INTEGRATED TECHNOLOGIES IN THE EDUCATIONAL PROCESS OF PROFESSIONAL TRAINING

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Abstract: Scientific research aims to investigate the influence of integration technologies on the quality of professional training of education seekers. The integrated educational disciplines of higher education institutions that prepare students of pedagogical specialties and future specialists in the medical field are analyzed. The results of a pedagogical experiment were presented, during which the importance of these integrated courses for students was studied in order to strengthen their professional training and formation of general competencies. Motivators for choosing integrated courses by students during the shaping of personal educational trajectories are identified and prioritized. Industry-related difference in determining motivators and choosing educational integration technologies is confirmed.

Keywords: Educational technologies, Integrative strategy in education, Interdisciplinarity, Multidisciplinarity, Pedagogical specialties, Professional training, medical specialists, Transdisciplinarity.

1 Introduction

Globalization processes have led to transformations in education, the need to update the educational strategy, and the use of innovative educational technologies [13]. One of the modern leading methodological principles of education has become integration as a process of creating a holistic and multidimensional picture of the world. The construction of an educational system based on an integrative approach ensures the successful realization of an education seeker in society. The implementation of this strategy expands the boundaries of the study of the surrounding world, overcomes the alienation between humanitarian and natural components of knowledge, contributes to the formation of education seekers' competencies that meet the demands of a dynamic information society.

From a philosophical point of view, the didactic integration of scientific knowledge is determined by the integration of natural, technical and social sciences. In pedagogy, integration in the educational process is interpreted as the selection and combination of educational content from various disciplines for the purpose of integral, systematic and versatile study of important cross-cutting topics (thematic integration); creation of integrated learning content – educational components that combined knowledge from various fields into a single whole [10, p. 16].

Integrativeness is understood by scientists-pedagogues as: focus on integral courses, search for new approaches to structuring knowledge as a means of holistic understanding and knowledge of the world [11, p. 139]; interdisciplinary cooperation of scientific research and educational components, content and structural-functional unity of the educational process.

Comenius [4, p. 132] noted: “Everything that is in a mutual connection should be explained in such a connection”. Therefore, the implementation of integration as a didactic principle occurs through the construction of integrated educational components, the development of interdisciplinary connections, the use of integrated forms of education, etc. In order to effectively implement pedagogical integration, it is necessary to use the integration of traditional and innovative educational technologies.

Educational technologies, which are associated with integrative processes in education, are most often classified as follows: interdisciplinary, multidisciplinarity, crossdisciplinarity, interdisciplinarity and the most progressive integration trend – transdisciplinarity.

Disciplinarity involves the study of a phenomenon or process within one discipline, which often limits knowledge of the object through subject boundaries. Adding knowledge and methods from other disciplines to the process of learning is interpreted as interdisciplinarity. More recently, the term "interdisciplinary" has become fashionable and is used in a wide range of contexts, always in the sense of broadening the perspective of knowledge [17, p. 9]. Interdisciplinarity has the ability to generate new disciplines (for example, media didactics, economic informatics, biochemistry, bioethics, and others). The study of the phenomenon by means of the integration of several educational components with separate disciplinary goals, the comparison of the obtained results is multidisciplinary research.

Interdisciplinarity is aimed at the use of unrelated disciplines (for example, natural sciences with humanities, medical with natural sciences, etc.). At the same time, not only the study of the phenomenon takes place, but also the creation of new knowledge and theories.

Transdisciplinarity consists in deepening the connection between educational processes and real life situations. Its essence is “not in the mastery of one or more disciplines, but in the unfolding of all disciplines to the level at which they are united and to the awareness and understanding that lies beyond them” [5]. Thanks to this educational technology, life skills are best formed for the realization of personality in real life. After all, transdisciplinarity is connected with the unification and unity of knowledge.

Nicolescu B. (2002, 2010) [15, 16] claims that there is an urgent need for bridges between different educational components, which was reflected in the emergence of multidisciplinarity and interdisciplinarity in the middle of the twentieth century. The scientist interprets the concepts of inter-, multi- and transdisciplinarity as a triad of approaches to crossing disciplinary boundaries, defining transdisciplinarity as a higher level, because transdisciplinarity refers to what is simultaneously between disciplines, between different disciplines and beyond the boundaries of all disciplines. Its purpose is to understand the modern world, one of the imperatives of which is the unity of knowledge.

Ya. Chaika [1] notes that multi- and interdisciplinarity is understood as a temporary interaction between scientific disciplines; inter- and transdisciplinarity are considered more sustainable types of knowledge synthesis. According to U. Koshetar [8, p. 62], transdisciplinarity is becoming a trend of modern education policy, which will significantly affect the principle of equal access to quality education.

Edgar Morin [12] believes that it is better to be able to structure a thought well in the head than to have a head that is only filled with a large amount of knowledge: the accumulation of a large amount of knowledge without proper organization is worth nothing. Only a complete system of knowledge gives an individual the ability to comprehensively solve problems. Knowledge obtained thanks to integrative educational technologies acquires practical meaning.

In the Ukrainian educational system at its various levels (starting from primary education to adult education), an integrative strategy of building the content of disciplines and the educational process in general is actively being implemented. The directions of educational integration are distinguished by the goals of the educational process, by educational content, by forms and methods.

The idea of integration is a determining factor in the Concept of the New Ukrainian School (NUS), according to which, since

2017, preschool, primary and general secondary education in Ukraine has been gradually modernized.

According to L. Nikolenko [14], integration solves the main contradictions of education – the contradiction between the limitlessness of knowledge and limited human resources and "the use of an integration approach in primary education contributes to the formation of a holistic picture of the world in younger schoolchildren, the development of systemic thinking, the ability to perceive objects and phenomena in a variety of ways, systematically, gives students the opportunity to form qualitatively new knowledge of a higher level of thinking, the dynamism of their application in new situations, the flexibility of the mind, the ability to generalize knowledge from various subjects, a creative attitude to work appears, the ability to solve complex practical tasks that require the synthesis of knowledge from various scientific fields". After all, in all educational systems, school education is aimed not only at preparing students for the transition to the next level of education path, but also at preparing them for life in the real world [20, p. 170].

Integration is not limited to primary school: it is a good base for further studies both at school and for obtaining professional education. According to T. Zasiekina [21, p. 50], today pedagogical integration is defined as the leading idea of the modern reform of general secondary education, therefore the integrative approach (a set of methodological ways of implementing integration) should be leading and interconnected with competence-based, personally oriented, activity-based, etc. theory and practice of school education.

The practical implementation of an integrative strategy in general secondary education is the creation of model curricula, the analysis of the content of which becomes a relevant topic for the intellectual and personal reflection of scientific and pedagogical workers, teachers of general secondary education institutions in general and teachers in particular [19, p. 41]. Also a good example is the STEAM approach in education, which is based on integrated learning according to certain topics, rather than individual disciplines, which is ensured by the planning of educational disciplines on an interdisciplinary basis.

The most common of the integration processes in professional training in institutions of higher education (HEIs) are those arising from the integration of knowledge: integrated classes; creation of integrative courses and disciplines; integration of theoretical training and the practical component of professional training; integrated educational programs for training specialists.

Our goal is to study the methods of implementing an integrative strategy in higher education institutions and establish their effectiveness.

2 Materials and Methods

The following methods were used to achieve the goal:

1. The method of analysis and synthesis, by means of which the interpretation of the main types of educational technologies related to integrative processes in education (interdisciplinarity, multidisciplinarity, transdisciplinarity) is generalized on the basis of the developed source base.
2. Statistical quantitative and qualitative analysis of the results of the experiment.
3. Abstract-logical, with the help of which the results of the research are theoretically summarized, conclusions are given and recommendations are formulated for the application of innovative methods of integration in higher education.
4. Interviewing education seekers about the effectiveness and significance of integrated training courses.

3 Results

M. Kovalchuk (2021) argues that integration in the professional training of students of higher education institutions is: 1) an integrative process that involves the introduction of fundamental ideas and concepts into the content of educational components, which is the basis of the formation of holistic views; 2) the state of connectivity of individual differentiated parts and functions of the body system as a whole; 3) the process of bringing together and connecting some parts, elements, uniting them into a single whole, which occurs together with the processes of their differentiation. "Integrative connections in professional training are carried out through the generalization of knowledge, practical skills, skills, activity experience and information obtained in the system of subject education.

The integration of information adds information links that seem to "return" the object to the student from different sides in the process of subject actions. New aspects and connections are added to the existing conceptual framework through processes of generalization and differentiation. Internal integration processes that occur in the minds of students lead to external integration processes, the first of which is the integration of knowledge" [9]. Teachers, based on their own experience and knowledge, create integrated classes of various types: integrated lecture, integrated practical class, integrated seminar practicum, which are conducted both by teachers of one department and with the participation of teachers of other departments.

A variety of integrated training courses are offered for students of pedagogical specialties of Vasyl Stefanyk Prykarpattia National University (Ivano-Frankivsk, Ukraine) (PNU named after V. Stefanyk). For example, for bachelors majoring in Elementary Education:

- "Media didactics in elementary school", the purpose of which is aimed at forming students' awareness of modern media technologies and how they are used in the educational process of the New Ukrainian School by revealing the didactic potential of the multimedia space, technologicalization of subject methods of elementary school, active-activity interactive approach to the organization of classes, mastery of methodological techniques of media didactics and electronic digital resources;
- "Ethnopsychology", the purpose of which is the formation of a system of general theoretical and practice-oriented knowledge, abilities and skills related to the awareness of the national-psychological properties of a person of a certain ethnic culture, its mentality; understanding of the socio-psychological mechanisms of the creation and development of a nation and the mental characteristics of an ethnic group.

For bachelors – future teachers of biology and chemistry in general schools, among the selective educational components, "STEM education" is in demand, the main task of which is the formation of skills of integration pedagogical technologies for successful teaching of STEM subjects. Master's students of the same specialties study "Innovative technologies in STEM education".

Masters students, future primary school teachers, listen the following courses:

- Normative course "Methodology of electronic learning in primary school", thanks to which they get acquainted with the best European practices of electronic learning and the possibilities of their implementation in the work of a primary school teacher; develop digital literacy, pedagogical creativity in the application of modern teaching methods of STEAM subjects and integrated courses; study various e-teaching methods (mobile learning, problem-based learning, inquiry-based learning, project-based learning, etc.) and the use of research e-learning in the educational process educational environments (Inquiry Learning Spaces), online laboratories, educational games and simulations, educational videos; master the tools of visualization of educational components (creating infographics, editing images, etc.);

- Elective course "Geocultural Scientific Literacy", the purpose of which is to improve the English language skills of future primary school teachers with the help of innovative teaching tools based on English-language educational electronic resources; acquainting students with the cultural and geographical features of some countries, trends and perspectives of international policy in the field of education in the context of globalization by means of innovative pedagogical learning technologies; improving their geocultural scientific literacy.

The educational disciplines "Media didactics", "Innovative technologies in STEM education", "Methodology of electronic learning in primary school", "Geocultural scientific literacy" have been developed and implemented in the educational process of PNU since 2019 as part of the implementation of the EU Erasmus+ KA2 program project "Modernization of pedagogical higher education on the use of innovative teaching tools – MoPED" (No. 586098-EPP-1-2017-1-UA-EPPKA2-CBHE-JP), whose academic group included one of the co-authors of our study (Prof. Halyna Mykhailyshyn).

Ivano-Frankivsk National Medical University (Ivano-Frankivsk, Ukraine) (IFMNU) has planned "Integrated course in biomedical disciplines" and "Integrated course in fundamental disciplines' for 3rd-year students of all specialties. In addition to these educational courses, the following courses are offered as optional components for students of Medicine and Pediatrics specialties: "Medical and biological physics", "Modern problems of biophysics in medicine", "Fundamentals of bioethics and biosafety", "Medical-social problems of modern bioethics", "Medical informatics", "Web design in medicine", "Nutrient biochemistry (food biochemistry)". Future pharmacists can choose the courses "Medical Sociology", "Medicine and Artistic Culture", "Medical Local History", "Computer Technologies in Drug Research".

Most of the listed integrated training courses provide for the formation of IT competence in future specialists. Scientists prove that the most promising of the integration processes in the professional training of future specialists is the use of information technologies, since future specialists will have to work in the conditions of an information society, where the main thing is the ability to integrate into the global information space. A specialist today must acquire, protect and effectively use any information [7].

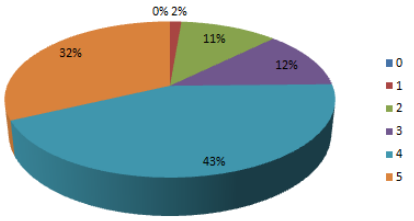
Information technology has changed the range of skills required for autonomous thinking. Modern education may eliminate exercises that develop memorization skills and focus on information integration skills. But the learner must realize that authentic knowledge requires some form of structural unity that cannot be found on the Internet. Therefore, Internet resources become useful only for those who have a sufficiently structured intellectual potential.

During 2020-2022, we surveyed students about the importance of the integrated courses we described for their professional training and the formation of general competencies. In particular, according to the results of the annual survey of students regarding the quality of teaching of academic disciplines, when evaluating selective educational components, it was found that students prefer integrated courses.

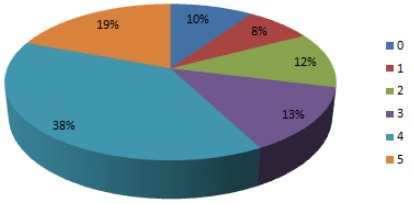
For our further research, we randomly selected 150 students of the Pedagogical faculty (PF) – future teachers of preschool education institutions and primary school teachers, 52 students of the Faculty of Natural Sciences (FNS) – future teachers from among the students of the PNU named after Vasyl Stefanyk chemistry and biology, and among the students of Ivano-Frankivsk National Medical University (IFNMU) there are 80 future doctors and pharmacists. Students were offered to rate from 0 to 5 points the degree of preference for the integrated course when forming the variable component of their educational trajectory. The obtained results are presented in Table 1 and displayed graphically in Figure 1: a), b), c).

Table 1: Degree of preference for integrated courses

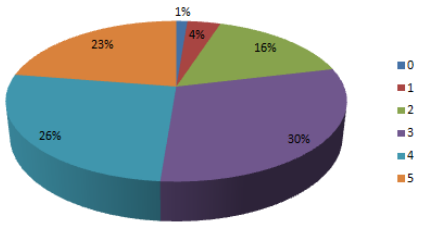
Group	The number of students by points												Total number of students	
	0		1		2		3		4		5			
	Q	%	Q	%	Q	%	Q	%	Q	%	Q	%	Amnt	%
PF	0	0	2	1,33	17	11,33	18	12	65	43,33	48	32	150	100
FNS	5	9,62	4	7,69	6	11,54	7	13,46	20	38,46	10	19,23	52	100
INFMU	1	1,25	3	3,75	13	16,25	24	30	21	26,25	18	22,50	80	100



a) PF students



b) FNS students



c) IFNMU students

Figure 1 – Steps of preference for integration courses of students

Thus, students of the faculty of pedagogy choose an integrated course more often: more than 75% rated their preferences with the highest scores of 4 and 5. In our opinion, this is due to the wide range of integrated courses offered to students, the relevance of topics, and the saturation of studying with the latest educational technologies. After all, future teachers will realize themselves as specialists in the conditions of the Concept of the National Academy of Sciences, which declares integration processes in education.

More than half of the surveyed future biologists and chemists (57.69%) study integrated courses, but 17.31% do not show a desire to gain knowledge with the help of integrative technologies. The analysis of educational programs followed by these students showed the need to update them with new and interesting courses, especially with the view on the fact that implementation of the NUS Concept after the modernization of the primary school moved into the second phase – the modernization of the general secondary world.

Almost half of future doctors (48.75%) give a stable preference to integrated courses, with 22.5% expressing the highest degree of preference and only 5% being indifferent (scores 0 and 1). In our opinion, this distribution of preferences is due to the presence in the curricula of large integrated courses – from

biomedical and from fundamental disciplines – which contribute to the deepening of the professional training of students of higher medical education.

The next stage of our research was a survey about the motivation for giving preference to studying integrated courses. To the question "What attracts you to studying an integrated educational course?" education seekers are offered the following answer options:

- Creates conditions for the formation of a holistic image of the world,
- Forms complex professional competences,
- Develops critical thinking and forms research interest,
- Increases motivation to study,
- Promotes creativity,
- Develops communication skills;
- Forms the ability to compare;
- Forms the ability to generalize and draw conclusions;
- Promotes comprehensive, harmonious and intellectual development of personality.

Most often, students noted the first five motivators and their answers were distributed as follows (see Table 2 and Figure 2):

Table 2: Motivators for choosing integrated courses by education seekers

Motivators		Students of Vasyl Stefanyk PNU				IFNMU students	
		PF		FNS			
		Q	%	Q	%	Q	%
M1	Creates condition for the formation of the holistic image of the world	79	52,67	31	59,62	54	67,50
M2	Forms complex professional competences	124	82,67	46	88,46	74	92,50
M3	Develops critical thinking and forms research interest	76	50,67	35	67,31	62	77,50
M4	Increases motivation to study	119	79,33	41	78,85	71	88,75
M5	Promotes creativity	01	67,33	38	73,08	50	62,50

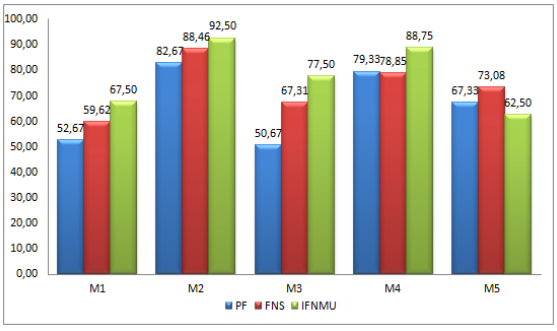


Figure2 – Distribution of students based on the motives of studying integrated courses

For future teachers, the most important integrated courses are for the formation of complex professional competences (82.67%) and strengthening of motivation to study (79.33%).

Students of the Faculty of Natural Sciences also believe that integrated courses are worth studying, because they well form complex professional competences (88.46%), increase motivation to study (78.85%) and promote creativity (73.08%). A significant part of the respondents (67.31%) prefer integrated courses also because they develop critical thinking and form research interest.

Applicants of the medical profession rated all motivators highly, the highest among their colleagues, except for M5 – manifestation of creativity. Almost all (92.50%) confirmed the importance of integrated courses for the formation of complex professional competences. This demonstrates the well-structured educational programs at IFNMU, their filling with modern integrated courses that ensure effective training of future workers in the medical field.

In addition to the use of integrated forms of classes, the filling of curricula with modern integrated educational disciplines, the educational facility' initiates interdisciplinary scientific research of teachers and students of education. In PNU named after V. Stefanyk, there has been a practice of scientific interdisciplinary diploma studies for the last three years.

Thus, within the synergy of international projects ERASMUS+ "Modernization of higher pedagogical education using innovative teaching tools" (No. 586098-EPP-1-2017-1-UA-EPPKA2-CBHE-JP) and "GameHub: cooperation between universities and enterprises in the game industry in Ukraine" (№56128-EPP-1-2015-1-ES-EPPKA2-CBHE-JP) completed and successfully defended in 2020 the master's theses "Economic education of students of general secondary education in STEAM classes by means of educational computer games" and "Integrated education of students in the New Ukrainian School by means of ICT (on the example of the lessons of the science and mathematics cycle)". These are final works of students majoring in Primary Education, Informatics, and Graphic Design. In the group of work leaders – professor H. Mykhailyshyn.

During the defense of diploma projects, students presented theoretical aspects of the integration of pedagogical and artistic knowledge in computer programming of educational games for primary school students; own pedagogical and graphic design of created computer educational games for STEAM lessons to improve the financial literacy of schoolchildren. They also presented other innovative forms and methods of integrated work with students at the New Ukrainian School: created educational site, problem tasks and situations, business games, quizzes, tasks for group educational activities, etc.

Under the leadership of prof. H. Mykhailyshyn, an interdisciplinary master's study is conducted on the topic "Communication and cooperation of participants in the educational process in the conditions of distance learning" in the specialties of Management (educational program "Educational Institution Management") and Informatics.

Initiated interdisciplinary scientific research at the level of diploma (master's) theses became the basis for the creation of relevant educational programs at the university.

4 Discussion

The high-quality assimilation of professional knowledge and skills by the students of education is facilitated by the interpenetration of individual educational components into each other. Thanks to integration, there is a convergence of various scientific disciplines, which is caused by the emergence of principles and theories beyond the boundaries of the discipline in which they originated. In the integration processes, the general principles and methods function most effectively, and they most adequately perform the methodological and heuristic role.

The obtained results of our experiment confirmed the importance of including integrated training courses in educational programs in order to motivate students for successful professional training. A modern student needs knowledge about new methods, their application, about the possibilities of a comprehensive study of phenomena and processes, about the practical significance of the obtained theoretical knowledge. The integration of the educational process is one of the factors of optimizing the learning process, it contributes to a systematic and holistic knowledge of the world.

"Multidisciplinarity relies on knowledge from different disciplines, but remains within their boundaries. Interdisciplinarity analyzes, synthesizes and harmonizes the connections between disciplines into a coordinated and coherent

whole. Transdisciplinarity integrates the natural, social and medical sciences into a humanitarian context and transcends traditional boundaries. The goals of multidisciplinary approaches are to solve real-world or complex problems, to provide different perspectives on problems, to create comprehensive research questions, to develop consensus clinical definitions and guidelines, and to provide integrated health services" [3]. Researchers Choi et Pak (2006) suggest the following correspondence between technologies and approaches to studying the phenomena of the surrounding world (Figure 3):

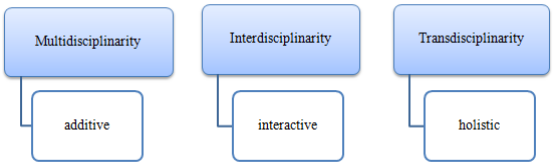


Figure 3 – Correspondence between technologies and methodical approaches

Source: Systematized based on (Choi, Pak, 2006).

Many of the discoveries and innovations that are part of today's world would not have happened if it were not for a transdisciplinary way of thinking. The use of multidisciplinarity, interdisciplinarity, and transdisciplinarity contributes to the development of a critical and scientific spirit in students [2], which was confirmed by our study, since the students chose the motivator M3 "development of critical thinking and formation of research interest" as one of the main ones when choosing integrated educational courses: 50.67% of PF students, 67.31% of FNS students, and 77.50% of future doctors.

The history of science claims that the most daring ideas are born at the interdisciplinary level, which fundamentally change scientific knowledge and, thanks to it, the surrounding world. An example of the relevance of this thesis is the practice of implementing interdisciplinary scientific research by students.

There is no doubt that there is an industry priority in the choice of pedagogical technologies. In particular, for students of pedagogical specialties, knowledge that will help them acquire a creative approach to their profession is important in the following percentage: 67.33% of future teachers of junior grades and 73.08% of future teachers of natural sciences are motivated by technologies that shape their creativity.

Scott and Hofmeyer [18] emphasize the importance of interdisciplinarity "to guide effective and high-quality health research; the contexts in which health and social problems arise do not recognize disciplinary boundaries". Helena S. et Batista S. [6] believe that the development of directions in medical education based on interdisciplinarity includes the implementation of curriculum projects that allow for the formulation of content, encourage problem-based approaches and promote academic activity guided by medical practice anchored in the context of medical services, inclusion of students and teachers as subjects in the process and production of basic knowledge. The example of IFNMU confirms the relevance of this thesis.

5 Conclusion

Researchers associate the problem of integration in education at the current stage of the development of pedagogical theory and practice with the social phenomenon of the era of globalization: that people's consciousness significantly lags behind the development of global processes, does not have time to comprehend their content, causes and interrelationships, which makes it impossible to predict the consequences. This means that the most diverse fields of scientific knowledge – both social and humanitarian, and natural and technical – should be jointly included in the study of global problems.

Integration, as a means of learning, should give the learner knowledge that reflects the interrelationships of individual parts of the world as a system. To teach him to perceive the universe as a single whole in which all elements are interconnected.

Training will be more effective if there is a synergistic combination of disciplines. Synergetics is the most acceptable methodology for modern education, which ensures the effectiveness of integration processes in education. Thanks to integrative educational technologies, different educational disciplines are combined not only for the purpose of researching the phenomenon, but also there is an exchange of methodological components. As a result, new theories and new knowledge are created. Thus, interdisciplinarity complements the modern picture of the world with new elements of anthropocentrism.

The implementation of integration processes is a significant factor in increasing the effectiveness of education, which can ensure the high-quality training of a creative, competitive specialist who is able to successfully adapt to new situations and make non-standard decisions.

The perspective of our further research is the development, implementation and diagnosis of the effectiveness of interdisciplinary educational programs at the junior bachelor's, master's and PhD educational levels.

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Primary Paper Section: A

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