ОБРАЗОВАНИЕ И ОБУЧЕНИЕ: МЕТОДОЛОГИЯ, ТЕОРИЯ, ТЕХНОЛОГИЯ
БІЛІМ БЕРУ ЖӘНЕ ОҚЫТУ: ӘДІСТЕМЕ, ТЕОРИЯ, ТЕХНОЛОГИЯ
EDUCATION AND TRAINING: METHODOLOGY, THEORY, TECHNOLOGY

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EMPLOYMENT OF STEM GRADUATES
IN KAZAKHSTAN: CURRENT SITUATION

Abstract

The paper analyses the current situation in sphere of STEM graduates' employment in Kazakhstan who obtained higher and postgraduate education with the STEM profile (science, technology, engineering and mathematics) in 2021. The aim of this study is to model the trajectories of STEM graduates directly after their graduation and assess the proportions of labor flows in the context of the national labor market of Kazakhstan. For the research, official statistics from the Bureau of National Statistics on the labor market and universities performance are used. The results of the analysis show that the majority of STEM graduates in Kazakhstan directly after graduation is employed with no connection to the STEM profile of activity. At the same time, for the vast majority of those who get a job related to the STEM profile after graduation, the job is not directly related to the profile of the received education. It has been found that annual enrollment in the STEM segment of the labor market can potentially affect only less than half of the graduates of STEM programs at both undergraduate, graduate, and PhD levels. Statistical data in conjunction with the results of previous qualitative studies made it possible to assess the prerequisites of graduates who focus on the effective use of acquired skills in the labor market. There are disparities associated with the number of STEM graduates, their desire to start a career in STEM fields and the employers' practice of hiring. Further trajectories of empirical research in STEM training and further employment are suggested, taking into account the limitations of the data sets.

Key words: STEM graduates, graduate employment, employment, higher education, graduate trajectories.

Introduction

The modern global economy sets special conditions for competition in global markets. In particular, one of the driving forces of this competition is the availability of productive and highly-skilled specialists capable to develop industries related to Science, Technology, Engineering and Mathematics (STEM) fields [1, 2, 3]. STEM graduates are considered major drivers of technological innovation, having a significant impact on long-term economic growth [3]. Many countries all over the world over the past decades have paid special attention to the issues connected with the training of STEM specialists and their subsequent employment [4]. The success of STEM graduates in terms of consistent integration into production processes in the labor market largely determines the competitive

potential of the national economy, and also sets incentives for the development of its sectors. This is largely due to the great number of positive externalities associated with higher education and the further implementation of acquired skills in the industries [3, 5]. At the same time, these externalities affect, among other things, the potential for long-term development of the economy by stimulating innovation in its various sectors [6]. In the context of this study, it is important to understand, what are the destinations of Kazakhstani STEM graduates after their graduation and how trajectories of their employment compare with employment patterns for STEM degrees holders.

The relevance of the research is characterized by the unique role of the STEM segment in the modern highly competitive economy and the need for an empirical assessment of the STEM graduates' choices on the labor market in Kazakhstan. Object of the research – STEM graduate labor market in Kazakhstan. Subject of the research – trajectories and features of STEM graduates' employment directly after graduation in Kazakhstan. Aim of the research is to model the trajectories and assess the scale of the STEM graduates' flows entering the local labor market directly after graduation from universities in Kazakhstan.

There are three key-issues that are stated in the study:

(1) how many STEM graduates enter the labor market in Kazakhstan in comparison with the total graduation from all education programs at the bachelor's, master's and PhD levels;

(2) what is the proportion of STEM graduates in the total number of annual recruitment at the local labor market in Kazakhstan;

(3) what career trajectories tend to be chosen STEM graduates directly after the graduation.

The research includes the following set of objectives:

1) to model the trajectories of entry into the labor market of STEM graduates directly after graduation;

2) 0to evaluate the proportions of employment taking into account the received STEM-specialty;

3) to analyze the prerequisites for the emergence of revealed STEM graduates' employment trajectories;

4) to identify key features of STEM graduates' strategies in the labor market of Kazakhstan.

The results of this study can be used by the Ministry of Science and Higher Education of the Republic of Kazakhstan and universities to analyze the local labor market and to provide the development of public policies in terms of admission for STEM higher education programs. So, this can be identified as the main subject characterizing the practical significance of the study.

The article consists of four parts. The first part describes the materials and methods of the research. The second part provides a general description with the main provisions of the exploring issues. The third part contains literature review with description of the key research trends and results in this sphere. The last part provides the results of the study and the possible challenges and directions for further discussion.

Materials and methods

The study uses two main research methods. The first one is analysis of statistical data from official agencies and open sources (Bureau of National statistics, Agency for Strategic planning and reforms of the Republic of Kazakhstan). The second one is analysis of secondary sources of literature (research articles, analytical bulletins, reports, etc.).

The article deals with two research questions. In connection with every research question, a set of data is defined that allows to formulate a detailed answer based on the results of the analysis (Table 1, p. 351).

To answer the mentioned research questions, two datasets of official statistics have been analyzed – (1) Statistics of labor and employment and (2) Statistics of education. Using the results of the datasets analysis, a detailed scheme has been created that clearly demonstrates the proportions of STEM labor market in Kazakhstan and STEM graduates in 2021 (Figure 2, p. 355).

The figure has two parts. Top part is calculated using data from the first dataset – Statistics of labor and employment – and focuses on labor market proportions. Data on the presence and movement of labor force by type of economic activity have been used to build the top part of the figure. In particular, the scales of the total labor market of Kazakhstan and its STEM segment have been compared. To determine an economic activity in terms of its connection with the STEM segment, the authors'

classification has been used. It focuses on the main types of economic activity that corresponded to the profile of STEM activities and takes into account the content of the labor activity. The set of STEM labor activities includes 13 types of economic activity in accordance with the methodology of Bureau of National statistics, including, for instance, engineering and industry, building and construction, IT, research and development, etc.

Table 1 – Interrelationship of research questions and data sources

Research questions	Datasets used in the analysis
What trajectories do STEM graduates choose directly after graduation in Kazakhstan?	1. Bureau of National statistics – Statistics of education (Distribution of students by specialties); 2. Bureau of National statistics – Statistics of labor and employment (Bulletin "On the presence and movement of labor force by type of economic activity"); 3. [7].
What are the quantitative characteristics of STEM graduates' flows?	1. Bureau of National statistics – Statistics of education (Distribution of students by specialties); 2. Bureau of National statistics – Statistics of labor and employment (Bulletin "On the presence and movement of labor force by type of economic activity").
Note: Compiled by the authors.	

Bottom part is calculated using data from the second dataset – Statistics of education data – and focuses on performance indicators of the universities in the segment of undergraduate and postgraduate education levels. Data on the distribution of students by specialties, their admission and graduation have been used to build the bottom part of the figure. To determine the education profile in terms of its connection with the STEM segment, a similar classification has been used: it includes main areas of study corresponding to the STEM profile. The set of STEM education programs contains 8 and 6 enlarged areas of study at the undergraduate (bachelor) and postgraduate (master, PhD) levels, respectively, including, for example, 6B05 Natural sciences, mathematics and statistics, 6B06 Information and communication technologies, 6B07 Engineering, manufacturing and construction industries, etc.

The results of the calculations allowed us to define the proportions of the figure. According to these proportions, the labor market is able to update itself through the recruitment of graduates directly after their graduation. The upper part of the figure has four interconnected levels:
1) KZ STEM Labor Market;
2) Annual Recruitment;
3) Annual Recruitment of Higher education institutions (HEIs) Graduates;
4) Recruitment in accordance with HE program.

The "KZ STEM Labor Market" level demonstrates the overall scale of the STEM segment in the whole Labor Market of Kazakhstan. The "Annual Recruitment" level shows how many employees with all education levels were hired in 2021, compared to the KZ STEM Labor Market. The "Annual Recruitment of HEIs Graduates" level shows how many employees with higher education among those who graduated in 2021 were accepted in 2021 in comparison with the total annual recruitment. The "Recruitment in accordance with HE program" level shows how many of the employed workers with higher education among those who graduated in 2021 were hired in the STEM segment for jobs that are directly related to the education received at the university.

The lower part of the figure has two interconnected levels:
1) Annual STEM Graduation;
2) Flows of graduates in accordance with the level of education.

The "Annual STEM Graduation" level demonstrates the number of graduates who have obtained education in areas of study directly related to the STEM segment. The graduates of this block potentially represent a source of labor for the KZ STEM Labor Market, while the interaction takes place only at the third and fourth levels of the upper part of the figure (as visually indicated by the dotted line in the middle of the figure). The "Alumni Streams by Level of Education" level represents the flows of

graduates who not only form the "Annual STEM Graduation" level, but also go on to study at higher levels of education (for instance, Master or PhD).

As a result, there is an interaction between two main blocks: KZ STEM Labor Market and Annual STEM Graduation. Let's look closer at the trajectories of STEM graduates directly after their graduation and highlight the quantitative characteristics of STEM graduates' flows.

Main provisions

The key purpose of the study is to model the trajectories of STEM graduates directly after their graduation using official statistics from the Bureau of National Statistics on the labor market and universities performance, as well as relevant secondary sources. Assessing the proportions of labor flows in the context of the national labor market of Kazakhstan allows to determine the needs and further possible steps in public higher education policy.

The analysis of KZ STEM labor market's current condition demonstrates that there is an imbalance between demand and supply: less than half of STEM graduates are potentially covered by the actual annual recruitment. Moreover, less than a half of STEM graduates directly after graduation are tend to get jobs in accordance with their obtained education. The annual recruitment in the STEM segment of the local labor market actually is only able to cover less than 50% of the STEM graduates from all education levels, including bachelor's, master's, and PhD levels. Thereby, key trajectories of STEM graduates directly after graduation are non-STEM oriented.

However, other studies with focus on international markets demonstrate that KZ labor market is close enough to some Western developed countries with one distinctive feature: there is a greater shift towards the non-STEM segment in terms of the final interests of graduates. The imbalance between STEM labor market's demand and STEM graduates' supply can be strongly connected with the higher education policy, contradictions between the expectations of graduates and employers, as well as available alternatives.

The deficiency of the empirical basis due to the lack of empirical data is complicated by technical and conceptual difficulties associated with defining an appropriate level of STEM graduates, assessing the skills acquired by students during the education process and expectations from employers at the moment of hiring, as well as estimation the intercorrelation between supply and demand. Identifying, analyzing and understanding the proportions and characteristics of supply and demand in the context of STEM graduates is extremely complicated issue. The complexity of this phenomenon has been the cornerstone of research by the great number of scholars for decades. To identify the reasons for the emergence of imbalances between supply and demand in the STEM segment at the country level, it is necessary to collect relevant data and to do a number of longitudinal studies of the higher education sector and the labor market.

Literature review

The employment of STEM graduates has been an object for the research in recent years, mainly in the context of the US labor market [6, 8, 9, 10, 11]. However, studies of the STEM graduates' integration in the labor market also covered other countries such as the UK [2, 12, 13, 14, 15], Canada [16, 17], as well as some Asian countries [18, 19], including Kazakhstan [20, 21].

Furthermore, a significant part of research is devoted to issues related to the gender characteristics of STEM education and choice of a further labor trajectory in the STEM segment [9, 11, 16, 20, 21]. It was found that in some countries there is no shortage of graduates as a phenomenon: the main problem is connected with the profile of graduates' work that could be far away from their obtained specialty or the lack of opportunities to get highly qualified positions as well as the absence of academic degree [2].

Along with the studies of career trajectories, gender characteristics and personal features, researchers devoted their papers to such an important issue such as shortage or inconsistency of graduates' skills with the requirements and needs of the labor market and particularly employers [4, 7].

Also, there are two significant facts identified by researchers as a result of studying issues related to STEM graduates:

1) STEM graduates create positive externalities in their segment of the labor market, increasing the competitiveness of the industry and the growth of wages for all working segments [3];

2) attracting STEM workers leads to economic growth and improvement in terms of social well-being in general, and particularly to wage growth due to the increase in productivity, especially among employees with higher education [5].

These facts additionally emphasize the necessity and relevance of the stated research issues. At the same time, the vast majority of studies use qualitative methods of analysis [7, 20, 21], while there are very few works based on quantitative methods of analysis using official statistical data or special data sets [2, 12, 13]. At the same time, in most studies, the lack and limited capacity of the data connected with the initial issue were underlined as the primal limitation of research. Thus, the choice of a quantitative method in the current study is characterized by both the availability of official statistics and the lack of research papers with an analysis of the situation in STEM Labor Market at the level of a particular country.

Results and discussion

In today's highly competitive world, there is a pressing need to prepare highly qualified specialists with knowledge-intensive specialties at a significant level and assess their prospects for future employment. The knowledge economy plays an especially important role in society, and the national system of higher education is intrinsically linked to the structure of the national economy. In recent decades, universities have become increasingly crucial as drivers of external and internal markets, adapting to labor market demands and dynamic changes while also considering the requirements of employers in both public and private sectors. Furthermore, the employment rate of graduates is a crucial indicator used to evaluate university performance [7]. Therefore, it is essential to analyze graduate employment in connection with the higher education structure.

To comprehend the situation regarding STEM graduate employment, it is essential to consider the role of STEM education programs in Kazakhstan's higher education system. This can be evaluated by determining the proportion of STEM graduates in total university graduates across all levels of education, including bachelor's, master's, and PhDs (Figure 1).
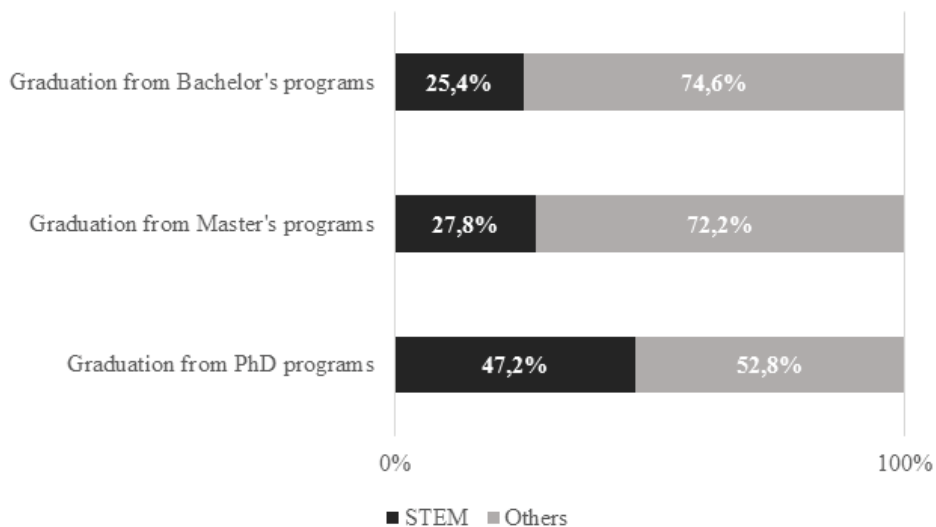

Figure 1 – STEM graduates in the total graduation from all education programs at the bachelor's, master's and PhD levels in Kazakhstan – 2021

Note: Compiled by the authors using data of Bureau of National statistics of Kazakhstan.

It is noteworthy that in 2021, at the bachelor's and master's education levels STEM graduates accounted for just over a quarter of the total graduation of students nationwide – 38,059 among 149,753 at bachelor's level and 5,405 among 19,457 at master's level. However, at PhD level, the situation was different: STEM graduates formed for almost half of the total graduation – 1,182 among 2,503. This fact can be explained by several interpretations:

1) public policy declares the need for highly qualified specialists in STEM areas and purposefully promotes persons with master degrees to enroll in PhD programs allocating more state-funded places for STEM-oriented education programs;

2) historical background in terms of the structure of higher education system, as well as the legacy of previous periods of development, determine the focus on education programs with STEM orientation (engineering, natural sciences, etc.).

Taking a closer look at the higher education system in Kazakhstan, it's apparent that the government prioritizes STEM fields of study and their relevance to the economy. Accordingly, public resources are allocated to educate specialists to meet industry needs. However, an important question arises: How many STEM graduates are actually recruited for jobs in their field of study immediately after graduation? Additionally, what are the trajectories of STEM graduates across each level of higher education?

In 2021, the number of employees participated in KZ STEM Labor Market was about 1 million people, which corresponded to 27% percent of the total KZ Labor Market (Figure 2). During the year, about 337 thousand new employees were hired, or a third of the average number of employees participated in KZ STEM Labor Market. Of the 337 thousand employees hired in accordance with the STEM profile, only 17.4 thousand people or 5% were university graduates who graduated in 2021. Of the 17.4 thousand people, only 15% were hired for positions corresponded to their received education.

In the same year, the universities of Kazakhstan graduated about 40.5 thousand people in the education areas corresponding to the STEM segment. The annual number of STEM graduates included persons, who finished undergraduate or postgraduate education programs and decided not to obtain a higher degree. The approximate share of graduates who directly after a bachelor's degree entered a master's program was 8% in 2021. Unfortunately, it is not possible to calculate the share of graduates who entered PhD programs directly after their master's program due to the limitations of the official statistics.

Comparing the number of Annual STEM Graduation and Annual Recruitment of HEIs Graduates (graduates of 2021), it becomes noticeable that the annual recruitment of staff in STEM segment could potentially cover about 43% of STEM graduates of all levels of education programs. At the same time, the remaining 57% could either go for a work that was not related to STEM economic activities, or decided not to enter the labor market at all, taking advantage of a wide range of alternatives, such as, for example, studying abroad, starting own business, shadow employment, unemployment, etc. It should be noted that these 43% of graduates, who could potentially be recruited in accordance with STEM economic activities, in fact may bypass STEM labor market. However, data on graduates who finished the education programs without relation to the STEM segment, and employed in positions related to STEM activities are absent in official statistical datasets.

Thus, during the initial consideration of the data characterizing the KZ STEM Labor Market and Annual STEM Graduation, it becomes clear that the main trajectories of STEM graduates directly after their graduation in Kazakhstan are weakly associated with an immediate entry into the STEM labor market. On the contrary, these trajectories are largely characterized by other opportunities, such as alternative employment or continuing education to improve skills. Quantitative characteristics of STEM graduates' flows show a clear shift towards the KZ non-STEM Labor Market.

The research reveals several key findings regarding the interrelation between the annual demand and supply of KZ STEM labor market in 2021:

1) The output structure of students from KZ universities has significantly shifted towards non-STEM education programs, although there is a higher tendency to prepare highly educated STEM specialists at the higher level of education, particularly in PhD programs;

2) Less than half of STEM graduates can potentially be employed through the actual Annual Recruitment of HEIs Graduates in KZ STEM labor market, indicating an imbalance between demand and supply even at the stage of entering the labor market right after graduation;

3) The absolute minority of STEM graduates directly after graduation gets jobs that correspond to the profile of the obtained education;

4) The key trajectories of STEM graduates directly after graduation are non-STEM oriented.
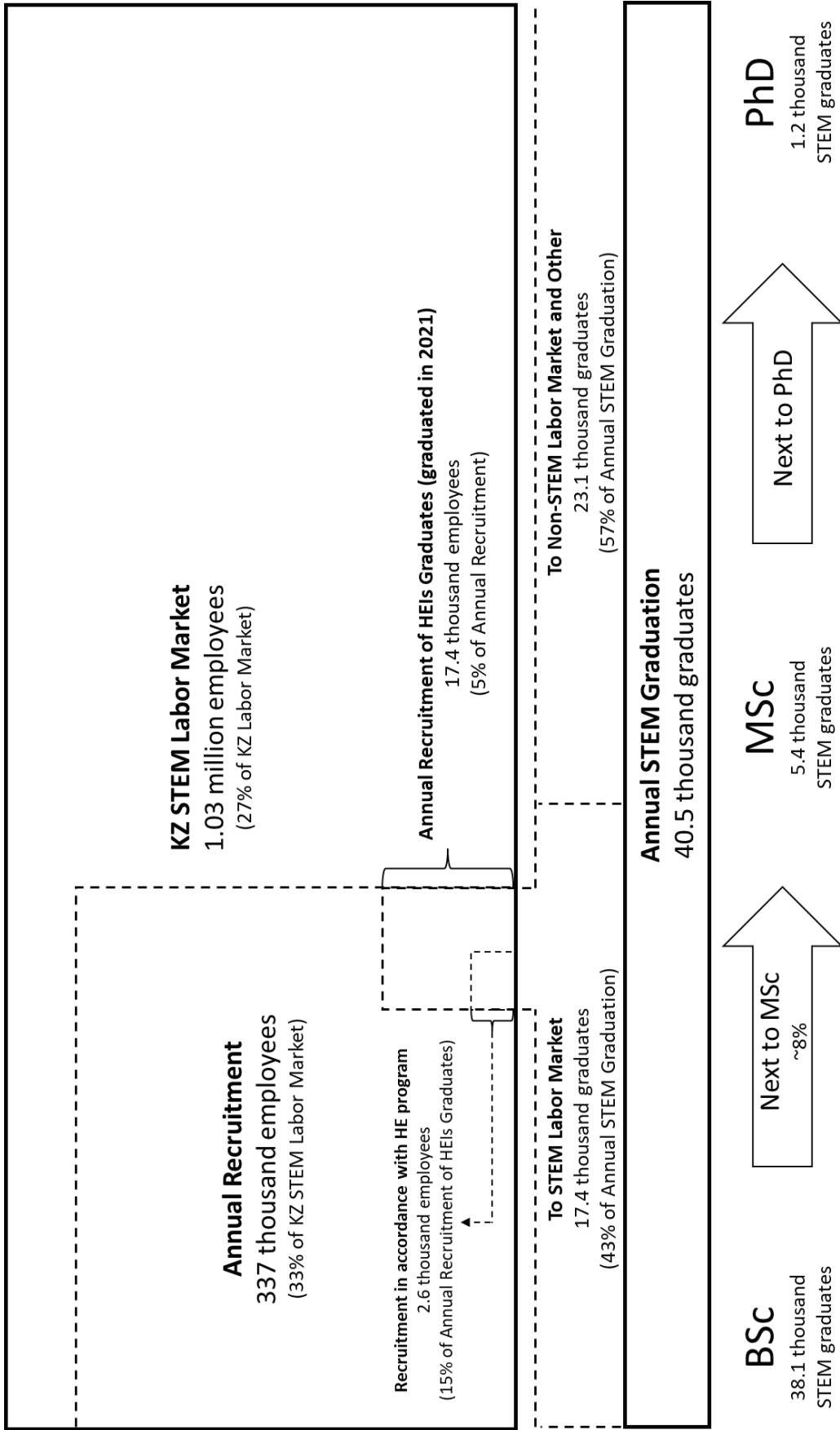
Figure 2 – Proportions of annual STEM labor market's demand and STEM graduates' supply in Kazakhstan – 2021

Note: Compiled by the authors using data of Bureau of National statistics of Kazakhstan.

The key-findings generally correlate quite well with the results of previous studies conducted, for example, in the UK and the USA [2, 3, 13]. However, it should be noted that the case of the labor market in Kazakhstan shows a more noticeable shift towards the non-STEM segment in the context of the final interests of graduates. Despite the fact that the methodology of the current study, based on official statistics, does not fully allow to trace the trajectories of STEM graduates, due to existing limitations, the results of the study by Francesco et al. (2020) can shed some light on the underlying premises of the observed phenomenon [7].

Graduates of universities in Kazakhstan in their last years of study generally have a rather weak assessment of the prospects for working in accordance with their specialty: obtaining a diploma comes to the fore, as well as further improving professional skills both in the context of vocational and postgraduate types of education [7]. KZ STEM labor market data show that the real recruitment of graduates to work in the STEM segment by organizations covers significantly fewer graduates with the relevant education.

Results of the university graduates' surveys in Kazakhstan underline the likely trajectories of further employment or professional development, which can be predominantly focused around:

(1) gaining work experience outside the STEM segment;

(2) continuing education at another university or abroad;

(3) starting own business.

Why is gaining work experience outside the STEM segment almost a top priority for graduates? The answer may also be found in the results of sociological surveys conducted among enterprises that hire graduates directly from universities in Kazakhstan. Among the main shortcomings mentioned in 2020, a significant lack of practical experience and the highly theoretical nature of knowledge were highlighted, which, in the context of complex STEM specialties, play a critical role. With rare exceptions, graduates are unable to demonstrate to employers the necessary competencies to secure desirable highly-qualified positions.

As a result, there is an imbalance between the demand and supply of the STEM labor market in Kazakhstan, which could be attributed to several reasons. Firstly, the education system plays a significant role. The quality of STEM education in Kazakhstani universities may not meet the industry demands, given the high rate of its development. Consequently, universities may not be able to prepare graduates with appropriate skills, knowledge, and expertise that are required by STEM organizations, leading to a gap between what is taught in the classroom and what is needed in the workplace. Furthermore, due to the rapid growth of industries such as engineering, IT and biotech, the demand for STEM workers may be increasing faster than the education system can produce qualified graduates. This tends to create a talent shortage, particularly in specialized fields.

Secondly, there is an influence of brain drain processes. A noticeable number of highly skilled STEM graduates tend to leave the country to pursue opportunities and gain additional skills abroad. This can lead to a shortage of highly skilled workers in the domestic market, which can contribute to a demand-supply imbalance. One of the most noticeable reasons for brain drain in Kazakhstan is the lack of a wide range of opportunities for highly skilled and educated workers in comparison to developed countries. Furthermore, the labor market may not be able to absorb all of the graduates due to fundamental reasons, which can result in underemployment or unemployment. Additionally, wages for skilled workers may not be competitive with those offered in other countries that are leaders in STEM industries, making it more attractive for graduates to seek better opportunities elsewhere.

Thirdly, there are current demographic trends to consider. The population of Kazakhstan is relatively young, and there is a large cohort of young people entering the workforce. However, there may not be enough job openings to meet the demand, particularly in connection with a certain set of skills. This can lead to a situation where many STEM graduates are underemployed or choose to work in non-STEM fields to obtain desirable working conditions. Furthermore, demographic trends may contribute to gender factors that create an imbalance in STEM fields in Kazakhstan, with fewer women than men pursuing careers in these fields. This can limit the supply of skilled workers in the industry and also contribute to a lack of diversity in the workplace. Addressing this issue may require targeted efforts to encourage more women to pursue STEM fields, such as mentorship programs, scholarships, and other initiatives.

Fourthly, the lack of incentives. There may not be enough incentives for students to pursue STEM fields in Kazakhstan. For instance, students may be discouraged by the difficulty of the coursework,

or they may not identify enough job opportunities in the field. Particularly, the perception of STEM fields in Kazakhstan could differ from the positive one, with some students and parents identifying these fields as difficult, uninteresting, or not potentially profitable or promising. This can discourage students as from pursuing STEM fields, as from continuing the career in the STEM trajectory and set additional limit for the supply of qualified graduates. Efforts to change the perception of STEM fields and to highlight the importance of these fields for the development of the country can change the situation. For example, improving incentives such as scholarships, internships, and job prospects, particularly in close cooperation with leading employers, is able to encourage more students to pursue STEM fields and get demanded skills at the appropriate level.

Overall, there is a set of factors that become contributing to the imbalance between STEM labor market demand and STEM graduates' supply in Kazakhstan. Addressing this issue will require a collaborative effort between the government, the education system, the industry, and other stakeholders to improve the quality of STEM education, create more job opportunities, and address other barriers to entry for students and workers in these fields. Primarily there need an additional attention to the peculiarities of the higher education process, discrepancies in the expectations of graduates and employers, as well as the availability of alternatives, such as working outside the STEM segment or abroad, changing profile of education or improvement of professional qualities in positions that require a lower level of qualifications from applicants. However, in the context of this study, it is not possible to assess in detail how many of STEM graduates choose one or another path directly after graduation, as well as during further career. So, wide use of qualitative methods for researching issues related to the strategies of STEM graduates in the labor market of Kazakhstan can provide a detailed answer to the issues mentioned in this research.

It should be noted that in order to build a higher education system that meets the requirements and demands of both the labor market and the national economy, active interaction between educational institutions, the government, and employers represented by the industrial private sector is obligatory. This can be achieved through the creation of integrated research and educational centers with the involvement of business and production representatives to build up a relevant education process. In order to get a timely response from the higher education system in terms of the labor market's demands, a detailed understanding of the situation is necessary. However, there are not many fundamental studies of this research issue in the context of Kazakhstan. Due to the lack of data, many points that help us understand the whole picture regarding the employment of STEM graduates still remain unclear.

For further analysis, it is crucial to initiate the longitudinal project for data-collection, including interviews with students and subsequently – STEM graduates over several years. The availability of such data would make it possible to precisely identify the number of graduates working in accordance with their education program directly after graduation. Additionally, the key opportunity to establish and analyze their career trajectories would be available. Moreover, it will be useful to study and then adjust the mechanisms of public policy to attract and retain STEM graduates in the relevant sectors of the national economy.

Thus, the key relevant vectors for further research can be proposed in accordance with the following list:

1. identifying the trajectories and assessing the scale of STEM graduates entering the local labor market directly after graduation from universities in Kazakhstan, using a more detailed dataset;

2. studying the STEM students' profile, including factors that influence the choice of education program, problems that students face during the education process, and career expectations;

3. investigating institutional shortcomings in terms of preparing specialists in accordance with the STEM profile. Special attention should be paid to the skills that students actually acquire and have the potential to acquire after graduation, as well as the development of the material and technical base necessary for proper training;

4. analyzing the structure and needs of the labor market in Kazakhstan, taking into account a wide spectrum of sectors;

5. studying the integration practices of universities, research institutes, and private sector organizations in the sphere of training specialists with the STEM profile.

At present, a variety of reforms are underway in Kazakhstan, alongside numerous programs and projects that aim to develop significant areas of economic and social activity. Some initiatives have already achieved notable results, while others require additional time to reach their objectives.

Researchers and experts are paying additional attention to possible risks associated with the local perception of labor, a lack of employees in certain industries, opportunistic behavior of actors during interactions, a low level of responsibility and professionalism, and the complicated innovation process and stimulation of entrepreneurship.

However, comparing the situation between vocational and higher education levels is tricky. Official statistics show that the unemployment rate among graduates with secondary vocational education is lower in Kazakhstan than among graduates with higher education. This can be explained by analyzing the initial expectations of these two groups of graduates. Those holding higher education diplomas often demand better conditions, such as higher wages, social insurance, career prospects, and better working environments. Consequently, it may be less complicated and cheaper for employers to hire candidates with some working experience rather than recent graduates who have not yet had practical confirmation of their education and skills. In this case, graduates of colleges may have better chances of finding a job. It should be noted that the public policy of the Republic of Kazakhstan has focused on creating an optimal structure in terms of the number of education programs and their spectrum at the levels of higher and secondary vocational education. Despite the imbalance between STEM and other non-STEM programs, the positive tendency in this field is confirmed by the case of PhD education level.

By conducting the studies mentioned, researchers and other interested parties, including employees, public authorities, universities, and representatives from the commercial sector, can obtain the necessary answers to several controversial questions that still exist. This research can fill the gaps in knowledge about the structure and function of the STEM education system, which trains specialists for the labor market. With a holistic view of how the STEM segment of the higher education system is organized, researchers can understand the skills students gain during courses and the extent to which these skills meet the real demands and needs of the labor market and employers' expectations. It is also important to understand the profile of people who choose to pursue STEM careers and their personal characteristics. By gaining a detailed understanding of these issues, it would be easier for the government and universities to implement an optimal policy for regulating and stimulating development in the STEM segment.

Conclusion

The current situation in terms of the interrelation between the STEM labor market's demand and STEM graduates' supply in Kazakhstan has been analyzed. Using official statistics, the trajectories of STEM graduates directly after their graduation have been designated. Proportions of STEM labor flows in the context of the national labor market of Kazakhstan have been assessed by comparing two official datasets. There are several key results of the research revealing the interrelation between annual KZ STEM labor market demand and KZ STEM graduates' supply in 2021. It has been found that the structure of student output from KZ universities is significantly shifted towards non-STEM education programs. However, in the case of PhD programs, there are twice as many graduates in total output compared with bachelor's and master's levels. Also, less than half of STEM graduates are potentially covered by the actual Annual Recruitment of HEIs Graduates in KZ STEM labor market, so there is an imbalance between demand and supply even at the stage of entering the labor market right after graduation. At the same time, the absolute minority of STEM graduates directly after graduation gets jobs that correspond to the profile of the obtained education. It has been revealed that the annual recruitment into the STEM segment of the labor market can potentially cover only less than half of the STEM graduates from all education levels (bachelor, master, and PhD). Moreover, the key trajectories of STEM graduates directly after graduation are non-STEM oriented. Previous research analysis shows that current findings in the context of the KZ labor market are quite close to the situation in some Western developed countries. However, the case of Kazakhstan demonstrates a more noticeable shift towards the non-STEM segment in the context of the final interests of graduates. It is noted that the revealed imbalance between STEM labor market demand and STEM graduates' supply can be caused by the features of the higher education process, discrepancies in the expectations of graduates and employers, as well as the availability of alternatives. To find the right answers in terms of public higher education policy development, it is important to conduct further studies with a focus on qualitative methods of analysis to understand the strategies of STEM graduates in the labor market of Kazakhstan more precisely.

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ҚАЗАҚСТАНДА STEM ТҮЛЕКТЕРІН ЖҰМЫСҚА ОРНАЛАСТЫРУ: ҚАЗІРГІ ЖАҒДАЙ

Аңдатпа

Жұмыста 2021 жылғы жағдай бойынша STEM сегментінің (ғылым, технология, инженерия және математика) бейіндері бойынша жоғары және жоғары оқу орнынан кейінгі білім беру бағдарламаларын игерген Қазақстан жоғары оқу орындарының түлектерін жұмысқа орналастыру саласында байқалған ағымдағы жағдайға талдау жасалады. Бұл зерттеудің мақсаты – STEM бағдарламалары түлектерінің жоғары оқу орнын аяқтағаннан кейінгі траекториясын модельдеу және Қазақстанның ұлттық еңбек нарығы тұрғысынан кадрлар ағынының ауқымын бағалау. Осы мақаланың мақсаттары үшін Ұлттық статистика бюросының еңбек нарығы және жоғары оқу орны қызметінің нәтижелері жөніндегі ресми статистикалық деректері, сондай-ақ түлектердің мансабын бастар алдындағы интеграциясының жекелеген аспектілерін сипаттайтын қосымша әдебиет көздері пайдаланылады. Талдау нәтижелері Қазақстандағы STEM түлектерінің басым көпшілігі жоғары оқу орнын аяқтағаннан кейін STEM бейініне қатысы жоқ жерлерде жұмысқа орналасқанын көрсетті. Сонымен қатар, оқуды бітіргеннен кейін STEM бейініне байланысты жұмысқа орналасатындардың басым көпшілігінің жұмысы алған білімінің бейініне тікелей байланысты болмаған. Еңбек нарығында бакалавриат дейінгі, сол сияқты магистратура және PhD деңгейлеріндегі STEM бағдарламасы түлектерінің жартысынан азы ғана жыл сайынғы STEM сегментіне жұмысқа алынатыны анықталды. Статистикалық деректерді алдыңғы сапалы зерттеулердің нәтижелерімен бірге пайдалану еңбек нарығында алған дағдыларын тиімді пайдалануға бағытталған түлектердің алғышарттарын бағалауға мүмкіндік берді. STEM түлектерінің санына, олардың STEM салаларында мансапты бастауға деген ұмтылысына және жұмыс берушілердің жалдау тәжірибесіне байланысты айырмашылықтар байқалады. Деректер жиынтығындағы шектеулерді ескере отырып, STEM-мамандарды даярлау және оларды одан әрі жұмысқа орналастыру саласындағы эмпирикалық зерттеулердің траекториялары ұсынылады.

Тірек сөздер: STEM түлектері, түлектерді жұмысқа орналастыру, жұмыспен қамту, жоғары білім, түлектердің траекториялары.

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ТРУДОУСТРОЙСТВО ВЫПУСКНИКОВ STEM В КАЗАХСТАНЕ: ТЕКУЩАЯ СИТУАЦИЯ

Аннотация

В работе анализируется текущая ситуация, наблюдаемая в сфере трудоустройства выпускников вузов Казахстана, освоивших образовательные программы высшего и послевузовского образования по профилям STEM-сегмента (наука, технологии, инженерия и математика) по состоянию на 2021 год. Цель данного исследования – смоделировать траектории выпускников STEM-программ непосредственно после окончания

вуза и оценить масштабы кадровых потоков в контексте национального рынка труда Казахстана. Для целей статьи используются официальные статистические данные Бюро национальной статистики по рынку труда и результатам деятельности вузов, а также вторичные источники литературы, характеризующие отдельные аспекты интеграции выпускников в начале карьеры. Результаты анализа продемонстрировали, что большинство STEM-выпускников в Казахстане по окончании вуза трудоустраиваются на места, не связанные со STEM-профилем. При этом у подавляющего большинства тех, кто после вуза устраивается на позиции, связанные со STEM-профилем, работа напрямую не связана с профилем полученного образования. Установлено, что ежегодный набор в STEM-сегмент рынка труда потенциально может затрагивать лишь менее половины выпускников STEM-программ как уровня бакалавриата, так и уровней магистратуры и PhD. Использование статистических данных в связке с результатами предыдущих качественных исследований позволило оценить предпосылки выпускников, фокусирующихся на эффективном использовании полученных навыков на рынке труда. Отмечается наличие диспропорций, связанных с численностью выпускников STEM, их стремлением начинать карьеру в сферах STEM и практикой найма работодателей. Предлагаются дальнейшие траектории эмпирических исследований в сфере подготовки STEM-специалистов и их дальнейшего трудоустройства с учетом имеющихся ограничений в наборах данных.

Ключевые слова: выпускники STEM, трудоустройство выпускников, занятость, высшее образование, траектории выпускников.