation main properties. The programme participants got acquainted with techniques for material properties investigation using

synchrotron and neutron radiation, as well as the state-of-the-art techniques to investigate materials structure using the method of structural analysis. The program participants were awarded with the certificates of vocational training and competences enhancement, see Table 2.

The online school «Online school for early-career researchers on using synchrotron and ionizing radiation» was organized by National Research Tomsk Poly-technic University; Institute of High Current Electronics of Siberian Branch of Russian Academy of Sciences (IHCE). The online school took two days, 4 hours each day, in the period of 7-8 December 2021 [Online school..., www] and included invited expert talks covering the topics such as the principles of generation and main properties of synchrotron radiation; diffraction techniques for investigation of functional materials with synchrotron radiation; X-ray spectroscopy of functional materials; In situ diffractometry with time resolution; X-ray tomography and microscopy; neutron diffraction for investigation of materials. Upon the online school completion the participants were awarded with the Certificate of Attendance and Participation, see Table 2 below.

The custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» was designed jointly by National Research Tomsk Polytechnic University (TPU), Tomsk State University of Control Systems and Radio-Electronics (TUSUR), and Institute of Strength Physics and Materials Science of Siberian Branch of Russian Academy of Sciences (ISPMS SB RAS); and Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences.

The custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» comprises 252 delivery hours and is focused on professional and ad-vanced training of postgraduate and PhD students, university research and teach-ing staff and research fellows of research and academic institutions. The program is delivered in the period of March-May 2022. The programme will pro-vide the participants with thorough understanding of the state-of-the-art techniques in radiation-plasma engineering of materials including common flow diagrams for ion, plasma and ion-plasma modification, materials treatment with concentrated energy flows as well as peculiarities of inspection with ionizing radiation. Further to that, the programme participants will learn about testing techniques and diagnostics of material structure using synchrotron and neutron radiation.

The learning process ends up with the defense of final attestation paper. The works for the final attestation paper are performed on the premises of organizations – partners within this programme; the research supervisors may be chosen from any organization which takes part in this programme realization. Some sample topics of final attestation papers are given here: 1. Analysis of structural and phrase state of titanium-based construction materials during gaseous phase hydrogen saturation using X-ray diffraction technique with synchrotron radiation sources. 2. Corrosion resistance of zirconium alloys with protective coatings and assessment of elements` interdiffusion using neutron and synchrotron radiation. Upon the programme completion the participants will be awarded with the diploma for vocational training, see Table 2 below.

During the learning process within the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» participants are allowed to the laboratories and synchrotron radiation source of Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences, located in Novosibirsk. Budker Institute is one of the leading centers in the world in a number of fields investigating high energy physics and accelerator; plasma physics and controlled thermonuclear fusion. Budker Institute conducts large-scale experiments in the field of elementary particles physics using

electron-positron colliders and unique complex of open plasma traps. In Budker Institute up-to-date accelerators are being developed; as well as intensive sources of synchrotron radiation and lasers on free electrons. Budker Institute is the only one in Russia in the majority of fields of its work [Budker Institute, www].

For the custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties» by TPU there were lecture series and practicals developed entitled as «Radiation safety and security provision in the field of using ionizing radiation sources (generating)»; «Electromagnetic radiation of charged particles»; «Physics and equipment for the sources of synchrotron and neutron radiation»; «Basics of X-ray and neutron optics» [Report..., 2021].

The academic programme discussed (including two custom-tailored programs and online school) has several unique features. The first one is its focus on target audience embracing research and teaching staff. The teaching process within this programme allows to pass on the experience of research and training organizations that realize the programme not only to students but also to research staff and fellows of academic and research organizations so that their knowledge can be broadened, and skills and competences trained can be immediately used in practice.

The second unique feature of the academic programme is that the programme participants have the opportunity to immediately solve the real actual problems using mega equipment and instrumentation. The academic programme provides for knowledge and skills and competences to enable solutions for real problems in solving which the programme participants are engaged at their institutions. This is embodied in practicals, laboratory works assignments and guided independent studies; as well as in summative assessment that is in pass/fail test and/or final attestation paper [ibid.].

The third unique feature of the academic programme is its delivery mode. Teaching and learning process takes place in blended format: all theoretical lectures are delivered online; practicals will be held in the laboratories of organizations, which are participants of academic programme using real equipment and instrumentation. Such combination allows for the programme participants not only enhance or brush up the knowledge within the topic stated but also master the up-to-date research and technology techniques targeted within the programme accomplishment.

Table 2 - Academic Event and Document of Completion Provided

Academic event	Document of completion provided
the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»	diploma for vocational training
the custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties»	certificate of vocational training and competences enhancement
«Online school for early-career researchers on using synchrotron and ionizing radiation»	Certificate of Attendance and Participation

All academic events described have the objectives, skills and competences to be trained via blended and hybrid format which is discussed further.

Programs Delivery

The academic programme discussed in this paper comprises three academic events as mentioned earlier: «Online school for early-career researchers on using synchrotron and ionizing radiation»; the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»; the custom-tailored program for

vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties».

Blended learning format of the academic programme realization is conditioned by the pandemics and participation of organizations and programme participants with different geographical locations (in Russia: Tomsk, Novosibirsk, Ufa; in Poland: Lublin). Interactive e-learning experience suggested hybrid format with-in blended learning approach to academic events delivery [Lider et al., 2021]. Blended and hybrid format including zoom sessions meets the needs of academic events` instructors and participants while delivering engaging content. They also allow for assessing academic events participants` progress and managing a blended learning classroom.

Hybrid and blended format allow for online synchronous lectures; formatting independent studies flexible along with work and studies of the academic program participants. Roughly put in around 10-12 hours per week for the custom-tailored programme for vocational training and competences enhancement (108 total hours) and 20-22 hours per week for the custom-tailored programme for vocational training (252 total hours); and 4 hours per day for the online school (8 total hours) [Online school..., www; Report..., 2021].

The academic events – the custom-tailored programs encompass lectures, practicals, laboratory sessions and independent studies as given in Table 3 below. Online school integrated invited guest speakers talk.

Table 3 - Number of delivery hours for academic events

Academic event	lectures	practicals	lab session	independent studies	total number of delivery hours
the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»	148	40	16	48	252
the custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties»	62	20	--	26	108
«Online school for early-career researchers on using synchrotron and ionizing radiation»	2 days 8 hours	--	--	--	8

The academic events developing and realization were performed by the following organizations, as in Table 4 below.

Table 4 - Institutions Involved in Academic Events Realization

Academic event	Institutions involved in realization
Online school for early-career researchers on using synchrotron and ionizing radiation	Organizers: National Research Tomsk Polytechnic University; Institute of High Current Electronics of Siberian Branch of Russian Academy of Sciences (IHCE). Online lectures were offered by experts from Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences; Institute of Solid State Chemistry and Mechanochemistry

Academic event	Institutions involved in realization
	of the Siberian Branch of the Russian Academy of Sciences; Federal Innovation Centre of Branch of Boreskov Institute of Catalysis of the Russian Academy of Sciences; and The Catholic University of Lublin.
Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation, custom-tailored programme for vocational training	National Research Tomsk Polytechnic University; Tomsk State University of Control Systems and Radioelectronics; Institute of Strength Physics and Materials Science of Siberian Branch of Russian Academy of Sciences; Budker Institute of Nuclear Physics of the Russian Academy of Sciences.
Generating synchrotron and neutron radiation for investigation of materials properties, custom-tailored programme for vocational training and competences enhancement	National Research Tomsk Polytechnic University; Institute of Strength Physics and Materials Science of Siberian Branch of Russian Academy of Sciences; Budker Institute of Nuclear Physics of the Russian Academy of Sciences; National Research Tomsk State University.

Theoretical material delivered in lectures online allows for online material organization to form professional knowledge background and enhance creativity, solve problems, with further building personal behavior provided in face-to-face meetings.

The programs content is distributed among materials delivered via online, in face-to-face meetings and assignments. This approach requires learning management to be done with balancing individual and group tasks, including individual and group assignments for assessment [Budiningsih, 2019]. The delivery mode (online, zoom meeting, face-to-face) is given in Table 1 above.

With different geographical locations as well as due to pandemics, blended for-format for lectures delivery is supported by hybrid format of practicals, laboratory sessions and independent studies realization. The specifics of independent studies organization is its guided format for the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» and the custom-tailored program for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties». As a way of summative assessment, in the first case the programme participants are to take pass/fail test and in the second programme along with pass/fail tests for each module, the programme participants are to prepare final attestation paper and defend it in viva. The assessment measures are discussed further in this paper.

Actual Outcomes

Programs objectives, skills and competences stated

The programme academic events have the following objectives and concept for realization, presented in Table 5.

Table 5 - Academic Events` Objectives and Concepts

Name of academic event	Objective of academic event	The Concept of academic event
Online school for early-career researchers on using synchrotron and ionizing radiation.	To form professional outlook in the field of using synchrotron and neutron radiation to solve different problems in fundamental and applied science.	To learn about up-to-date state of science and techniques for investigation based on interaction of synchrotron and neutron radiation with matter.
Techniques to investigate properties of materials modified by beam-plasma	To form professional competences in the field of investigation of materials properties modified by beam-plasma	To form thorough understanding about state-of-the-art techniques of plasma and radiological engineering of

Name of academic event	Objective of academic event	The Concept of academic event
engineering using ionizing radiation, custom-tailored programme for vocational training.	engineering using ionizing radiation.	materials, including common schematic diagrams of ion, plasma and ion-plasma modification; materials treatment with concentrated energy flows and peculiarities of inspection methods using ionizing radiation. Participants will get acquainted with the techniques for diagnostics of materials structure using synchrotron and neutron radiation.
Generating synchrotron and neutron radiation for investigation of materials properties, custom-tailored programme for vocational training and competences enhancement.	To form professional competences in the field of using synchrotron and neutron radiation sources to study materials properties.	To form thorough understanding about the techniques of investigating materials properties using synchrotron and neutron radiation. Participants will get acquainted with up-to-date techniques to investigate materials structure using structural characterization - precision diffractometry, anomalous scattering, in-situ diffraction scanning; diffractometry using hard synchrotron radiation.

The academic events gathered participants from various education and research institutions, numbers are given in Table 6 below.

Table 6 - Number of Participants

academic event	number of participants	category of target audience
Online school for early-career researchers on using synchrotron and ionizing radiation.	134	including 102 persons under 39 years old (the requirement of federal subsidy – grant provision)
Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation, custom-tailored programme for vocational training.	29	including 9 research fellows; 3 university research and teaching staff; 9 master degree students; 8 PhD students
Generating synchrotron and neutron radiation for investigation of materials properties, custom-tailored programme for vocational training and competences enhancement.	11	including 11 research fellows

In total the academic programme has gathered 172 participants. Participation in both custom-tailored programs for vocational training and competences enhancement and online school is free for the participants. The programme realization is supported within Federal research and engineering programme for development of synchrotron and neutron investigations and research infrastructure for 2019 – 2027 – federal grant subsidy.

Assessment Formats

Two custom-tailored programs for vocational training for early-career re-searchers are supported by the following summative and formative assessment developed within this academic programme, see Table 7.

Table 7 - Formats of summative and formative assessment suggested for two custom-tailored programs for vocational training

Academic events	Formats of summative and formative assessment
custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation»	assessment via testing including multiple choice testing; presentation and defence of laboratory works; practicals assignments and pass/fail test for each module; and final attestation paper
custom-tailored programme for vocational training and competences enhancement «Generating synchrotron and neutron radiation for investigation of materials properties, custom-tailored programme for vocational training»	assessment via testing including multiple choice testing; presentation and defence of laboratory works; practicals assignments and pass/fail test

In overall the professional skills of specialists for academic and research institutions are decomposed into knowledge; skills and competences formulated and delivered by TPU and its partner organizations within this academic programme. Assessment within both custom-tailored programs comprises the following main parts. The specifics are that formative assessment becomes part of summative assessment. Other specifics for the custom-tailored programme for vocational training «Techniques to investigate properties of materials modified by beam-plasma engineering using ionizing radiation» is accumulation of learning out-comes in the final attestation paper. The topics for final attestation paper are dis-cussed in Section 3.1. The assessment formats and their description are provided in Table 8.

Table 8 - The Assessment Formats and Their Description

Type of assessment	Name of assessment format	Description
summative and formative	Testing	Testing is conducted in the format of multiple choice questionnaire; participants need to choose the correct answer to each question. Each correct answer is graded with one point. Upon the test completion the programme participants are awarded with the number of points gained for the correct answers. The testing is to contain five questions as its minimum with four answer options in each. This is not an open book test; the programme participants are not allowed to use any teaching and learning aids; instructions or calculators.
formative	Defense of laboratory work	Laboratory works are being assessed by a programme instructor. The programme participant hands in the detailed laboratory work report. The programme instructor asks questions in relation to the information provided in the laboratory work report. Under assessment are detailed and broadness of description of laboratory work results; comprehension of theoretical basis of the technique used to perform the laboratory work.
formative	Practical session	Practical session is conducted in the format of solving typical problems. The session is instructor guided; the programme participants solve the problems on their own, independently. The skills to solve problems independently within the topic given are evaluated.
summative	Pass/Fail test	Pass/fail test is conducted by the end of the studies in oral format. During final attestation the programme participants prepare the answers to the questions within the whole range of the topics covered within the programme. The evaluation criteria for the answers include quality, details and breadth of answer provided.

Type of assessment	Name of assessment format	Description
summative	Final attestation paper	The final attestation paper encompasses solution provided by the programme participant to real actual problem. See the suggested topics above in this paper.

Independent studies in blended teaching and learning are delivered in guided format. The independent studies are focused on each topic – module within the custom-tailored programs and presuppose the following:

- Studies of readings – lecture materials; literature and online resources search and review concerning the individually set problem within the programme.
- Studying the topics assigned for individual studies.
- Search, analysis, structuring and presentation of the information.
- Translation of the texts from foreign languages.
- Analysis of research publications within the set in advance topic approved by a programme instructor.
- Preparation to assessment measures [Report..., 2021; Lider et al., 2021].

Guided independent studies secured the programs participants` progress through the custom-tailored programs delivery. Realizing blended and hybrid delivery mode allowed for exploration of how instructional activities can be integrated into a blended learning environment; learning about the various purposes for assessment; exploration of formative assessment strategies for blended classroom; consideration of the benefits of summative assessment methods; de-sign assessment timeline; and exploration of considerations for implementing effective blended learning programs; as well as learning management techniques for creating outcome-based learning environment for academic events participants` to gain practical skills and professional competences which are in demand by academic and research institutions.

Conclusions

The academic programme was an interactive e-learning experience that allowed for hybrid and blended teaching and learning for organizing institutions and academic events participants. The knowledge, skills and competences addressed were developed. The teaching goals successfully met the learning outcomes. The recommendations to boost teaching and learning in the new novel for academic and research institutions specialists are underway including academic solutions through interactive tutorials and exercises, a facilitated online discussion, and individual work; also, requirements are developed for successful completion of the academic events within the academic programme.

References

1. Budiningsih C. et al. (2019) The Development of Blended Learning Theories of Learning Course for Educational Technology Student in FIP UNY. *International Conference on Meaningful Education*, 171, pp. 170-182.
2. *Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences Homepage*. Available at: <https://www.inp.nsk.su/budker-institute-of-nuclear-physics> [Accessed 06/06/2022]
3. Lider A.M., Sklyarova E.A., Slesarenko I.V. (2021) Vozmozhnosti universiteta v organizatsii uchebnogo protsessa v gibridnom formate v usloviyakh pandemii [Possibilities of the university in organizing the educational process in a hybrid format in a pandemic]. In: *Budushchee sistemy obrazovaniya v usloviyakh COVID-19* [The future of the education system in the context of COVID-19].
4. *Online school for early-career researchers on using synchrotron and ionizing radiation*. Available at:

- <http://portal.tpu.ru/science/konf/snr/>, last accessed 2022/04/22 [Accessed 06/06/2022]
5. (2021) *Otchet o vypolnennykh rabotakh po realizatsii issledovatel'skoi programmy (proekta) po teme: «In situ metody sinkhrotronnykh issledovaniy mnogoslownykh funktsional'nykh struktur s unikal'nymi parametrami i svoistvami, sozdannykh puchkovo-plazmennoi inzheneriei poverkhnosti» (promezhutochnyi)* [Report on the work performed on the implementation of the research program (project) on the topic: "In situ methods of synchrotron studies of multilayer functional structures with unique parameters and properties created by beam-plasma surface engineering" (interim)]. Tomsk.
 6. Orchakova L.G., Smirnova Yu.V. Internet and higher education: prospects, challenges, problems. // Opcion. 2020. T. 36. № S26. С. 76-93.
 7. Alekseicheva E.Yu. (2021) Gumanizatsiya obrazovaniya kak sposob sozdaniya gumannogo budushchego [Humanization of education as a way to create a humane future] Metodologiya nauchnykh issledovaniy. materialy nauchnogo seminar. / Ser. «Biblioteka Masterskoj orgdeyatel'nostnykh tekhnologij MGPU». [Methodology of scientific research. materials of the scientific seminar. / Ser. "Library of the Workshop of organizational activity technologies of MSPU". Yaroslavl]. pp. 131-135.
 8. Alekseicheva E.Yu. (2021) Mnogomernoe obrazovanie: vybor ili predopredelennost' [Multidimensional education: choice or predestination] Metodologiya nauchnykh issledovaniy. materialy nauchnogo seminar. / Ser. «Biblioteka Masterskoj orgdeyatel'nostnykh tekhnologij MGPU». Yaroslavl' [Methodology of scientific research. materials of the scientific seminar. / Ser. "Library of the Workshop of organizational activity technologies of MSPU"]. Yaroslavl. pp. 201-204.
 9. Alekseicheva E.Yu. (2019) Nepreryvnoe obrazovanie v kontekste global'nykh trendov razvitiya ekonomiki vpechatlenii [Life-long learning in the context of global trends of the development of the experience economy] Novoe v nauke i obrazovanii. Sbornik trudov mezhdunarodnoi ezhegodnoi nauchno-prakticheskoi konferentsii. Otvetstvennyi redaktor Yu.N. Kondrakova. M.: ООО "Maks Press". [The International Annual Scientific and Practical Conference "New in Science and Education", organized by Jewish University. Ed. by Kondrakova Yu. N. Moscow: MAKS Press] pp. 5-15
 10. Alekseicheva E.Yu. (2021) Sovremennye podhody k organizatsii kreativnogo obrazovaniya [Modern approaches to the organization of creative education] Metodologiya nauchnykh issledovaniy. materialy nauchnogo seminar. / Ser. "Seriya «Biblioteka Masterskoj orgdeyatel'nostnykh tekhnologij MGPU». Vyp. 2" Moskovskij gorodskoj pedagogicheskij universitet (MGPU). Yaroslavl' [Methodology of scientific research. materials of the scientific seminar. / Ser. "Series "Library of the Workshop of organizational and activity technologies of MSPU". Issue 2" Moscow City Pedagogical University (MSPU). Yaroslavl] p. 215-219

Разработка и реализация индивидуальных программ повышения квалификации специалистов по синхротронным и нейтронным исследованиям в период пандемии

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Аннотация

В статье представлен опыт Национального исследовательского Томского политехнического университета (ТПУ) и его организаций-партнеров по разработке и реализации образовательной программы, включающей в себя онлайн-школу для начинающих исследователей и специализированные программы профессиональной подготовки и повышения квалификации в рамках тема «Методы синхротронного исследования многослойных функциональных структур с уникальными параметрами и свойствами, разработанные с помощью плазменной и лучевой инженерии поверхности». Академическая программа представляет собой уникальную презентацию опыта научно-исследовательских и обучающих организаций. Специфика академической программы заключается в ее реализации в гибридно-смешанном формате в новом формате, ситуации пандемии. Академическая программа реализована в рамках Федеральной научно-технической программы развития синхротронных и нейтронных исследований и исследовательской инфраструктуры на 2019 – 2027 годы – федеральная грантовая субсидия на развитие и повышение квалификации специалистов академических и научных организаций.

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Лидер А.М., Склярлова Е.А., Слесаренко И.В. Custom-Tailored Programs Development and Realization for Professional Skills in Synchrotron and Neutron Investigation during Pandemics // Педагогический журнал. 2022. Т. 12. № 4А. С. 525-537. DOI: 10.34670/AR.2022.37.56.063

Ключевые слова

Индивидуальные программы, смешанное обучение, пандемии, синхротронное и нейтронное излучение, образование.

Библиография

1. Budiningsih C. et al. The Development of Blended Learning Theories of Learning Course for Educational Technology Student in FIP UNY // International Conference on Meaningful Education. 2019. Vol. 171. P. 170-182.
2. Budker Institute of Nuclear Physics of Siberian Branch of Russian Academy of Sciences Homepage. URL: <https://www.inp.nsk.su/budker-institute-of-nuclear-physics>
3. Online school for early-career researchers on using synchrotron and ionizing radiation. URL: <http://portal.tpu.ru/science/konf/snr/>, last accessed 2022/04/22
4. Orchakova L.G., Smirnova Yu.V. (2020) Internet and higher education: prospects, challenges, problems. Opcion. Т. 36. № S26. pp. 76-93.
5. Алексейчева Е.Ю. Гуманизация образования как способ создания гуманного будущего // Методология научных исследований. материалы научного семинара. / Сер. «Библиотека Мастерской оргдеятельностных технологий МГПУ». Ярославль, 2021. С. 131-135.
6. Алексейчева Е.Ю. Многомерное образование: выбор или предопределенность // Методология научных исследований. материалы научного семинара. / Сер. «Библиотека Мастерской оргдеятельностных технологий

-
- МГПУ». Ярославль, 2021. С. 201-204.
7. Алексейчева Е.Ю. Непрерывное образование в контексте глобальных трендов развития экономики впечатлений // Новое в науке и образовании. Сборник трудов международной ежегодной научно-практической конференции. Ответственный редактор Ю.Н. Кондракова. 2019. М.: ООО "Макс Пресс". 2019. С. 5–15.
 8. Алексейчева Е.Ю. Современные подходы к организации креативного образования // Методология научных исследований. материалы научного семинара. / Сер. "Серия «Библиотека Мастерской оргдеятельностных технологий МГПУ». Вып. 2" Московский городской педагогический университет (МГПУ). Ярославль, 2021 С. 215-219
 9. Лидер А.М., Склярова Е.А., Слесаренко И.В. Возможности университета в организации учебного процесса в гибридном формате в условиях пандемии // Будущее системы образования в условиях COVID-19. 2021. С. 67-71.
 10. Отчет о выполненных работах по реализации исследовательской программы (проекта) по теме: «In situ методы синхротронных исследований многослойных функциональных структур с уникальными параметрами и свойствами, созданных пучково-плазменной инженерией поверхности» (промежуточный). Томск, 2021. 97 с.