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Training of specialists for the valorization of mineral resources of the globe

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Abstract. In modern times, young people strive to become diplomats, economists, artists, lawyers, noble professions but irrelevant to the development of industry, technology and technology. The innovative development of the industry requires saturation with highly qualified technicians, continuously guided, educated and improved. The paper addresses the issues related to their personality, factors determining personal development, criteria for assessing personal development, technological culture, philosophy, basic qualities, attitude and skills necessary for the mining engineer, starting from the principle "Deep in the bowels of the Earth you find the root of knowledge!". The paper indicates, without being limiting, the authors' vision on how to approach the training of specialists for the exploitation of useful mineral substances (solids, liquids and gases).

Keywords: specialists, mining, earth, resources, minerals.

1. Introduction

From prehistoric times to the present day, mining has played a significant role in the existence of the human race.
At the beginning of civilization people extracted stones and clay and later minerals found on the soil, then near the surface of the earth and later deeper and deeper into the subsoil. Slowly but surely, the extracted minerals have changed the life of ancient man, whether we are talking about building materials, precious stones or metals such as copper, lead, gold, silver or iron. Ancient man learned how to

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become a miner by constantly and continuously dreaming of exploiting the planet's resources and practicing different methods of extraction.
Currently, if a high school graduate's dream is to become a miner, he must start his career by obtaining a degree in one of the best mining engineering schools in the world. Only in this way is there the certainty that a licensed mining engineer can manage any phase of a mining operation: from prospecting, exploration and evaluation of mineral resources, to drawing up the feasibility study, mine design, developing plans for opening, production, operation, processing, transport and up to the closure and greening of mining perimeters, temporarily or permanently affected by exploitation works.

2. Situation of mining schools

There are many schools that offer bachelor programs in mining engineering, designed to provide students with both the skills and specialized training necessary for such a large responsibility, required by this specialized field. The criteria for selecting these schools include, but are not limited to, the following factors: academic reputation; accreditation; employment index; exam success rate; acceptance and graduation rate; number of programs; average income of graduates; Admissibility; job placement rate; Specialization; reputation and global influence. Thus, in order to facilitate the choice of a prestigious university in the mining field, we present the best mining engineering schools in the world [1] and in Romania (University of Petroșani, Petroleum-Gas University of Ploiesti, University of Bucharest), which offer study programs.
Internationally, the most renowned mining engineering schools are: *Colorado School of Mines*; *Curtin University*; *McGill University*; *University of Queensland*; *University of Western Australia*; *St. Petersburg Mining University*; *University of New South Wales* (UNSW Sydney); *University of British Columbia*; *Pennsylvania State University*; *University of the Witwatersrand*; *University of Alberta*; *Queen's University*, *Melbourne University*. [1]

a. Colorado School of Mines

The Colorado School of Mines was established in 1859 and served as a supply center for miners and settlers in the area. Courses offered to students in the early years of the Colorado School of Mines included: chemistry, metallurgy, mineralogy, mining engineering, geology, botany, mathematics, and drawing. Early academic programs focused on gold and silver and the analysis of those minerals. As the institution grew, its mission expanded to focus specifically on understanding the Earth, harnessing energy, and supporting the environment. *{Visit school}*

b. Curtin University

Established in 1966, Curtin University has become a vibrant and collaborative setting where ideas, skills, and cultures come together. With campuses in Western Australia (Perth and Kalgoorlie), Malaysia, Singapore, Dubai and Mauritius, as well as a network of university partners around the world, Curtin is an international

university with a rapidly expanding global footprint. Curtin's growing reputation saw the university quickly climb the international rankings. *{Visit School}*

c. McGill University

Based in Montreal, McGill University ranks among Canada's most prestigious universities, attracting thousands of international students from more than 150 countries each year. It has the highest percentage of PhD students among Canadian universities. McGill owes its reputation to its 50 research centers and institutes, more than 400 programs, rich history, and thriving alumni network (250,000) around the world. *{Visit school}*

d. University of Queensland

The University of Queensland (UQ) consistently ranks among the world's top universities, being one of only three Australian members of *Universitas 21 globally*. UQ has maintained a global reputation for positive change through management knowledge for a *better world*. Here, more than 53,600 students learn the secrets of the trade at three campuses in southeast Queensland. These include approx. 18,000 international students contributing to the diversity, support and inclusion of the UQ community. *{Visit school}*

e. University of Western Australia

With campuses in Perth and Albany, the University of Western Australia (UWA) is a dynamic and progressive community of lecturers, researchers, students and staff, focused on learning, research and innovation. UWA is internationally recognized as a leader in research and higher education. *{Visit school}*

f. St. Petersburg Mining University

Founded by decree of Empress Catherine II in 1773, St. Petersburg Mining University is the first technical institution of higher education in Russia. Today, the university has a unique combination of the richest tradition and state-of-the-art modern technologies and facilities in its eight schools (faculties).

Its well-developed infrastructure and high competence of academic staff provide its more than 12,000 students with the best education through the wide range of bachelor's, master's and doctoral profiles for future employees of Russian and international companies, engaged in estimating, prospecting, exploring, exploiting and processing solid, liquid, gaseous mineral raw materials (coal, oil, gases, diamonds and ores). The University offers: "Summer School" programs; Bachelor programs; Master programs; Specialized bachelor programs; Graduation programs. It should be emphasized that the University of Petrosani has had a Cooperation Agreement with St. Petersburg University for many years. The agreement reached was extended in 2021. *{Visit school}*

g. The University of New South Wales (UNSW Sydney)

The University of New South Wales is one of the world's leading research and teaching universities. Established in 1949, it is home to more than 60,000 students from over 130 countries and a community of 300,000 alumni worldwide. UNSW is committed to pioneering research and preparing the next generation of *talented global citizens for career success*.

The main campus is located on a 38ha site in Kensington, seven kilometers from Sydney city Centre. Other campuses are UNSW *Art & Design (*Paddington) and *UNSW Canberra* at ADFA (Australian Defense Force Academy).
UNSW provides opportunities for students to discover opportunities with world-class undergraduate, graduate and research programs. *{Visit school}*

h. University of British Columbia

The University of British Columbia has an excellent reputation with both academia and employers, and a particularly international faculty. The University of British Columbia excels in several subjects, including: Geography; Mineral and mining engineering; Sports-related fields. With beautiful campuses in Vancouver and Okanagan, the University of British Columbia is home to world-class science labs for subatomic physics and a center for interactive sustainability research, a concert hall, a work farm, an Olympic ice hockey venue, and the world's largest blue whale skeleton. *{Visit school}*

i. The State University of Pennsylvania (Penn State)

Founded in 1855 as an agricultural college, it opened its first class in 1859. The Pennsylvania legislature designated *Penn State* as the sole institution of the Commonwealth in 1863, which eventually expanded the university's mission to include teaching, research, and public service in many academic disciplines. *Penn State* also has 23 additional locations in Pennsylvania and *Penn State World Campus* that feature online degree offerings. And even though some of these locations have specialized academic roles, e.g., *Milton S. Hershey Medical Center* in Penn State all adhere to an overall mission, a set of core values, and shared strategic goals**.** *{Visit school}*

j. University of the Witwatersrand

Based in Johannesburg in South Africa, the University of the Witwatersrand (Wits) offers over 3,600 undergraduate and postgraduate courses in English in: Science; Health Sciences; Humanities; Engineering and Environment; Trade, law and management. Wits academics regularly publish top research in the fields of natural sciences, medical and health sciences, social sciences, humanities and engineering. *{Visit school}*

k. University of Alberta

The University of Alberta is one of Canada's top universities and among the world's leading public research universities, with a reputation for excellence in the humanities, sciences, creative arts, business, engineering and health. With over 100 years of history and 250,000 graduates, the University of Alberta is known worldwide for training leaders. It is located in Edmonton, Alberta, a dynamic city of one million people and the major center of the energy industry. The main campus, in central Edmonton, is minutes from downtown, with bus and subway access through the city, hosting nearly 40,000 students, including more than 7,000 international students from more than 150 countries. *{Visit school}*

l. Queen's University

Queen's is one of Canada's oldest degree-granting universities and a contemporary hub of academic research in Kingston, Canada.

The university is among Canada's top medical-doctoral universities. Its university- and faculty-based research centers provide dynamic and collaborative settings for researchers.

Queen's researchers are leaders in numerous fields, having recently made notable advances in particle astrophysics, cancer research, art conservation, geotechnical engineering, biodiversity and clean energy technology. *{Visit school}*

m. University of Melbourne

When the University of Melbourne was founded in 1853, it was a simple group of buildings in a large park on the outskirts of the city, with four professors and 16 students. The University is now at the heart of a thriving international city and is consistently ranked among the world's leading universities and Australia's number one. Here, more than 8,000 employees and professionals support a vibrant body of around 65,000 students, including 30,000 international students from over 130 countries around the world. The city of Melbourne is known for offering students an experience that is much more than just structured learning. Parkville's main campus is close to transportation, cafes, shopping, arts and sports spaces, and accommodation.

The university has 10 residential colleges where most students live, which provides a quick way to build an academic and social network. Each college offers sports and cultural programs to enrich the academic experience, which is at the heart of university life. *{Visit school}*

3. Important aspects of mining engineering

Mining engineering is associated with many other disciplines such as mineral processing, exploration, excavation, geology and metallurgy, geotechnical engineering, and surveying. A mining engineer can manage any phase of mining operations, from mineral resource exploration and discovery, to feasibility study, mine design, plan development, production and operations to mine closures.

Successful completion of the mining engineering curriculum qualifies the student for a professional career in the evaluation and development of properties of useful mineral substances, design and management of mining systems, as well as research and consultancy.

-*What should a high school graduate consider when choosing a mining engineering school?* [4]

Basically, one of the factors is the cost of tuition. The cost of an engineering program varies. Mostly, by the chosen institution. Apart from tuition, there are other additional costs to consider, which include: Cost of books, School and laboratory fees. Other course materials such as uniforms, Cost of living expenses which may include room and board on campus.

-*How long does it take to study in mining engineering schools?* [4]

Engineering degrees are typically designed to take four years to complete. To achieve this goal, however, a full load of hours each semester will need to be ensured. In most schools, this means 15 hours of class.

Mining engineers with a recognized diploma can find employment as: Geological engineers; Geophysical engineers; Mineral engineers (for coal and ores); Mining safety engineers; Seismic engineers.

Looking at the job outlook for mining engineers, it is estimated that mining engineer employment will grow by 3% from 2018 to 2028, slower than the average for all occupations. Employment growth for mining engineers and geologists will be driven by demand for mining operations. Additionally, as companies look for ways to cut costs, they are expected to contact more services with engineering services firms rather than hiring engineers directly. The thesis that education is the basis of social progress is indisputable. "In order to ensure economic and national security, mining extractive of useful mineral substances must register a spectacular technical and economic progress, but which must also take into account the European Union's policy on environmental protection, free competition and energy. In this sense, the key to success lies in transforming science into a productive force and increasing its role in the life of society." [5] Useful mineral substances used in high-tech industry [6] are vital elements for sustaining and developing modern economies. At EU level, in 2017 the industrial sectors using them had an added value of € 1.324 billion / year and generated EUR 30 million. jobs. EU industry, being 70% dependent on the U.S., covered only 29% of the metals market needs from European own resources, compared to 40-60% provided by waste recycling. [6]

4. Conclusions [4] [7] [8]

Studying a mining engineering program in any of the best schools for mining engineering in the world is one of the best decisions. In addition to the quality of education there was an opportunity to learn various levels of engineering. Training specialists for the exploitation of useful mineral substances (solids, liquids and gases) of the Earth, not so much today as for the future, is associated with the achievements of technology today and tomorrow. And this means that a graduate of the university must be competitive, constantly learn and adapt to the changing conditions of life. [9]

Moreover, in modern society, the cost of time risk increases. Therefore, we cannot wait, endure some time; Life requires urgent solutions to the urgent problems of the mineral resource complex. The longer we postpone without addressing urgent issues, the greater the payment of this risk will be.

„Earth's capacity is finite, but human possibilities are not”.[10] Society can exist only on condition of continuous technological progress, and a slowdown in development leads to disaster. We believe that the state should support more the aspirations of young people in science. Science plays the role of conductor, receiver and collector, providing objective information about reality, making it possible to make the necessary decisions. Students who want to become mining engineers are reminded that they must be diligent, curious, devoted to the sciences they study. A student at the university should get used to independent work, since

the knowledge gained is the basis for successful work throughout life. The education of the country's younger generation should have a strategic priority. The continuous intellectualization of knowledge is a requirement of the life of modern society. At the same time, we should not forget the well-known statement that "the more enlightened a person is, the more useful he is for his homeland", and an uneducated person, unfortunately, is often socially dangerous. At the same time, we must not forget that a good specialist in his field must receive a broad general human education.

Today's young people will have to learn more and better, because the future world is not the "promised land" and they should be responsible not only for themselves, but also for the future of the country. The modern economy needs a specialist capable of mastering new knowledge, creating new intellectual products, finding new ways to solve production problems, giving birth to new ideas and technologies. Today the demand for education is increasing, which means that there will be competition, that is, universities need to create an opinion about themselves. In order to attract students, it is necessary to create a brand that arouses the interest of applicants. The innovative development of the industry requires its saturation with highly qualified specialists in new technological areas. It should be understood, however, that education cannot be given or communicated. The student must achieve it with his own work. The teacher does not teach, he must create a situation in which the student understands and master's new knowledge. The modern development of science-intensive technologies requires an increase in interdisciplinary research in the training of a mining engineer, who must possess a wide range of key competencies, in addition to the usual assimilation of highly specialized disciplines. Today, when an important part of young people strives to become diplomats, economists, artists or lawyers, it is necessary to actively promote the specialty of a mining engineer on a national scale in order to attract the most talented students to the orbit of technologists for the exploitation of Earth's resources.

The 21st century is the century of knowledge that young people acquire in families, schools and universities. The acquired knowledge and professional skills will determine their fate in society and the state. In principle, a good education is an investment in human capital, the growth of which is the responsibility not only of the state, but also of any self-respecting person. We emphasize that without the personal interest of a person in modern conditions, mastering knowledge at a high level is almost impossible.

-*Let's try to figure out what needs to be done?* [4]

1. The young man, after graduating from school, wants to continue studying. Who and what? Most applicants do not have a clear idea of the future, they have no decision about who to be. Although the success of his entire life actually depends on it. Therefore, the choice of specialty should be significant. As often happens, parents determine for their child the specialty they choose, sometimes applicants use the advice of friends, the possibilities of "countertop", sometimes the choice of a university is determined not by calculations, but by random circumstances,

such as the proximity of the university to home, that is, an assessment of prospects is made for obtaining random benefits.

- If the young man does not have a strong desire to choose a particular specialty, then before deciding on the choice of specialization, assess his capabilities, who he would like to be, what is the likelihood of continuing with employment.
- If you enter a university in Romania, for example, University of Petrosani, University of Oil and Gas, or University of Bucharest, which trains professionals in areas related to mineral resources understand the specifics of the chosen specialization and try to obtain a broad specialty.
- In a modern university, science and education are connected and that is why the student must participate in research work. After graduating from college, the specialty is in the hands of the young engineer. But in life you need constant self-education – getting another knowledge, sometimes from a completely different field. Knowledge is the "irreplaceable currency", which must be constantly updated, in order to assimilate new knowledge, skills to apply them in business to achieve the set goals. Everything that follows during life will be determined himself. Therefore, it is necessary to be constantly creative so that, as the Romans said, he "is and does not seem" a true professional.

A university graduate - a mining engineer must [4]:

- be able to use the knowledge acquired for the benefit of the country and its own;
- independently solve emerging problems;
- constantly improve their competitiveness;
- acquire new knowledge (and their combination with applied skills provides a balance between scientific and practical skills);
- adapt to changes in the external environment;
- solve emerging problems at the level of inventive problems;
- understand the needs of customers - buyers of minerals;
- possess a spirit of enterprise and inventiveness;
- When making decisions, thinking is not standard.

At the heart of all areas of mining in the era of globalization there should be a flood of patents – obtaining patents for inventions that counter competitors and income from your work. It is not for nothing that Bill Gates, after paying a fine of $ 160 million, addressed employees with: "patent everything you can". When making inventions, innovations it is necessary to obtain patents and implement them in production.

A mining engineer trained at a university is obliged to solve all problems related to the prospection, exploration and exploitation of mineral deposits, that is, the opening of the relationship between man and nature within mining. This means that he has knowledge for determining the goal, goals and ways of developing production.

These include the following functions [4] [5]:

- methodology – contributes to the discovery of the legality of methods, technologies, creates a basis for the development of theoretical considerations of mining science in the field of exploration, construction, development and

processing of extracted raw materials;

- analytics - conducts analyzes, evaluations, performance of research organizations, universities and industrial enterprises;
- predictive - assesses the development of technologies of the mineral resource complex, the likelihood of negative events and correct them in a timely manner; regulation - through the market acts on people and technologies, that is, on the life of the country and society;
- creative and ideological - helps to evaluate and control public and private interests in the valorization of mineral resources;
- cognitive - reveals trends in their development and assesses the situation in the future;
- educational - creates the basis for the training of qualified personnel for the complex of raw materials, forms a culture of production and research.

Today, the innovative development of the industry requires its saturation with highly qualified graduates in new technological fields. In this regard, the University of Petrosani, the Petroleum-Gas University of Ploiesti, the Universities of Poland, Germany (Freiburg, Aachen) and many other universities are a breeding ground for staff training for all spheres of services in the mining industry, therefore, only the technical qualifications of a mining engineer are no longer enough: it is necessary for the engineer to have a wide erudition, master information technology, as well as knowledge of foreign languages, business fundamentals, management, psychology and, most importantly, the ability for lifelong self-study. We would like to note that the task of training mining engineers at the international level requires from their own state, when hiring, to ensure the appropriate salary, otherwise there will be a leak of personnel abroad. In this regard, it is especially important to train scientific and pedagogical personnel capable of being the driving force of scientific and technological progress in mining. Young specialists will have to study more and better to work in the field of exploitation and valorization of useful mineral substances of the globe, because the future world is not a "promised land" and they must be responsible not only for itself, but also for the future of the country.

Below, we present the characteristic aspects of the training of a mining specialist, which make it possible to comprehensively assess his training, and these are the answers to the questions: what is the personality of a mining engineer (Fig. 1), development factors (Fig. 2), evaluation criteria (Fig. 3) and what are the characteristic features of his personality (Fig. 4). And, as a result, what a mining engineer trained at a profile university is capable of. (Fig. 5)

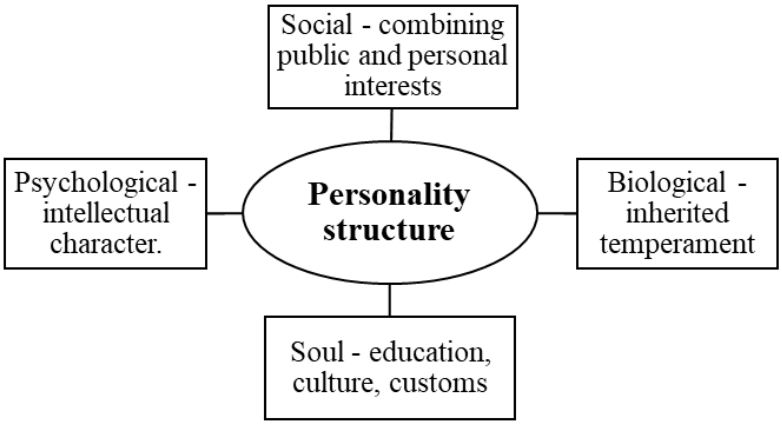

Fig. 1. Analysis of the personality structure of a mining engineer.

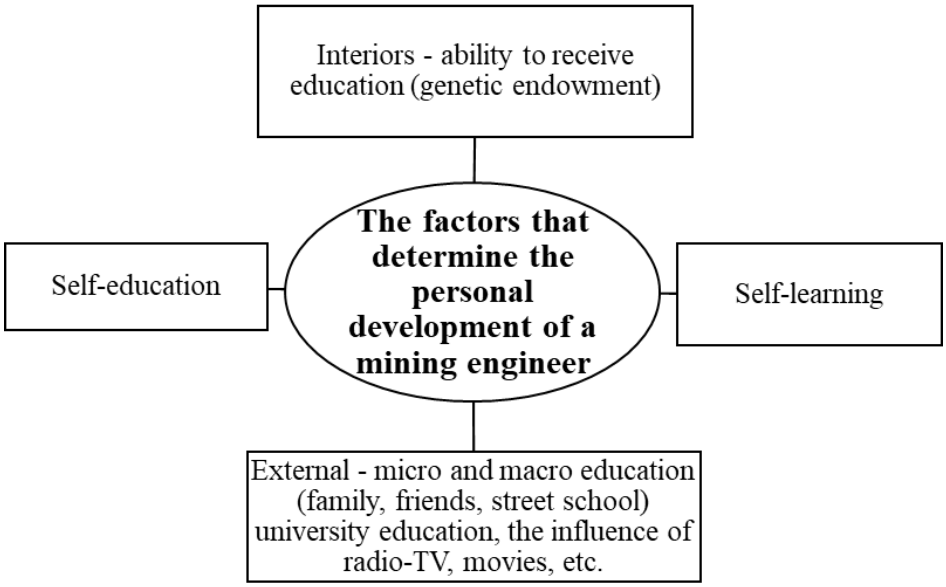

Fig. 2. Factors determining the personal development of a mining engineer.

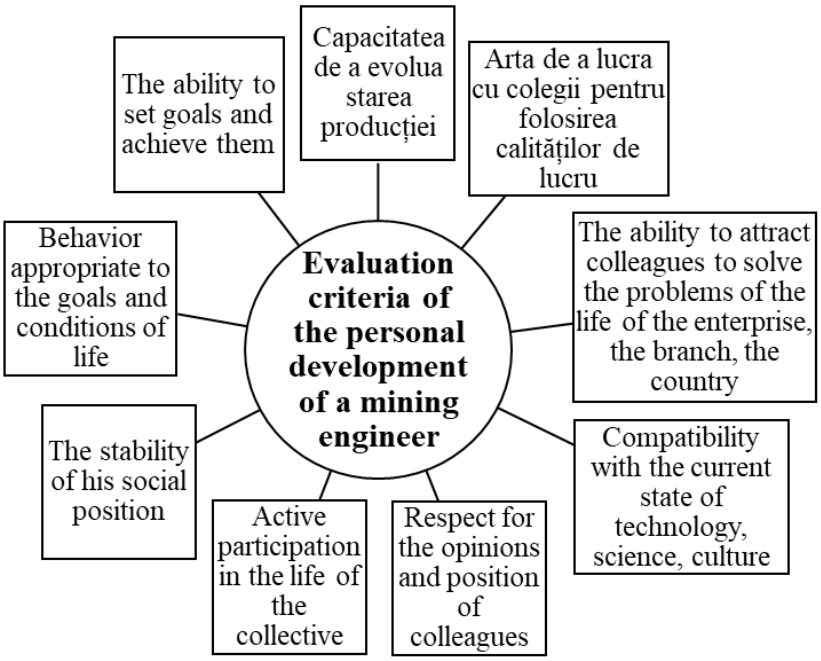

Fig. 3. Criteria for assessing the personal development of a mining engineer.

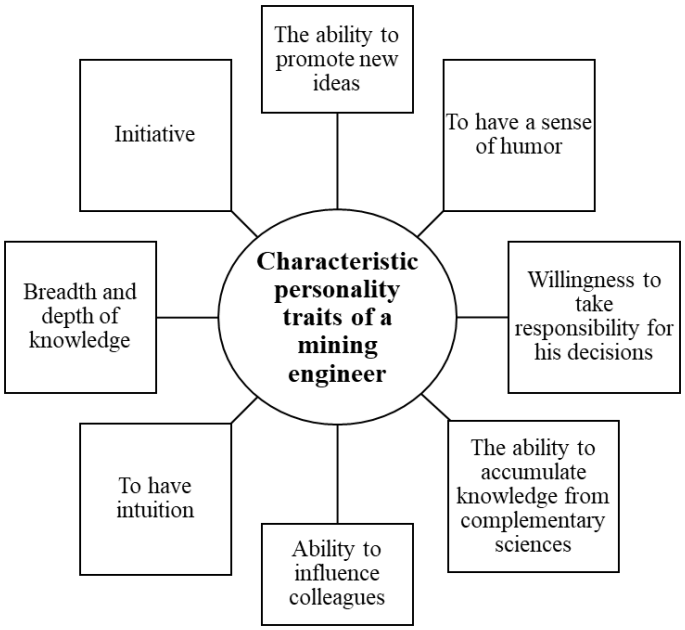

Fig. 4. Characteristic personality traits of a mining engineer.

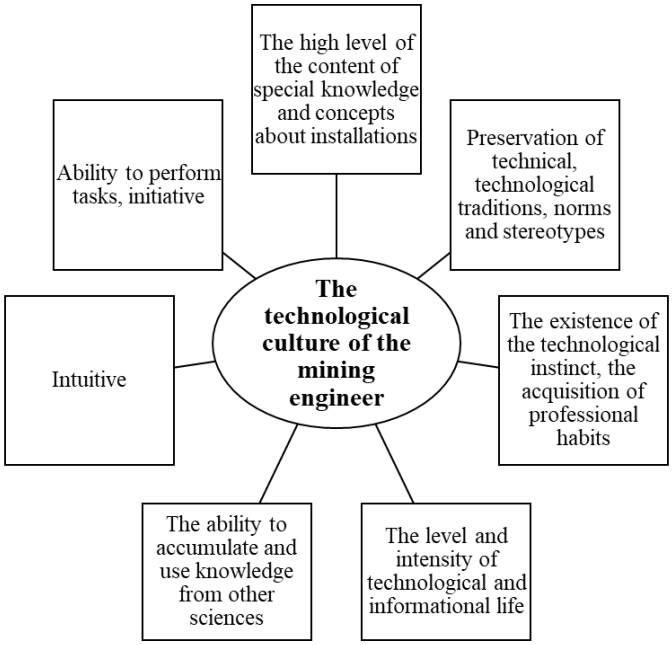

Fig. 5. The technological culture of the mining engineer.

Advice from the teacher to the young man:
-Read! Think constantly, because "The big is in the small." Get ready to look for something new in your work.

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