Pedagogical Model for Raising Students’ Readiness for the Transition to University 4.0

Bakytgul Jugembayeva 1,*, Aliya Murzagaliyeva 2 and Gita Revalde 3

1 Department of Plasma Physics, Nanotechnology and Computer Physics, Al-Farabi Kazakh National University, Almaty 050040, Kazakhstan
2 Department of Theoretical and Nuclear Physics, Al-Farabi Kazakh National University, Almaty 050040, Kazakhstan; almurzagaliyeva@rambler.ru
3 Department of Materials Sciences and Applied Chemistry, Riga Technical University, LV-1658 Riga, Latvia; gitrevalde@yahoo.com
* Correspondence: bjugembayeva@rambler.ru

Abstract: The study goal was to analyze the impact of using modern technologies and pedagogical innovations based on the University 4.0 model on the educational process effectiveness, the development of professional competencies (in humanities and engineering) and skills in students (abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity, motivation), and learners’ readiness and motivation to shift to University 4.0. The experiment was conducted in the Al-Farabi Kazakh National University among 464 undergraduate students of different academic years. All the study respondents were distributed into two groups, one of which did not change the training program (control group), and the other studied under the program grounded on the University 4.0 model using modern technologies (experimental group). According to the results of the survey addressed to the students of both groups after the experiment ended, the indicators for all parameters were higher among the individuals of the experimental group. The practical significance of the results obtained and further research prospects are in the possibility of using the developed training program in different universities and departments worldwide to compare both students’ readiness for the transition to University 4.0 and the program’s impact on educational outcomes.

Keywords: abstract-logical thinking; creativity; critical thinking; imagination; modern technologies

1. Introduction

Considering that almost all aspects of our life undergo active modernization, the use of innovative teaching methods and technologies in the educational process becomes of paramount importance. The University 4.0 as an integrative and multifunctional system contributes to the sustainable development of university education as it adjusts to all the changes and challenges of information and technologically advanced society [1].

The University 4.0 model focuses on a specific set of aspects, one of which is the process of internationalization of a higher education institution through the participation of instructors and students in various multinational projects and conferences, organization of educational or work exchanges, and the like activities [2]. Accordingly, the University 4.0 model fosters international cooperation through networking with foreign universities in order to exchange professional competencies and skills and thus improve the overall professional development of higher educational institutions [3]. Such an exchange facilitates the formation of new educational priorities, directions, and values based primarily on the latest technological innovations, so-called multiple intelligences (linguistic intelligence, logical-mathematical intelligence, spatial intelligence, bodily-kinesthetic intelligence, musical intelligence, interpersonal intelligence, intrapersonal intelligence, naturalist intelligence), and the use of knowledge of different fields (e.g., biology, ecology, creativity, business, and entrepreneurship) [4]. Grounded on digital principles, the University 4.0
model encourages lifelong learning presupposing the acquisition of new knowledge and professional competencies throughout the entire life [5]. This model of education is developed in response to societal needs and global events that affect the educational process and contribute to the emergence of new methodological approaches and directions in learning with account taken on global issues’ implications [6]. Researchers argue that the University 4.0 model develops a person-centered approach to learning and improves practical skills for critical and strategic thinking in the use of information technology, which students need for future employment [7]. This model is seen as a trend in the knowledge economy and a central direction in higher education modernization characterized by the integration of humanities and engineering specialties as one of the critical components of online learning [8].

In fact, online learning is considered in the context of University 4.0 specifically in terms of transforming the traditional learning system through the introduction of innovative technologies and new teaching methods [9].

As a digital university model, University 4.0 was inspired by the Industry 4.0 paradigm covering all areas of social life with innovative digital technologies. Hence, it is natural that today’s academic world is in need of two points: professionals trained according to the new educational pattern and more efforts to increase the readiness of educators and students to fully transition to it [10,11]. In general, University 4.0 uses the concept proposed by Industry 4.0. This implies that the educational process is to be based on a flexible, dynamic, and adaptive approach to learning [12,13]. In the context of the University 4.0, Industry 4.0 promotes using advanced technologies such as 3D printing, augmented and virtual reality, and artificial intelligence, as it is based on modern practice-oriented approaches to learning [14,15]. The goal of Industry 4.0 to establish and support the connection between technology and society has provided the foundation for the core principle of the University 4.0 model: to connect technology and educators to build engineering competence (a set of skills and abilities to work with modern technologies and use them in education) in higher education institutions [16].

However, ill-preparedness of instructors to using digital technologies and pedagogical innovations in the process of preparing future specialists is among the central reasons for the slow transition of modern universities to the University 4.0 model requiring critical thinking, cooperation, creativity, digital literacy, and emotional intelligence, not provided by the traditional education in full [17]. Accordingly, in order to modernize the educational system, universities striving to upgrade and optimize the learning process by means of world-leading technologies and principles are preparing to implement the University 4.0 model using information technology, mobile applications, and educational platforms for distance learning in case of emergency, like the pandemic [18].

The primary objectives of the investigation are to develop a special educational program using modern technologies and trace its impact on students’ readiness and motivation for innovation activity in the context of transition to University 4.0; to analyze the effect of the developed program on the professional competencies and skills of students based on a survey conducted after training. The secondary objective is to trace the possibility of transition of the university chosen for the experiment to the University 4.0 model.

Research questions: to assess the readiness of students to move to the model “University 4.0”; to trace the peculiarities of teaching students according to the program developed on the basis of modern technologies and to make a conclusion on this basis about the possibilities and effectiveness of the transition to the model “University 4.0”.

1.1. Literature Review

According to Chinese researchers considering the fact that the modern education system is evolving under the influence of informatization and digitalization processes, it requires the development of new methodological approaches and active use of innovative technologies [19]. Researchers from Canada on the basis of research note that the traditional learning system does not allow the precise tracing of the leading trends in learning and influence all areas of society because it is based on outdated educational principles [20]. The process of transformation,
which intensified even more with the advent of COVID-19, has much affected the field of education due to the necessity to shift to online learning and search for new learning opportunities [21,22]. Thus, new professional competencies and skills (creativity, critical thinking, lateral thinking, strategic thinking, communicative competence) are in demand today, which in turn indicates the need to introduce new pedagogical models and approaches to learning, such as person- and practice-oriented ones [23].

The training pattern developed on the basis of University 4.0 technology is gradually gaining momentum in today’s educational process, though its popularization is uneven in different countries. Hence, for example, the use of the University 4.0 model in Kazakhstan intensified precisely during the pandemic, when all spheres sought a quick way out of the arisen crisis situation [24]. As such, University 4.0 presupposes the use of information and communication technologies, innovations, different mechanisms, as well as an open innovation laboratory developed by researchers from Mexico, which studies and develops modern high-functioning technologies and the possibilities of their implementation in the educational process [25]. In this day and age, University 4.0 is known for an active utilization of mobile technology, as the functions of smartphones have expanded and are now exploited for educational purposes as interactive tools to visualize learning material, allowing more attention to practice [26]. At the same time, currently, researchers reflect upon the possibility of using artificial intelligence, the Internet of Things devices (smart-watches), and virtual reality in Education 4.0. These means and their effectiveness are now only being tested, and instructors are yet poorly prepared for the transition to such digital learning tools, which, correspondingly, does not allow for their active application in the educational process [27]. In view of this, it is of critical importance now to develop digital literacy as one of the pedagogical competencies considered in the context of the University 4.0 model [28].

However, not all countries have familiarized universities with the University 4.0 model to date. A good example here will be the current education system in Thailand, which still uses the University 3.0 model linking education, science, and innovative entrepreneurship, allowing students to engage in science and entrepreneurship through the development of their business projects [29]. The main difference between the University 3.0 and University 4.0 models is that in the latter, the university is viewed in the context of the knowledge economy aimed at innovative digital activities that can meet the needs of society as a whole since information and communication links permeate all social development areas [30]. The evolution in the development of the university to the 4.0 format can be described in the following stages:

- University 1.0—aims to develop only the field of education.
- University 2.0—adds science to education, that is, the ability to conduct research of different types depending on the university’s specialization.
- University 3.0—based on education, science, and industry.
- University 4.0—unites education, science, industry, and knowledge economy; it is considered as a university of the future developing innovations [31,32].

After the transition to the University 4.0 model, the higher education institution can expand the opportunities for its development and activities of students, who, in addition to gaining knowledge of a particular field, will also be able to engage in scientific and industrial activities, as well as use innovative technologies.

Researchers emphasize that not all universities are ready for the transition to University 4.0. This can be explained by insufficient development; lack of control, design, and empowerment; insufficient level of technical support; and poor general knowledge about the features of the implementation of this model in the educational process at all levels of its organization [33]. To increase the readiness of teachers and students for the transition to University 4.0, first of all, it is necessary to familiarize them with the specifics of this model and the features of its implementation in the learning process through educational programs, special courses, and seminars. In addition, it is imperative to show the possibilities of applying modern technologies in practice, describe all the advantages of University
4.0 in advancing professional competencies and skills, and explain how this model will better professional and psychological preparation of students and faculty.

The University 4.0 model requires a new-format instructor who possesses modern competencies of personal and professional growth (communicativeness, critical thinking, reflective thinking, creativity, self-organization), prefers modern teaching methods (person-centered and interdisciplinary approaches, use of cutting-edge teaching means, emphasis on practice and lifelong learning), and can adjust to the new requirements of the modern world and develop new competencies and skills [34]. The pandemic experience has shown the importance of being prepared for the transition to a new format of learning, in particular, a remote one, and use of digital technologies [35]. Thus, as researchers indicate, one of the priorities in today’s universities should be to increase the readiness of educators to move to the University 4.0 model and introduce digital technologies in the educational process [36].

1.2. Problem Statement

The proposed learning program developed on the basis of the University 4.0 model and implying the use of advanced technologies was expected to increase the readiness and motivation of students to the transition to University 4.0 and facilitate the development of professional competencies and skills. The ultimate goal of this study was to investigate the impact of using modern technologies and pedagogical innovations based on the University 4.0 model on the educational process effectiveness, the development of professional competencies (in humanities and engineering) and skills in students (abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity, motivation), and learners’ readiness and motivation to shift to University 4.0. In view of this, the study objectives were defined as follows:

- Trace the possibility of transition of the university chosen for the experiment to the University 4.0 model.
- Develop a special educational program using modern technologies and trace its impact on students’ readiness and motivation for innovation activity in the context of transition to University 4.0.
- Analyze the effect of the developed program on the professional competencies and skills of students based on a survey conducted after training.

2. Methods and Materials

2.1. Research Design and Sample

In order to determine students’ readiness for the transition to the University 4.0 model and the use of modern technologies in the learning process, this research work used a comparative method tracing the results of teaching students under two different programs: the traditional one (control group—CG) and the one based on University 4.0 principles (experimental group—EG) [37]. This methodological approach made it possible to study the effect of University 4.0 on the development of students’ professional competencies, skills, readiness, and motivation to move to this learning model. The main advantage of the chosen research method is the ability to track the effectiveness of the model “University 4.0” based on the analysis of the peculiarities of student learning in two groups, one of which studied using modern technologies. The disadvantages of this method are not identified. The difference between EG and CG is primarily in the use of modern technologies, because the CG group studied without the use of modern technologies, while the program of the EG group was developed in education with the help of modern technologies.

The experiment was conducted at the Al-Farabi Kazakh National University from April to May 2021. As far as the paper intended to determine the readiness for the transition to the University 4.0 model and for use modern technologies in the learning process among individuals of different ages, it involved 464 students of 1–4 academic years.
2.2. Survey

The overall investigation was carried out in three stages. In the first stage, a learning program grounded on the University 4.0 principles was developed. Its purpose was to analyze the effectiveness of teaching with the use of the latest technologies (in accordance with the University 4.0 model) and discover the impact of such training on the formation and development of skills and competencies.

During the second stage, the training according to the developed program was organized. For this purpose, all students were divided into two groups. The first group (CG) was trained according to the traditional curriculum without the use of advanced technologies, while the second (EG) used the developed University 4.0-based program with the modern technologies implemented. The training continued for one month within the Al-Farabi Kazakh National University. The proposed educational program was placed on the Moodle online learning platform. Access to the program was open to educators and students of the EG solely. To get acquainted with the program and see all of its components, it was necessary to register with a Google account. For this step to be successful, everyone was sent an email invitation to join the program and an access code. To log in, each instructor or student had to enter the email address provided during registration and the access code. The platform page contained the program itself and the necessary materials and links to the websites allowing one to get acquainted with modern technologies or download the applications needed for training. The program consisted of one thematic module ("Modern technologies in the learning process") that was divided into several sessions during which different professional competencies (in humanities and engineering) and skills (abstract-logical, critical, strategic thinking, imagination, and creativity) were to be developed. Apart from this, these sessions aimed to raise students’ readiness and motivation to be engaged in innovative activities in the context of the transition to University 4.0.

The third stage was held after the one-month training completion and implied students’ testing. For this, a Google Form questionnaire consisting of the following questions was developed:

1. Are you familiar with the University 4.0 model? (Yes, well familiar; Yes, to a certain degree; No, not at all; Difficult to answer)
2. How did you learn about the University 4.0 model? (Internet; Social networks/media/advertising; University; Not familiar with this model)
3. How can you assess the level of your readiness for the university transition to the University 4.0 model? (High; Average; Low; Not ready at all)
4. Rate the proposed factors of motivation to study on a five-point scale: modern technologies, University 4.0, professional competencies and skills, knowledge, other (diploma, success, approval of others)
5. Assess your level of the following professional competencies and skills on a five-point scale: competency in humanities, competency in engineering, abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity.

Students in both groups were emailed a questionnaire with instructions for taking the test. Since it was necessary to find out the answers to the question as a result of a quick response, there was a time limit (40 min).

2.3. Statistical Processing

Respondents’ answers were processed with the help of Statistica and Microsoft Excel programs. On their basis, diagrams with the indicators for each question for both groups separately were built in order to compare the outcomes and conduct a comparative analysis.

2.4. Research Limitations

Research limitations reside in a rather small study sample as the experiment was conducted at the Al-Farabi Kazakh National University. Other higher educational institutions or countries were not considered.
2.5. Ethical Issues

The experiment was carried out in compliance with all ethical norms and anonymity. No confidential information (name, surname, age, place of residence, etc.) was necessary to be provided. Respondents were only asked to indicate the year of study at the time of the experiment. To conduct and process this information and testing outcomes, written agreements were obtained from all the participants. Since the survey was conducted after respondents’ training, it was mandatory to indicate the program under which the individual studied since this factor was imperative in investigating student readiness for the transition to University 4.0. The invitation to participate in the experiment mentioned the right not to participate or to refuse to participate, so participants were warned in advance. There were no issues of power to be acknowledged.

3. Results

In the first research stage, a learning program taking into account the specifics of the University 4.0 model and using modern technologies was developed (Figure 1). The training process took place in the second stage before surveying respondents to identify its effect on learning outcomes and professional competencies and skills.

![Figure 1. Structure of the training program using modern technologies.](image)

The elaborated training program consisted of one module (“Modern technologies in the learning process”) divided into several sessions aiming to familiarize students with the University 4.0 model and modern technologies, promote their professional competencies’ development, and increase their readiness and motivation for the transition to University 4.0 (Table 1). To undertake the developed program, students needed only a computer and headphones—they were required to view the necessary training materials and access educational platforms. In parallel, no additional facilities, except an interactive whiteboard, were needed for the instructor to demonstrate a presentation about the University 4.0 model and latest technologies. The human resources organizing the learning process were represented by EG students and instructors of the university, on the basis of which the experiment was conducted. The educators enrolled got acquainted with the features of the University 4.0 model independently and, based on the knowledge gained from various foreign sources, developed presentations for students. All training sessions were held in special university rooms. For convenience, EG students were divided into several groups of 20–25 people, so that only 20–25 workstations were needed for each session. The training lasted one month. The materials chosen for the course had to familiarize students with the modern technologies used in the University 4.0 model, contribute to the development of professional competencies and skills, and increase students’ readiness and motivation for
the transition to University 4.0. The educators also proposed such educational platforms for students’ work with different learning courses as “Coursera,” “EdX,” and “Khan Academy.” The developed program does not include homework and student assessment.

Table 1. The content of the program for learning with modern technologies.

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Module Tools</th>
<th>Module Tasks</th>
<th>Resources Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Modern technologies in the learning process”</td>
<td>Modern technologies: - whiteboard; - desktop and laptop computers; - projectors; - 3D printing facilities; - distance learning; - lifelong learning; - emotional intelligence; - artificial intelligence; - virtual reality</td>
<td>- Formation of the skill to work with modern technologies in the learning process; - Increasing readiness for the transition to the University 4.0 model; - Development of professional competencies (in the field of humanities and engineering) and skills (abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity)</td>
<td>- Computer with internet access; - Headphones; - Interactive whiteboard; - Faculty-developed presentation about the University 4.0 model and modern technologies [38]; - “Core Humanitarian Competencies Guide” [39]; - “Handbook of Research on Barriers for Teaching 21st-Century Competencies and the Impact of Digitalization” [40]; - “Emotional and Social Intelligence” course on the Coursera educational platform [41]; - “Emotional Intelligence” [42]; - “Artificial Intelligence for all” course on the Coursera education platform [43]; - “Creativity and A.I.” course on the Coursera education platform [44]; - “Introduction to Logic and Critical Thinking” course on the Coursera education platform [45]; - “The Basics of Critical Thinking Workbook” [46]; - “Virtual Reality” course on the Coursera education platform [47].</td>
</tr>
</tbody>
</table>

During the third experiment stage, students of both groups were surveyed in order to determine the effectiveness of the University 4.0 model in the learning process and its impact on the development of their professional competencies, skills, motivation, and readiness for the transition to University 4.0. The processed questionnaire responses are presented in Figures 2–6. The diagrams were developed with reference to responses of students from both groups in order to conduct a comparative analysis.

Figure 2. Respondents’ answers to the question “Are you familiar with the University 4.0 model?”.
The answers to the question “Are you familiar with the University 4.0 model?” differed drastically across the two groups (Figure 2). Hence, CG students were more inclined to answer “No, not at all” (75%), 10% chose the option “Yes, to a certain degree,” the other 10%—“Difficult to answer,” and only 5% answered “Yes, well familiar.” The outcomes of surveying EG participants were significantly higher compared to those of CG. More precisely, they were distributed as follows: 86%—“Yes, well familiar,” 10%—“Yes, to a certain degree,” 2%—“No, not at all,” and 2%—“Difficult to answer.”

Figure 3. Respondents’ answers to the question “How did you learn about the University 4.0 model?”.

Figure 4. Respondents’ answers to the question “How can you assess the level of your readiness for the university transition to the University 4.0 model?”.
were scattered in the following order: 56%—"University," 28%—"Internet," 14%—"Social networks/media/advertising," 2%—"Not familiar with this model". The answers of CG respondents were allocated in the following order: 5%—"High," 20%—"Average," 45%—"Low," and 30%—"Not ready at all." The majority of respondents were allocated to the "Low" readiness category, with a significant portion (45%) indicating they were not ready at all. The situation in EG was fully the same as in CG, with a predominant focus on the "Low" readiness category (76%).

The first and second questions became the basis for the question “How can you assess your level of readiness for the university transition to the University 4.0 model?” (Figure 4). Here, the answers of CG respondents were allocated in the following order: 5%—"High," 20%—"Average," 45%—"Low," and 30%—"Not ready at all." The majority of respondents were allocated to the "Low" readiness category, with a significant portion (45%) indicating they were not ready at all. The situation in EG was fully the same as in CG, with a predominant focus on the "Low" readiness category (76%).

Figure 5. Respondents’ answers to the question “Rate the proposed factors of motivation to study on a five-point scale: modern technologies, University 4.0, professional competencies and skills, knowledge, other (diploma, success, approval of others)”.

Figure 6. Respondents’ answers to the question “Assess your level of the following professional competencies and skills on a five-point scale: competency in humanities, competency in engineering, abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity”.

Answers to the question “How did you learn about the University 4.0 model?” were tightly connected with the previous responses (Figure 3). In CG, they were distributed as follows: 5%—“Internet,” 5%—“Social networks/media/advertising,” 15%—“University,” and 75%—“Not familiar with this model.” The situation in EG was fully the same as with the replies to the first question—their indicators were higher than those of CG and were scattered in the following order: 56%—“University,” 28%—“Internet,” 14%—“Social networks/media/advertising,” 2%—“Not familiar with this model”.

The first and second questions became the basis for the question “How can you assess the level of your readiness for the university transition to the University 4.0 model?” (Figure 4). Here, the answers of CG respondents were allocated in the following order: 5%—“High,” 20%—“Average,” 45%—“Low,” and 30%—“Not ready at all.” The majority
of students (75%) in the EG, in turn, assessed their level of readiness for the transition to the University 4.0 model as high, 15% as average, 8% as low, and 2% were not ready at all because, as the indicators for the first and second questions show, they were not familiar with the University 4.0 model. Higher rates of readiness for the transition to the University 4.0 obtained on the basis of EG answers after the experimental training indicate the need to familiarize all students with the features of this model and, thus, prepare them before its implementation in the educational process.

Figure 5 displays the answers to the question “Rate the proposed factors of motivation to study on a five-point scale: modern technologies, University 4.0, professional competencies and skills, knowledge, other (diploma, success, approval of others).” As can be seen, the most positively assessed motivation factor among CG students was “Knowledge”—the highest score was given by 48% of them. “Professional competencies and skills” took the second place (22%). The third was the factor “Other (diploma, success, approval of others)”—20%, and then came “Modern technologies”—5%, and “University 4.0”—5%. What concerns the responses of EG students, they also differed significantly from CG’s answers. Thus, the option “Modern technologies” was rated by most students with the highest score (45%), followed by the “University 4.0”—25%, “Professional competencies and skills”—15%, “Knowledge”—10%, and “Other (diploma, success, approval of others)”—5%. Possible explanations for such results in the first group are the low level of students’ awareness of modern technologies and the model “University 4.0” and their proper use in the educational process. Instead, the students of the second group, who studied according to the program developed on the basis of modern technologies, were acquainted with the model “University 4.0”, which explains the high performance of these criteria.

Figure 6 presents the answers to the question “Assess your level of the following professional competencies and skills on a five-point scale: competency in humanities, competency in engineering, abstract-logical thinking, critical thinking, strategic thinking, imagination, creativity.” The responses of CG students were distributed in a way that the highest level of development was assigned to competency in humanities (73%), while in EG, the competency in engineering prevailed (76%). Such an outcome most probably resulted from training under the developed program using modern technologies. Other professional competencies and skills among CG respondents were assessed as follows: competency in engineering—42%, abstract-logical thinking—62%, critical thinking—38%, strategic thinking—29%, imagination—71%, and creativity—31%. As concerns the EG, professional competencies of its participants were characterized by the following indicators: competency in humanities—47%, abstract-logical thinking—71%, critical thinking—86%, strategic thinking—76%, imagination—82%, creativity—87%. Possible explanations for such results are training in different programs: the first group studied in the regular program and, accordingly, among the participants dominated by humanities, the second group studied in a program based on modern technology, which explains the predominance of engineering competence.

In sum, the collected results demonstrate higher scores in the EG, whose members were trained according to the program developed on the basis of the University 4.0 model and using modern technologies. This testifies to its effectiveness for learning and development of professional competencies and skills.

4. Discussion

In general, the conducted experiment and literature review indicate the lack of students’ familiarity with the University 4.0 model and modern information, communication, and interactive technologies, which confirms the relevance of this topic not only for Kazakhstan but for other countries as well. This point is supported by many world researchers. Thus, for example, scholars from New Zealand proved the need to move to the adoption of innovations in higher education that have not only a material representation but are also embodied in specific means enabling building progressive relationships with students based on the principles of interaction, emotional engagement, and assistance [48]. Likewise,
researchers from Spain argue that innovation competence extends to the personality of the instructor, who must meet all the requirements of modern education and develop the leading competencies necessary for student learning, in particular, the ability to work with modern technologies and develop new methodological approaches in education [49].

Other studies on the matter also point to the low readiness of students for the transition to learning with modern technologies. For example, an experiment conducted by researchers from Saudi Electronic University aiming to determine the level of readiness of faculty and students to use augmented reality in learning showed that educators do not use this technology in the classroom, despite having enough knowledge about it. Although their perception of modern technology is positive, they are not ready for its implementation [50]. Comparison of those results with the findings of the current study revealed a similar level of readiness in the group trained using the traditional curriculum with no cutting-edge technologies included and not familiarized with the principles of the educational institution under the University 4.0 model.

In higher educational institutions of the US, Slovakia, Germany, and Japan, the University 4.0 model is in great demand due to its notable influence on learning effectiveness. Another reason for it to become so popular lies in that it is based on an interdisciplinary approach and relies upon the development of professional competencies using the latest interactive technologies, which increases students’ learning motivation [51]. On the other hand, University 4.0 model still has prospects for growth. Despite the fact that in the US, Germany, and South Korea 4.0-format technology is developed on an adequate level, there are countries requiring more attention to be paid to this direction (e.g., India) [52]. Kazakhstan is one of the world states where the University 4.0 model is only beginning to develop. Correspondingly, it is quite natural that its complete implementation in the educational process is yet to come. There is an insufficient number of studies focusing on the opportunities to improve the conditions for applying technologies and mechanisms of this model in higher education of Kazakhstan. Moreover, in most cases, the core emphasis of such works is set on Industry 4.0, while the University 4.0 model remains outside of the study area. Some scholars claim that the difficulties with implementing the 4.0-format are associated with poor understanding of its features and benefits, lack of highly qualified professionals, and low digital literacy [24]. The findings of this and the small number of domestic and foreign studies available allow the inference about the weak state of development of the University 4.0 model in Kazakhstan and the need to promote this technology in universities.

Suggestions for future research are based on the introduction of the model “University 4.0” in the education of students of various specialties, as well as the development of innovative programs for learning not on the basis of traditional methods but on the basis of advanced methods using modern technologies. Difficulties in our study may be related to the implementation of training in two groups for different training programs.

5. Conclusions

Given the obtained analysis results, one can confidently claim that students of the Al-Farabi Kazakh National University are not ready for the transition to the University 4.0 model. This highlights the need to introduce modern technologies and pedagogical innovations in educational plans and encourage their active use by educators in the classroom. Furthermore, the conducted examination proved that training programs developed in accordance with the University 4.0 model and using interactive information technologies contribute to the development of students’ professional competencies and skills.

The results of the survey conducted among EG and CG students after they were trained under different programs (with and without modern technologies, correspondingly) revealed that the indicators for all parameters were higher among the EG participants. Moreover, EG students turned out to have higher levels of readiness (75%) for the transition to the University 4.0 model compared to individuals included in the CG (5%) as students of this group studied according to the developed program, had an opportunity to get ac-
quainted with the University 4.0 model and modern technologies. Higher rates of readiness for the transition to University 4.0 point to the necessity to make all students aware of the features of this model in advance as this would prepare them for its implementation. The most frequent motivation factors to shift to a new learning model in EG were modern technologies (45%) and University 4.0 (25%). Interestingly, in CG, these factors had the lowest share of positive responses—5% and 5%, respectively. EG respondents were also marked with far better developed professional competencies and skills: abstract-logical thinking was maximally assessed by 71% of individuals, critical thinking—by 86%, strategic thinking—by 76%, imagination—by 82%, and creativity—by 87%. In turn, in the CG, these indicators were as follows: abstract-logical thinking—62%, critical thinking—38%, strategic thinking—29%, imagination—71%, creativity—31%. Provided that CG studied under the traditional curriculum not presupposing the active utilization of the advanced technologies, its students had far more developed competency in humanities than those enrolled in the EG (72% against 47%, respectively) as they worked more with modern technology and had the opportunity to better develop technical competencies, the training program for this group was designed in such a way that less attention was paid to humanitarian competencies. Competency in engineering, however, was characterized by a reverse situation: the outcomes for the EG were better than those for the CG students (76% against 42%, respectively).

Author Contributions: Conceptualization, B.J. and A.M.; methodology, B.J.; software, A.M.; validation, B.J., A.M. and G.R.; formal analysis, A.M.; investigation, B.J.; resources, G.R.; data curation, G.R.; writing—original draft preparation, B.J. and G.R.; writing—review and editing, A.M.; visualization, G.R.; supervision, B.J.; project administration, G.R.; funding acquisition, A.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Al-Farabi Kazakh National University.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data will be available on request.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Giesenbauer, B.; Müller-Christ, G. University 4.0: Promoting the transformation of higher education institutions toward sustainable development. Sustainability 2020, 12, 3371. [CrossRef]
4. Himmetoglu, B.; Aydug, D.; Bayrak, C. Education 4.0: Defining the teacher, the student, and the school manager aspects of the revolution. Turk. Online J. Distance Educ. 2020, 21, 12–28. [CrossRef]
7. Singh, D.; Tilak, G. Implementation of education model 4.0: Developing industry 4.0 skills in graduates’ engineers for improving employability skills. HSSR 2020, 8, 601–613. [CrossRef]


13. Hussin, A.A. Education 4.0 made simple: Ideas for teaching. IJELS 2018, 6, 92–98. [CrossRef]


31. Li, J. Autonomy, governance and the Chinese University System 3.0: A Zhong–Yong model from comparative, cultural and contemporary perspectives. CQ 2020, 244, 988–1012. [CrossRef]

32. Liu, S.; van der Sijde, P.C. Towards the entrepreneurial University 2.0: Reaffirming the responsibility of universities in the era of accountability. Sustainability 2021, 13, 3073. [CrossRef]

33. Alzahrani, B.; Bahaitham, H.; Andejany, M.; Elshennawy, A. How ready is higher education to embrace 4.0 transformation according to the LNS research framework? Sustainability 2021, 13, 5169. [CrossRef]

34. Ramirez-Montoya, M.S.; Loaiza-Aguirre, M.I.; Zúñiga-Ojeda, A.; Porteguez-Castro, M. Characterization of the teaching profile within the framework of Education 4.0. Future Internet 2021, 13, 91. [CrossRef]

35. Santoveña-Casal, S.; Fernández Pérez, M.D. Sustainable distance education: Comparison of digital pedagogical models. Sustainability 2020, 12, 9067. [CrossRef]


48. Ramsey, P.L.; Khan, S. Dilemmas, emotion and innovation in tertiary education. IETI 2021, 58, 250–260. [CrossRef]
49. Fernández-Cruz, F.J.; Rodríguez-Legendre, F. The innovation competence profile of teachers in higher education institutions. IETI 2021, in press. [CrossRef] [PubMed]
51. Hábánik, J.; Grencíková, A.; Krajič, K. The impact of Industry 4.0 on the selected macroeconomic indicators in Slovak Republic, Germany, the USA and Japan. J. Int. Stud. 2021, 14, 26–37. [CrossRef] [PubMed]
52. Agrawal, A.; Kumar, P.; Tyagi, A. Industry 4.0 and comparisons with Germany, South Korea and the USA. In Human & Technological Resource Management (HTRM): New Insights into Revolution 4.0; Emerald Publishing Limited: Bingley, UK, 2020; pp. 133–156.