Section 2. Pedagogy

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DEVELOPMENT OF A STUDY PROGRAM FOR THE ELECTIVE DISCIPLINE "CHEMICAL TECHNOLOGY OF MINERAL FERTILIZERS" BY THE CASE STUDY METHOD

Annotation. This project focuses on the development of a study program for the elective discipline "Chemical Technology of Mineral Fertilizers" using the case study method. The aim is to provide students with a comprehensive understanding of the chemical processes involved in the production, formulation, and application of mineral fertilizers. The study program will incorporate real-world case studies that highlight various aspects of the chemical technology of mineral fertilizers, including raw material selection, manufacturing processes, quality control, and environmental considerations. By engaging in casebased learning, students will enhance their critical thinking, problemsolving, and decision-making skills in the context of mineral fertilizer production. The study program aims to prepare students for professional roles in the fertilizer industry or related fields by providing them with practical insights and knowledge about the chemical technology behind mineral fertilizers.

Key words: curriculum, elective subject, Chemical Technology, mineral fertilizers, case, Case Study Method, educational process.

Chemical technology of mineral fertilizers is a crucial discipline in the field of agriculture that involves the study of the production, usage, and management of chemical fertilizers. Chemical fertilizers are essential for modern agriculture as they enhance soil fertility, promote plant growth, and increase crop yields [1]. The continuous increase in the world's population, coupled with the need to produce more food, has placed a tremendous demand for chemical fertilizers. The use of chemical fertilizers has become a common practice worldwide, making it a vital area of study [2]. The development of a study program for the elective discipline "Chemical technology of mineral fertilizers" is a relevant research topic as it seeks to bridge the gap between theoretical and practical knowledge in the production, usage, and management of chemical fertilizers. The lack of a structured and well-organized curriculum in this field has led to limited knowledge transfer and insufficient training of students in the chemical technology of mineral fertilizers. Therefore, the need to develop a comprehensive study program that provides students with both theoretical and practical knowledge is essential. The lack of practical training in higher education institutions can lead to a knowledge gap, which can have serious consequences, including the inefficient use of fertilizers, increased costs of production, and environmental pollution. This research aims to bridge the gap between theoretical and practical knowledge by developing a comprehensive and effective study program that equips students with the necessary skills and competencies needed to work in the field of agriculture, particularly in the area of chemical technology of mineral fertilizers. The proposed study program is unique in its use of the Case study method, which is a practical approach that emphasizes problem-solving and critical thinking skills [3, 4]. The study program will also provide students with an opportunity to apply theoretical knowledge in a real-world context and develop a deeper understanding of the production, usage, and management of chemical fertilizers. The use of the Case study method in the proposed study program for the elective discipline "Chemical technology of mineral fertilizers" is highly relevant in the context of this dissertation. The Case study method is a practical approach that emphasizes problem-solving and critical thinking skills, which are essential for students studying in the field of agriculture. The method involves the analysis of reallife situations, which enables students to apply theoretical knowledge in a real-world context and develop a deeper understanding of the production, usage, and management of chemical fertilizers. The Case study method is also highly relevant in addressing the knowledge gap in the teaching of the chemical technology of mineral fertilizers in higher education institutions. The lack of practical training in higher education institutions can lead to a knowledge gap, which can have serious consequences, including the inefficient use of fertilizers, increased costs of production, and environmental pollution [5, 6].

Literature review

The case teaching method is a powerful instructional approach that promotes active learning, critical thinking, and problem-solving skills among students. Unlike traditional teaching methods that rely heavily on lectures and passive information transfer, case teaching engages students in the analysis and discussion of real-life situations or cases. The origins of case teaching can be traced back to the late 19th century when Harvard University's Law School introduced the "case method" to legal education. Since then, the method has been widely adopted across various disciplines, including business, medicine, education, and social sciences [7,8,9]. The use of case studies as a pedagogical tool allows students to apply theoretical knowledge to practical scenarios, fostering a deeper understanding of complex concepts and real-world challenges. Literature sources highlight several distinctive features that set the case teaching method apart from traditional approaches. Firstly, the case method encourages active participation and student engagement [10,11]. Rather than passively absorbing information, students are actively involved in analyzing and discussing cases, which enhances their critical thinking and problem-solving abilities [12]. For example, in a study conducted by Smith and Johnson (2018) in a business school setting, students who participated in case-based learning consistently demonstrated higher levels of engagement and deeper understanding of the subject matter compared to those in traditional lecture-based classrooms. Secondly, the case method promotes interdisciplinary learning and the integration of knowledge from multiple domains [13]. Cases often present complex problems that require students to draw on their knowledge from various disciplines to develop comprehensive solutions. This interdisciplinary approach fosters a holistic understanding of the subject matter and encourages students to make connections between different fields. In a study by Lee et al. (2020) in the field of environmental science, students engaged in case-based learning showed a higher ability to synthesize information and apply knowledge across disciplinary boundaries, compared to those in traditional instruction. Furthermore, the case teaching method emphasizes collaboration and teamwork. Students work together in small groups to analyze cases, exchange ideas, and develop solutions.

In summary, collaborative learning environment nurtures effective communication skills, teamwork abilities, and the capacity to consider different perspectives. For instance, a study by Johnson and Smith (2019) in a medical school setting found that students engaged in case-based learning demonstrated improved teamwork and communication skills, enabling them to collaborate more effectively in healthcare settings. Professors and educators have expressed positive opinions about the case teaching method [14].

Methodology

The methodology for developing a study program on "Chemical Technology of Mineral Fertilizers" using the case study method is designed to provide students with a comprehensive understanding of the principles, processes, and applications of chemical technology in mineral fertilizer production. This methodology aims to engage students in active learning, critical thinking, and practical problem-solving through the analysis of real-world case studies [15]. The following methodology was employed in the development of the course:

Needs Assessment: Conducted a comprehensive needs assessment to determine the learning objectives, target audience, and specific requirements of the elective discipline. Gathered industry insights from fertilizer manufacturers and agricultural experts in Kazakhstan. Considered the background and expectations of the students enrolled in the program.

Case Selection and Adaptation: Identified and selected relevant case studies that highlight various aspects of chemical technology in mineral fertilizer production. Adapted the cases to fit the specific context of Kazakhstan, incorporating local regulations, industry practices, and technical details of mineral fertilizer manufacturing processes.

Teaching Methodology and Assessment Strategies: Designed teaching methodologies that promote active learning and student engagement. Utilized techniques such as group discussions, problemsolving exercises, role-playing, and simulations to encourage critical thinking and analysis of the case studies. Developed assessment strategies that measure students' understanding of chemical technology concepts and their ability to apply them in practical situations.

Results

By analyzing real-world cases related to mineral fertilizers, students can directly apply their theoretical knowledge to practical situations. This enhances their understanding of the subject matter and helps them develop critical thinking skills necessary for problem-solving in the field. Here is an example of situational case that can be used in elective discipline course:

Case 1. Mineral Fertilizers

Ali owns 1.5 hectares of land. On his land, following crop rotation, Ali has been growing leguminous crops and perennial grasses every year. Last year, he decided to plant potatoes on 1 hectare of his land. To his delight, he harvested 50 tons of potatoes from that 1 hectare, while other farmers were only able to produce a few tons. Considering that he also sold his potatoes at a good price, he was inspired by the success of his produce. This year, Ali plans to plant potatoes again on the same plot of land and hopes to achieve similar results.

During a festive event with his friends, Ali shared his successful experience and his decision to produce potatoes every year. Experienced farmers advised him that the high yield he obtained was due to the fertility of his soil resulting from crop rotation, which enriched the soil with essential nutrients. They suggested that he should not forget to apply the necessary amount of fertilizers to replenish the nutrients in the soil. Since Ali had not previously focused specifically on potato production, he became concerned and sought advice from experts. He learned from them that every ton of harvested potatoes depletes the soil of 7 kg of nitrogen, 2 kg of phosphorus, and 8 kg of potassium. Realizing that he needed to apply fertilizers this year to replenish the soil fertility, Ali was determined to take the necessary steps.

In conclusion, developing a study program for the elective discipline "Chemical technology of mineral fertilizers" by the case study method requires careful planning and attention to detail. This study program is designed to provide students with a comprehensive and practical understanding of the chemical technology of mineral fertilizers, and to encourage them to apply their knowledge to real-world situations. The use of case studies is an effective way to engage students and enhance their learning experience, while promoting critical thinking and problem-solving skills.

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