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Motivating factors of innovative research activities and barriers to R&D in Kazakhstan

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ABSTRACT

While higher education, science, and industry have become key factors in the national and economic growth of a country, they perhaps act as independent performers. This paper aims to describe the development of innovative commercialization activities based on the dissemination of innovations in the fields of research, education, and business. The present research, using empirical studies as its research method, first reviewed the current worldwide status of research studies to see their contribution to knowledge transfer. Second, it portrayed the results of an online survey of 100 respondents studying and teaching or researching at Kazakhstani universities to better understand the innovative research activities and motivations of and barriers to research and development (R&D) in the Republic of Kazakhstan. The results of the proposed approach are presented in the case of Kazakhstani researchers. Based on such findings, some recommendations are made for better Kazakhstani education, industry, and science alignment so that research in this country can have a greater impact on economic growth.

Keywords: innovation, commercialization, education, research, and development

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INTRODUCTION

The economic development of any state in the modern world has greatly involved the maximum use of innovative technologies, the expansion of the introduction of new technologies, the improvement of forms of commercialization of scientific developments through the stimulation of innovative goings-on by combining science, education, and industry (Johnston & Sasson, 1986). A business based on innovations in Kazakhstan is developing very slowly, however, as a huge number of technologies remain unclaimed, scientists are constrained in implementing of their developments. This in turn possibly limits their ability to receive additional income while all their attention is focused on obtaining government funding. Besides, industry and science seem separated from each other as there is no interaction nor joint projects or collaboration, and few specialists are capable of competently commercializing scientific and technical developments. Lack of marketing tools and information about technology markets, and a shortage of qualified personnel also hinder effective R&D in commercialization activities.

In developed societies, the advance in the economy, education, science, and technology are interconnected. While the economy provides financial support for science and education, creating new values and placing them in global markets, science is the one that provides the necessary prerequisites for the competitiveness of the economy, creating new knowledge and putting it into a function. In well-heeled sets, education provides a critical mass of both scientists and the general population who will apply the most modern knowledge for the development of the economy and society (Arsenijević et al., 2011).

In order to keep a vibrant alliance between science, education, and industry in Kazakhstan, educational programs must be adjusted in an inventive way at all levels of education. When creating instructional programs, this issue should receive special consideration. The learner must be provided with the foundational information needed to work in diverse sectors (Abdibekov et al., 2015). Accordingly, problem-solution recommendations about education, science, and industry would be proposed in this paper.

It is thus necessary to pay attention to developing innovative capacities, as well as the ability of these experts to engross and adapt technological innovations from abroad where it is applied. The problem would possibly be a lack of an appropriate regulatory, technical and scientific-methodological framework to ensure the commercialization process, which could show the value of intellectual resources and give direction to the creation of the economic value of the intellectual property (Europe, 2011). The paucity of a regulatory and methodological framework likely does not allow providing unified, systemic approaches to commercialization. In practice, however, each organization is forced to develop its own localized strategies, models, and methods of commercialization that are not adapted to the full range of existing market conditions, which might negatively affect the competitiveness of scientific and technical developments in Kazakhstan in the international arena.

While it has been known that economic growth is based on entrepreneurial activity, especially at the level of new start-ups, based on Global Entrepreneurship Index data, Kazakhstan is in the 64-th place out of 137 countries (Bosma et al., 2021). At the same time, based on Global Startup Ecosystem Index data, the country ranks 76th in 2021. Research on the impacts of the research team on the project success has been carried out for a long time in such disciplines as marketing, management, innovation management, etc., and as evidenced, Hernandez (2006) 2006) indicates that two authors, Gupta and Wilemon, prioritized teamwork over other factors.

Taking into account the described tendencies, based on modern concepts on research issues, innovation activity in Kazakhstan is not attractive to students/academics/researchers in start-up activities in higher education, frayed from the fact that projects in the field of R&D commercialization are not successful. The authors put up a hypothesis that the failure of the R&D commercialization project is directly dependent on such a factor as the level of the team's qualifications. The purpose of this study is to discover if the team’s skill level plays a decisive role in deciding whether to invest in a project or not.

This study also contributes to the literature review of the interaction between university, science, and industry by adding the world experience. The interaction between university and industry has been researched since the 1970s. It has been an actual research topic worldwide (Etzkowitz & Leydesdorff, 2000). In the last years, many researchers have studied the collaboration between universities and industry, and as a result, manufacturing sections would like to get a new product as soon as possible before its appearance, and in contrast, scholars are usually encouraged to publish their research findings before its manufacturing. Thus, there is a mismatch between the university and industry agreements about secrecy and misalignment of expectations with a new product in Vietnam. Another problem is that there have been no tax incentives for the collaboration between universities and research institutions, which are the key factors in R&D activities for the industry (Hoc & Trong, 2019).

Besides, the economic development of a country also likely depends on the professionalism and competency of the workforce. These skills should be developed in teachers because they are key actors in human development (Triyono et al., 2020). A trained workforce and modern science are essential for human development. The relationship between academic institutions and business should bridge the gap between science and education. Today, industrialized nations use

the concept of collaboration between academia, science, and industry. For instance, Baranovichi State University in the Republic of Belarus is one of the examples of how academia and industry can work in tandem. In this, a number of qualified researchers put their ideas into practice in the manufacturing sectors for social good as well as to foster innovation and produce products that are competitive (Klimuk et al., 2020). Simsek & Yildirim (2016) likewise explored constraints to open science and technology parks in Turkey and concluded that there are closed and open innovation principles that might constrain the research and development of firms in Turkey. They also highlighted that fostering university-industry cooperation increases performance and is possibly the most important strategy for both industrialized and developing countries.

However, earlier studies showed that there is no cooperation between higher education and economy, science, and economy in Serbia, and there is also no careful systemic and strategic planning of scientific development. In addition, research commercialization in terms of knowledge transfer between science and industry is almost nonexistent in Serbia (Arsenijević et al., 2011). Efremova & Romanova (2020) hence proposed a methodological approach that makes it possible to make a comprehensive assessment of the level of development of the innovative activity of universities by covering the main directions of the development of innovative activity (research, educational, administrative) and the main stages (input - process - output). The results obtained in the course of approbation of the approach – namely the level of development of innovative activities of the university under consideration – reflect the trends observed at the level of the national economy of the Russian Federation. The results obtained also become a reflection of the contradictions and gaps observed in the organization of innovation in domestic universities: gaps in the chain of support for innovation; lack of "soft" competencies among participants in innovative activities; contradictions in support programs and innovation policy.

In view of this, Frank et al. (2019) studied industry 4.0 as a new industrial stage in which several digital technologies can be implemented in manufacturing. Digital technologies play a central role in the current industry for augmented intelligence can provide a piece of real production information to consumers. Big data and analytics via information communication technologies (ICT), however, have been still used by manufacturing companies at a low level according to Frank's et al. (2019) study in Brazil. Open online sciences in educational sciences provide five databases such as open data, open analysis, open materials, preregistration, and open access. All these open science online research projects can offer knowledge to the public at different levels regarding their goals (van Dijk et al., 2021).

Digital technologies have not, however, been fully integrated into the education system yet. Yahya et al., (2021) conducted a survey on the use of ICT in Malaysian teaching and found out that there is a lack of technological pedagogical content knowledge in teachers. In addition, some students struggle financially to purchase smart devices for their educational needs (Ambikapathy et al., 2020). From the perspective of educational psychology, the smart education system cannot be recognized as a substitute for instructors in the debate because it may harm both students' and teachers' attitudes toward life and because students are accustomed to being consumers of smart technology in education. Proper implementation of smart technologies will be able to increase educational quality if they meet the educational goals of institutions (Kassymova et al., 2021). Based on the study results, the authors suggest that for the effective commercialization of scientific and technical products, great attention should be paid to the choice of method of commercialization in Kazakhstan (B. Kenzhaliyev et al., 2020; O. B. Kenzhaliyev et al., 2021). However, the literature review has not found much research works on the interaction amongst education, science, and industry in Kazakhstan yet.

It is a fairly well-known fact that startups are high-risk enterprises that require a high level of motivation from the project team. Studies of such a factor as motivations in entrepreneurship are well covered in the works of various authors, the well-known term Need for Achievement (N-Ach) is even more relevant for startups since the startup itself implies the absence of any finance to start operating activities and all that is for team members, this is the only motivation. The influence of motivations on the very process of entrepreneurship is one of the success factors (Shane et al., 2003).

The development of entrepreneurship in society is strongly influenced by entrepreneurial education and education in general. Although according to the author, entrepreneurship educational programs do not lead to the development of an entrepreneurial society, all the same, entrepreneurial education is an important factor in the process of entrepreneurship development (Ahmed et al., 2020). For the increase of intentions to open a startup, the confidence of a single individual in the success of the project is necessary, the level of education, in particular, the presence of a business education increases the intentions and impetus to start an entrepreneurial activity.

The central idea of creating a business and a startup, as well as the motivation towards entrepreneurship, depends largely on the students themselves. In addition, mentoring from teachers plays an important role in entrepreneurial endeavors. An entrepreneurial learning environment and dedicated curriculum can succor students recognize ideas. According to some of the authors, the learning model has a direct impact on the development of the movement of startups; it increases not only qualifications but also motivation for entrepreneurial activity (Santoso et al., 2021). The investment aspect of venture financing also lies in the fact that the investor, in addition to the very head ideas of the startup, pays strong attention to the qualifications and motivation of the startup team.

Furthermore, according to entrepreneurship researchers, students who had such assets as a qualitative business vision and are highly motivated to succeed (Habisch & Adaui, 2017; Shane et al., 2003) hardworking, and experienced such as entrepreneurs in a family business or parent's business mentoring (Palmer et al., 2021; Sahinidis et al., 2019) more often than others start to create a startup being in the areas of their interest more successful than others. Based on the opinions of various authors, there is a strong belief that special education programs for entrepreneurship, as well as the qualifications of a team, play a significant role in the success of startups.

The level of the team's competence, if not decisive in the success, in any case plays a rather high role. Taking into account the factor of education, it is also necessary to take into account the role of the university in the growth of entrepreneurial activity in society. Currently, in a developed society, higher education likely undertakes not only the process of education and transfer of knowledge, but its role in cultivating students' thinking capacity, leadership, and entrepreneurship capital has also heightened (Audretsch, 2014).

METHOD

Based on the literature review, the article summarizes and suggests some ideas on innovative research activities, commercialization efforts, and barriers, to measure the current situation in Kazakhstan. Such conditions are portrayed through questionnaires administered online to 100 participants ranging from lecturers and researchers to students. Respondents were randomly selected by sending a questionnaire via email. The majority of the voluntary respondents were from Satbayev University. The questionnaire which was previously developed served as a toolkit for a quantitative assessment. Thus, descriptive data detailing percentages were employed in this study. The reliability of validity was based on the knowledge and experience of expecting and acting respondents who are devoted to solving the issues of R&D commercialization activities in Kazakhstan.

The questionnaire includes two sections of an online questionnaire that was randomly conducted among researchers in Kazakhstan. The first section assessed respondents' socio-demographic characteristics including gender, age, and academic level, whereas the second section described an evaluation of their interest in participating in innovative activities, the important factors of commercialization of research and development, and the influence of each factor on the success of the project, and so on.

The preamble to the questionnaire provides information on: (1) what is thought about creating startups or other innovative activities? (2) Which research grants have been well-known among respondents? (3) Evaluation of their interests in participating in research innovative activities. (4) Influence of each factor on the success of the project. (5) Importance of performing

scientific innovative activities. (6) Degree of the importance of the learning factor for the achievement of the goals and objectives of the startup. (7) Respondents' opinions about what is meant by achieving success in life variables.

FINDING AND DISCUSSION

Finding

First of all, the survey recorded respondents' socio-demographics as presented in Table 1. It is readily clear from the table that more than half (65%) of the respondents were female, while males constituted 35%. The most active respondents were aged between 25 and 34. There were only 3 % of participants aged 65-74. It is also notable that none of the respondents is at the age of 18-24, which means respondents were of the working age, i.e., no bachelor students. All of them are educated, have graduated from college (57%), and even attained a scientific degree (43%).

Table 1. Respondents' socio-demographics

Variable	Category	%
Gender	Female	65
	Male	35
Age	18-24	0
	25-34	37
	35-44	22
	45-54	19
	55-64	19
	65-74	3
Academic level	Higher education	57
	Scientific degree	43

Besides, Figure 1 depicts the percentages of respondents with thoughts about creating startups or other innovative activities. It is evident that (1) 35% of the respondents would like to be involved in scientific and innovative activities. (2) 22% of the respondents aim to create a new product, and (3) 19% of survey participants are likely to open their own business. (4) 12% of the respondents would like to create a startup; (5) 10% of survey participants indicated that they would like to join a startup research project. Finally, (6) there is just a small portion (2%) of the respondents doing other business.

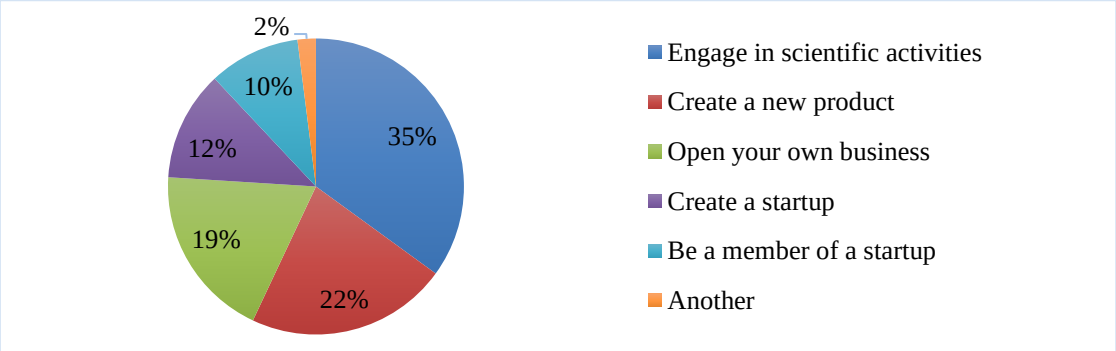

Figure 1. Percentage of Innovative Activities to Create Startups

In short, the largest number of respondents who consider themselves involved in innovative activities in the future are working at universities as teaching or administrative staff and researchers. Participants of the latter are representatives of schools or are studying for master's degree and Ph.D. programs. Thus, it can be concluded that people are more interested in research and the creation of a new product, after which business and their own well-being start.

Table 2. Organizations providing grants for research & innovation activities indicated by respondents

Grant Provider	%
Science Fund JSC	37%
QazTech Ventures JSC (National Agency for Technological Development)	22%
Another	17%
Project to stimulate productive innovation	14%
I did not come across	10%

Table 2 shows the degree of the respondents' involvement in working with the main operators of financing innovative activities in the territory of the Republic of Kazakhstan. As seen from the table, people are very familiar with and have worked with such organizations as Science Fund JSC, QazTech Ventures JSC (National Agency for Technological Development), and Project to stimulate product innovation, 37%, 22%, and 14%, respectively. Also, 17% of respondents indicated that they had experience working with other organizations that finance scientific and innovative activities, and only 10% of those surveyed had no experience working with this type of organization. The survey was conducted with reviewers, one way or another, effective in research activities, and many of the respondents were active workers in education and science.

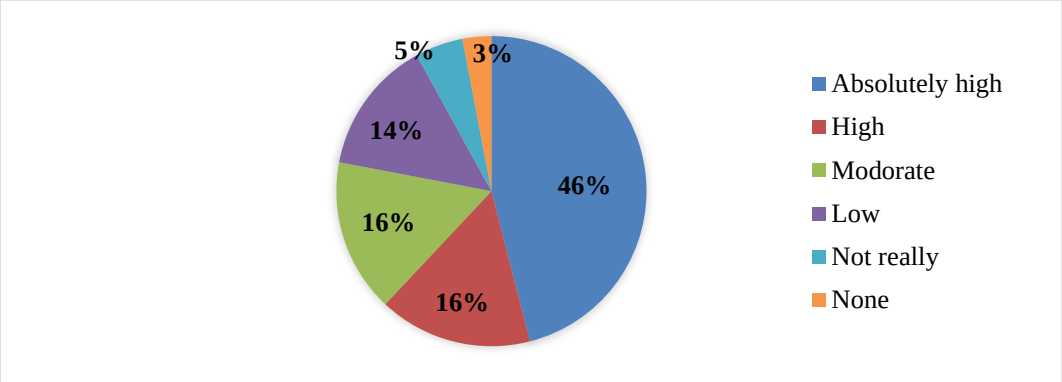

Figure 2. Interest in Participating in Startup Ventures

In terms of motivation, it can be clearly seen from Figure 2 that the enthusiasm to contribute to innovative research activities seems to be absolutely high (46%) and of high interest (16%). This possibly means that more than half of these people are readily active, if possible, to create a startup based on an innovative product, and participate in various competitions for grant funding for the commercialization of technologies. Accordingly, the majority of people are likely entranced in the commercialization of the results of research activities. This group of citizens can theoretically be classified as interested, while the other large group of people can be taken to medium and low interest in scientific and innovative activities, with 16% and 14% respectively. It is possible therefore to distinguish this group in the category of those who do not agree, while they potentially with a certain approach or changes in the market situation, may become interested. Lastly, some others, with just a very few followers, are not really (5%) or not (3%) interested in startups.

With regard to factors affecting project achievement, respondents view the following nine elements as having a considerably high impact. According to Table 3, respondents did not name the most important factor influencing the project's success among the factors listed, including “The number of allocated funds”, “Synergy”, “Motivation”, “Teamwork”, “Product/Idea Innovation”, “Implementation Period”, “Market Conditions”, “Self-development of team members”, and “Team Qualification”. The “Implementation period” was the sole exception, scoring lower than the other factors. According to the poll, the majority of respondents pay

attention to all the project success criteria, with teamwork, motivation, and product/idea innovation being the top three contributors to success.

Table 3. Impact of each factor on project accomplishment

Factor	Perceived Impact (%)		
	High	Moderate	Low
The amount of allocated funds	80%	20%	0%
Synergy	68%	29%	3%
Motivation	91%	6%	3%
Teamwork	94%	3%	3%
Product/idea innovation	85%	15%	0%
Implementation period	56%	41%	3%
Market conditions	70%	24%	6%
Self-development of team members	70%	30%	0%
Team qualification	81%	19%	0%

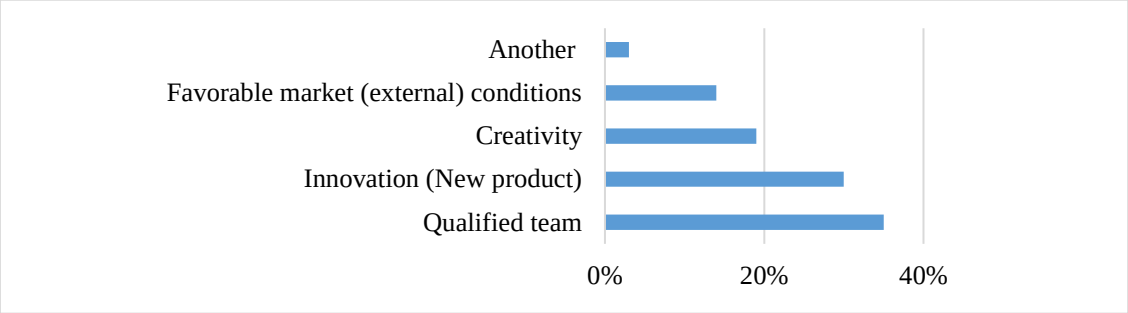

Figure 3. Importance of Factors Performing Scientific Innovative Activites

The above Figure 3 looked at both internal and external factors for the success of the project. To a greater extent, these factors influence in parallel and can act or influence the project independently of each other. Moreover, the influence of the factor can be negative or positive. However, in Figure 3, the respondents were required to highlight the main fact that, in their opinion, is the most important. There was no consensus among the respondents, but there are two following factors that scored the largest number of votes: Qualified team and Innovation (new product), 35% and 30%, respectively. Creativity and Favorable market (external) conditions are about the same ratio, 19%, and 14%, correspondingly, and only very small part of the respondents marked 'Another' (3%). However, these figures also indicate that, during scientific and innovative activities, people focus on internal factors such as qualifications and the product itself, forgetting that market conditions are likewise vital.

Table 4 shows the benefit of the hypothesis that people, when choosing to start scientific and innovative activities, focus their attention on the internal factor namely qualification of the team. This study uncover that the success of a project is strongly determined by the factor of team members' qualifications as more than half of the respondents noted 'Absolutely high' and 'High', 41% and 22% for the factor of the level of training of the project team for successful implementation. Likewise, 14% of them vote for 'Moderate', which in this case is a neutral answer. This indicator illustrates the fact that when assessing the success of a project and subsequent funding, people are most likely to pay attention to the qualifications of the project team.

As noted in the previous data from figures and tables, the last finding of this study (Figure 4) would also confirm the main hypothesis that the success or failure of R&D commercialization projects is directly reliant on such a factor as the level of the team's qualifications. Such expressions as ‘Knowledge is power and the experience gained in practice is invaluable’, yielded the highest results of 41% and 29%, consecutively. Therefore, it is obvious that the level of

knowledge of people increases the degree of confidence in research activities and stimulates greater interest in financing such high-risk projects.

Table 4. The degree of importance of the learning factor for the successful achievement of startups

Degree of Importance	%
Absolutely high	41%
High	22%
Moderate	14%
Poor	8%
Low	8%
Not really	5%
None	2%

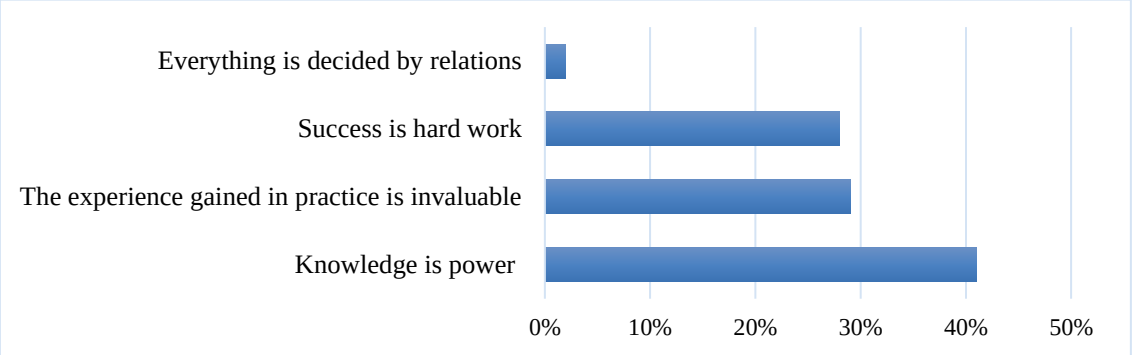

Figure 4. The Main Opinion Describing Factors od Success by Respondents

Discussion

In view of this, due to the limited economic resources, the question of the effectiveness of public investments in the field of science and innovation is always an acute issue. In Kazakhstan, this research topic has been poorly studied (Alibekova et al., 2018; O. B. Kenzhaliyev et al., 2021). The science and innovation policy are aimed at developing the potential of Kazakhstani science. The issues of development of the venture financing sector, protection of intellectual property, support for research and innovation, as well as the role of business in the Kazakhstani model of commercialization of scientific developments remain open (O. B. Kenzhaliyev et al., 2018). To achieve the development of Kazakhstani science and its commercialization, it is necessary, therefore, to use a systematic, integrated approach to the system of technology commercialization, in which the pace of mastering new knowledge can be significantly accelerated by combining many components.

Firstly, improving regulatory legal acts in terms of stimulating the commercialization of intellectual property can be the choice. Secondly, the organization of a professional network of commercialization support structures can be developed. Third, creating an effective financing mechanism for the commercialization of technologies to ensure the flow of quality projects can be put forward. Forth, workforce can be reinforced through providing consultation, methodological support, and strengthening human resources. The last one is the organization of partner networks for effective exchange of information and achievement of commercial links between the main participants in the process of commercialization of technologies.

It was revealed that the identified organizational and pedagogical conditions have an impact on the formation of specialists' professionally significant qualities which underlie their productive competitiveness in the field of professional activity (Kenzhaliev B.K et al., 2019; O. B. Kenzhaliyev et al., 2018; Sheriyev et al., 2016). In this regard, the educational system of every country should focus on the development of all students to succeed in science and industry. In the next section of this study, the authors would like to propose some recommendations.

CONCLUSION

Overall, this study solely examined descriptive data which included percentages. In light of the above-described online survey findings, it is possible to assign a mini-rating for each indicator of all elements that contribute to the growth of creative research activities. A thorough assessment of the status and level of the respondents' "innovativeness" will be possible through comparative analysis of their responses, which will take into consideration the advancement of all scientific, educational, and industrial fields of innovation. Also, interested parties will likely get new ideas to adapt to internal and external contemporary challenges and solve new tasks that the world community poses to them. The limitation is that some researchers can underestimate or misunderstand the value of the commercialization of science, education, and innovative technology. This study would like to offer some suggestions for fostering industry, scientific, and education cooperation in Kazakhstan. In order for students to successfully perform their theoretical tasks in practice, the most effective, correct resources should be devoted to creating relationships with industry and science in educational institutions. The educational system should be set up such that professionals from the business world teach students in practical ways using their academic prior-knowledge. Internship and applied research case studies are also important factors in the development of education, industry, and science. Furthermore, industrial sectors in Kazakhstan should support educational institutions in sharing practical knowledge to provide qualified human resources to society. In contrast, representatives of the industries should be welcomed to participate in scientific boards of universities for developing joint research. The last one, senior and junior research members should have access to any interested science parks built in nearby universities in Kazakhstan and interact with each other and implement their obtained research results in industries.

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