The potential of the "Green microbiology" approach for facilitating the human capital in Kazakhstan's chemical and petrochemical industry

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Abstract. Today, human capital is one of the main factors for the effective functioning of the modern economy. Human capital is the basis for developing any production branch, the basis on which all production is built. Therefore, analyzing human capital formation in the chemical and petrochemical industries is relevant today. The chemical and petrochemical industries are industries with high labor productivity. Analyzing human capital formation in these industries is necessary for further productivity growth and production efficiency. Therefore, the relevance of human capital formation in Kazakhstan's petrochemical and chemical industries is increasing. The study aims to identify the problems in human capital formation in the chemical and petrochemical industries and provide the most effective approaches to solving these problems. The most innovative approach to forming human capital in the chemical and petrochemical industries is the "Green Microbiology" approach, which reduces the risks of diseases of workers in this industry.

1 Introduction

Human capital represents knowledge, abilities, skills, professionalism, work experience, and intellectual potential. For many enterprises, especially in the manufacturing industry, improving human capital is the only way to strengthen their competitiveness, particularly those in the chemical and petrochemical industries. A person's positive, productive activity mostly depends on his skills, abilities, and desire to fulfill these goals, all of which are studied in the human capital theory. Similarly, human motivation for excellent and qualified work is the main component of constructing and establishing human capital essential for a country's economic growth in the industrial and innovative spheres. At the same time, the productive component is the primary source of production and the main form of its realization.

The chemical and petrochemical industries are priority sectors in shaping our country's competitiveness. Today, the leading producers of petrochemicals are the USA and European countries. However, the future also belongs to the UAE and Venezuela, which will become

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the leading producers of petrochemicals. Kazakhstan will also be able to occupy its niche in forming the world's chemical and petrochemical industry. The petrochemical industry will soon need more experts, engineers, and managers at all educational levels.

The purpose of the study was to analyze literary resources and identify the problems of human capital formation in the chemical and petrochemical industry of the Republic of Kazakhstan. Based on the analysis of these sources, we will give directions for solutions. We will propose an innovative approach, “Green microbiology," to solve the problem of reducing the health risks of workers in the chemical and petrochemical industries in the Republic of Kazakhstan.

2 Materials and Methods

Literature sources were analyzed to identify problems related to human capital formation in the Republic of Kazakhstan's chemical and petrochemical industry.
Criteria for searching literary sources:

We searched the public domain for literary sources from 2015 to 2024.
Search methods. We used the following databases: Elsevier (https://www.sciencedirect.com/search?qs), e-library (https://www.elibrary.ru/defaultx.asp), and Google. Kazakh sources are on Google, and Russian articles are in the e-library.

Based on Elsevier, we searched for the following keywords:
"Human capital in the chemical and petrochemical industry."
#"Green microbiology in the petrochemical industry."
According to the source "Human capital in the chemical and petrochemical industry," 544 sources were found in the public domain in base Elsevier for the period 2015-2024.

But we also used the Google database to find literary sources by the very definition of human capital.

According to the source "Green microbiology in the chemical and petrochemical industry," 168 sources were found in the public domain for 2015-2024.

We also used the Russian e-library database. We have selected the most relevant sources that most fully describe the problems of human capital formation in the Republic of Kazakhstan's chemical and petrochemical industry.
We also used earlier sources to review the word human capital for a more complete understanding of what we are exploring.

Therefore, we have selected 18 literary sources that are most suitable for our article, which is about finding problems and ways to solve them.

3 Results and Discussion

According to T. Schultz and G. Becker, human capital is an investment in educational skills that improve work skills [1, 2]. T. Schultz suggested that human capital is more of an investment than a consumption [1]. G. Becker assumed these investments would cause costs (direct costs, tuition costs, and salary reductions during training, but they would be justified in the future) [2].

B. Weisbord believed that human capital is the cost of education, training, health, information, and labor mobility [3]. The works of scientists Bovles S., Gintis G., and Osborne M. also considered human capital. They believed that human capital is an individual human ability that can be used as a production function [4].

Blundell R., Dearden L., and Goodman A. believed that human capital had two components: early abilities and skills acquired through university studies and skills acquired directly by an employee at work [5].

There are many methods of calculating the human capital. There are production models for estimating human capital, which are considered in Ackerman's works [6].

Market capitalized, value-added, and return methods were considered in the works of Stein, Schultz, Bechtel, and others [7]. All these methods evaluate the human capital based on the company's staff's future rent to generate market capitalized production volumes, profitability, profit, and other indicators. Thus, in Stewart's works, human capital was assessed as intangible values, and the physical value was considered the human capital through financial indicators such as Return On Investment (ROI) in the human capital [8, 9].

In their article "New Approaches to Measuring Human Capital in the Chemical and Petrochemical Industry," A. Ussenova and N. Sailaubekov also link the components of human capital: the share of internal R&D costs in %, the share of personnel who have completed advanced training in %, the share of personnel with higher education in %, and the share of personnel with secondary vocational education in % with company financial indicators [10]. In particular, the fifth factor is that they take companies' financial stability into account. They compared two companies (JSC Kazazot and KazMunaiGas) and identified weaknesses for both companies.

The current study aims to analyze the petrochemical industry, which can potentially become the main driver of growth for Kazakhstan's economy regarding human capital formation. It will consider the problems in forming human capital in Kazakhstan's chemical and petrochemical industry and give directions for solving them.

After analyzing the literary sources, the following problems were identified [10-13].

In Kazakhstan, there is a problem of training qualified personnel, which is associated with workers' lack of professional skills and significant disadvantages in obtaining education [11, 11p.].

The main reasons for the shortage of highly qualified and medium-qualified specialists in the domestic chemical and petrochemical industry based on literary sources are [12, 26p.]:

-weak connection of universities and colleges with scientific and manufacturing companies and enterprises.

-weak educational programs that need to meet the modern requirements of the industry.

-poor compliance with the terminology of specialties for training specialists with the needs of industries.

-the need for modern mechanisms and tools for managing the industry's staffing, which would predict and meet the demand of specialists in the oil and petrochemical industry in the modern labor market.

However, the main problem with the industry's shortage of qualified and highly qualified personnel is the separation of engineering education from the realities when the labor market requires specialists who do not have the breadth of university education but the opposite direction—intensive training of specialists for specific enterprises.

Today's labor market is filled with university graduates who need more competencies to work in industrial enterprises [13, 133p.]. However, most enterprises cannot and do not want to hire graduates; they say their main task is not to train personnel but to hire them for work [13, 133p].

Today, specialists with good technical and technological training but lacking the industry competencies necessary to work at these enterprises are released to the labor market annually [13, 133p.].

One of the main problems of human capital formation in enterprises of the chemical and petrochemical industry in Kazakhstan is the unpopularity of the profession among young people. This may be due to the risks inherent in this profession, as there is a high risk of cancer and injury in the industry. Still, they do occur [13, 3p.]. Unfortunately, the effect of harmful and dangerous factors on the production environment cannot be eliminated [13, 3 p.]

Analyzing the source identified the following problems [14]. An essential issue of human capital formation in the chemical and petrochemical industries is the need for more innovation activity. Fig. 1 shows that the level of innovation activity in producing coke and refined petroleum products in 2007 was about 24%; in 2020, it fell to 17%.

That is, there has been a decrease in the level of innovation activity in this industry. In the production of chemical products, there was an increase from 14.4% to 28.7% in 2020, and in the production of rubber and plastic products from 5.6% to 10.5%. However, more is needed for further innovative growth of these industries and the growth of human capital in the petrochemical and petrochemical industries of the Republic of Kazakhstan.

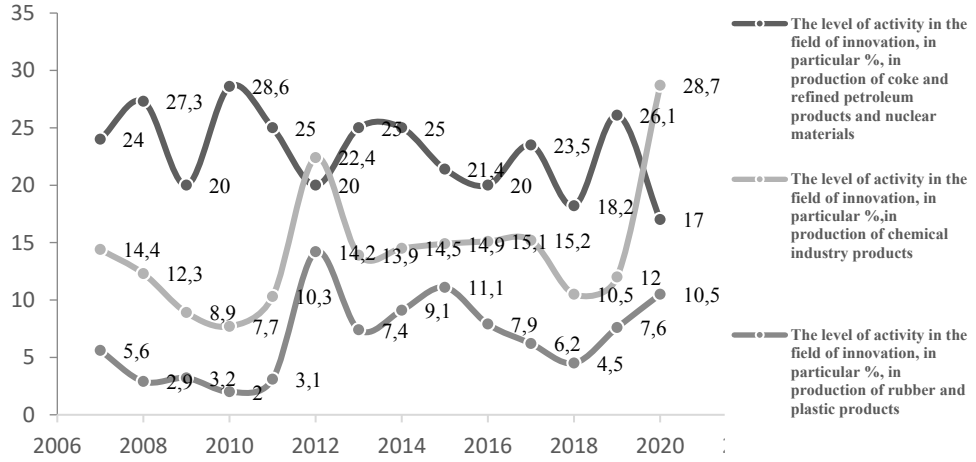

Fig. 1 The level of activity in the field of innovation % for the period 2007-2018 in the production of coke and refined petroleum products, the production of products of the chemical industry in Kazakhstan, and the production of rubber products of the Republic of Kazakhstan. The figure was produced according to the source [14].

An essential problem with encouraging human capital in Kazakhstan's chemical and petrochemical enterprises is the need for higher salary levels to attract young specialists. So, in 2000, it was 65,142 tenge; in 2021, it was 915,945 tenge. As for coke and refined petroleum products, products of the rubber and plastic industries, the wage level here is also relatively low compared to the average monthly wage in other industries [14].

In general, the salary level in the chemical industry, in producing coke and refined petroleum products, chemical products, rubber, and plastic products, except for oil, is at most the average. Still, more is needed to attract young specialists into this industry and cover the risks that exist in these industries.

Analyzing the following source- [15]. We can propose a solution to the following problem, reducing risks coherently in the branch: creating a professional pension system within the social insurance framework for working-age citizens in the petrochemical industry [15, 761p.].

It is possible to create voluntary medical insurance under corporate programs and additional pension provisions under corporate programs for chemical workers and the petrochemical industry of the Republic of Kazakhstan to level the risks inherent in this industry further [16,761p.].

– To solve the problem of releasing specialists with insufficient competencies, the dual system is further improved through direct training by students at industrial enterprises. This system is now present in industries but may be further strengthened.

Analyzing the following source, we can propose a solution to reducing risks for workers in the chemical and petrochemical industries by using an approach called "Green

microbiology" [16]. This field studies microorganisms. "Green microbiology" can be used to produce renewable resources from waste and in the production of the petrochemical industry.

This will reduce the risk of occupational diseases for workers in the chemical and petrochemical industries. The main activity in "Green microbiology" is the possibility of applying it to environmental protection [16, 2p.].

"Green microbiology" is suitable for solving environmental problems that require decomposing organic and inorganic compounds. At its core, "Green microbiology" can explore how different microorganisms can be used to form microbiological consortia. Microorganisms such as *Proteus* and *Aspergillus* are used in various phases to split toxic and non-toxic waste into no less harmful and beneficial compounds [16, 2p.].

Analyzing the following source, we can propose a solution to the problem of poor compliance with the terminology of specialties for training specialists with the needs of industries. In Germany, there is an incentive for young workers so that they can fully complete an internship—a qualifying internship when applying for a job—"Betriebliche Einsiegsqualifizierung" by the Federal Employment Agency—"Bundesagentur für Arbeit" [17].

They can complete a paid internship from the Federal Employment Agency for 6 to 12 months. The BA pays companies 231 euros per month in salary for internships and part of social benefits of about 120 euros so that a young employee can fully complete an internship at the enterprise [17, 11p.].

To improve the forecasting of the need for qualified and medium-skilled personnel, it would be possible to compare the labor and education markets in this industry, build predictive models for labor and education markets in this industry, and compare them, hence finding the need.

Analyzing the following source, we can propose a solution to the problem of poor compliance with the terminology of specialties for training specialists with the needs of industries.: tax incentives for companies engaged in R&D can also be offered for tax incentives for innovation activity [18]. This can be a research loan, such as in the United States, where companies that contribute a certain amount to R&D receive a tax loan of 20% of the base rate. The primary condition is maintaining the ratio of research expenses to the company's gross income [18].

It is possible to increase the salary level by making financial indicators dependent on profit and salary level. That is, an employee who wants higher wages should be interested in growing profits ROI. This will significantly increase labor productivity in this industry and help raise wages.

4 Conclusion

Based on the results of the study, it would be possible to propose a further improvement of the industry, the development of a dual training system, the creation of a pension system to compensate for the risks inherent in this profession, linking the salary level to key performance indicators of enterprises to motivate employees and raise wages, and increasing the productivity of workers in the chemical and petrochemical industries. Applying the "Green Microbiology" method will also help reduce the risk of diseases among chemical and petrochemical workers by reducing the harmfulness of waste components. The formation of high-quality human capital will help the industry to develop and help Kazakhstan occupy a niche among the world's leading players in the chemical and petrochemical industry. Eliminating problems and improving human capital will help Kazakhstan's economy grow further, its chemical and petrochemical industries diversify, and its ability to produce high-quality, competitive products.

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