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THE IMPORTANCE OF ORGANIZING INDEPENDENT WORK IN CHEMISTRY LESSON

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ABSTRACT

The article analyzes the work of scientists and teachers on the organization of independent work of students in the modern education system. During the research, tasks were prepared for independent work in accordance with the content of the lesson on the topic "Electrolytes and non-electrolytes", "The mechanism of electrolytic dissociation" of the chapter "Electrolytic dissociation" in chemistry of the 9th grade.

In the formation of an effective system of independent work, the principle of accessibility and consistency and the relationship between theory and practice are preserved. In the pre-lecture content on the topic of the lesson, information was given in electronic form. During the lesson, new topics were analyzed and the content was revealed through questions aimed at independent work.

The performance and analysis of tasks, evaluation were carried out in the presence in accordance with the prepared criteria. At the stage of summing up the lesson, in order for students to develop the ability to search and work independently, each group was asked to make a report using the design method for preparation. It was shown that independent work has a special place in the development of student 's creative abilities. This article presents methodological approaches to the organization of independent work of students in accordance with the topic and analyzes the results. In the organization of independent work of students, methodological approaches were used aimed at achieving individual and subject learning results, creating favorable conditions for the development of students ' creative abilities, metacognitive, systematic skills.

Keywords: Independent Work, Interactive Teaching Methods, Project Independent Research, Electrolytes, Metacognition.

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KİMYA DERSİNDE BAĞIMSIZ ÇALIŞMANIN ORGANİZASYONUNUN ÖNEMİ

ÖZET

Makalede, bilim adamlarının ve öğretmenlerin modern eğitim sisteminde öğrencilerin bağımsız çalışmalarının organizasyonu konusundaki çalışmalarını analiz ediyor. Araştırma sırasında 9. sınıf kimya dersi "Elektrolitik ayrışma" bölümünün "Elektrolitler ve elektrolit olmayanlar", "Elektrolitik ayrışma mekanizması" konulu dersin içeriğine uygun olarak bağımsız çalışmaya yönelik görevler hazırlanmıştır.

Etkili bir bağımsız çalışma sisteminin oluşturulmasında, erişilebilirlik ve tutarlılık ilkesi ve teori ile pratik arasındaki ilişki korunur. Ders öncesi içerikte dersin konusu ile ilgili bilgiler elektronik ortamda verildi. Ders sırasında yeni konular analiz edildi ve bağımsız çalışmaya yönelik sorularla içerik ortaya çıkarıldı.

Görevlerin yerine getirilmesi ve analizi, değerlendirmesi hazırlanan kriterlere uygun olarak huzurunda gerçekleştirilmiştir. Dersin özetlenmesi aşamasında, öğrencilerin bağımsız olarak araştırma ve çalışma becerilerini geliştirmek için her gruptan hazırlık için tasarım yöntemini kullanarak bir rapor hazırlamaları istenmiştir. Bağımsız çalışmanın, öğrencinin yaratıcı yeteneklerinin gelişmesinde özel bir yeri olduğu gösterilmiştir. Bu makalede, öğrencilerin bağımsız çalışmalarının konuya göre düzenlenmesine metodolojik yaklaşımlar sunar ve sonuçları analiz eder. Öğrencilerin bağımsız çalışmalarının organizasyonunda, öğrencilerin yaratıcı yeteneklerinin, üstbilişsel, sistematik becerilerinin gelişimi için uygun koşullar yaratarak, bireysel ve konu öğrenme sonuçlarına ulaşmayı amaçlayan metodolojik yaklaşımlar kullanıldı.

Anahtar Kelimeler: Bağımsız çalışma, Etkileşimli öğretim yöntemleri, Projeden bağımsız araştırma, Elektrolitler, Üst biliş.

INTRODUCTION

Through individual work during the learning process, a learner develops their knowledge, skills, and familiarity with practical activities. Incorporating individual work into the learning process leads to increased engagement and efficiency in class. Organizing and developing individual learning tasks are fundamental processes in the field of education. This is because learners fully absorb knowledge through personal learning activities. Therefore, opportunities for learners to engage in individual work are created, teachers provide lists of necessary literature, and, in addition, demonstrate algorithms for completing individual tasks that correspond with the subject matter and provide guidance on execution and interpretation of the results. Trends in education are focused on developing individual learning tasks and arranging them in order to facilitate learners' familiarity with practical activities and their ability to accomplish them. This approach fosters scientific research and constructional-experimental development opportunities (Khorrami, Fallah, 2015).

In the realm of education, the instructor facilitates the autonomy of pupils in their knowledge acquisition process by nurturing their self-directedness and application of knowledge in practical domains. The fundamental characteristic of contemporary education is centered around empowering learners to deploy their acquired knowledge in tangible contexts. Ergo, in the present epoch, the educational process ensures that pupils have access to the requisite amenities to enable self-directed learning (In'am, 2015). In the process of learning, students go through

several stages of independent learning through familiarization with textual material, understanding of the content, and analysis of the text. These stages are carried out through the use of various methods and techniques, with metacognition playing a significant role in problem-solving and understanding of chemistry concepts. The Indonesian basis of education in the learning revolution has been consistent with the 21st-century teaching process, which centers on the 4Cs (critical thinking, creativity, communication, and collaboration), with problem-solving being a crucial component (Greenstein, 2012). The problem-solving process encourages the development of independent thinking and the formation of one's own ideas and opinions in the course of carrying out tasks (Gama, 2004).

The solution of such problems enhances problem-solving skills and cognitive flexibility, making it an essential component of teaching and self-directed work (Efklides, 2011). This knowledge encourages learners to engage in self-directed work and supports them in planning, using, and evaluating their outcomes.

Thus, by exploring the authors' contributions related to the topic, this study highlights the importance of implementing self-directed learning techniques during chemistry lessons. The aim of this research is to promote the development of the necessary knowledge system through the execution of self-directed work, mastering the system of necessary knowledge through the formation of cognitive independence.

RESEARCH MATERIALS AND METHODS

The present study aims to enhance the quality of education and pedagogy by utilizing personalized instruction as a means of addressing individual student needs. Personalized instruction has emerged as a necessary component of modern education, given the importance of catering to individual student needs. Factors necessitating the adoption of personalized instruction include the utilization of contemporary information in teaching, creativity, scientific advancements, societal changes, and motivation. As such, personalized instruction represents a crucial stage in the learning process, allowing for effective organization, monitoring, evaluation, and management of the educational process. Through the incorporation of personalized instruction, the present study seeks to establish a framework that addresses individual student needs and incorporates the key components of personalized instruction (Abasov, 2007).

When choosing a type of independent work, it is necessary to take into account its volume and content in order to adhere to the main principles of didactics. The principle of feasibility and organization, as well as the relationship between theory and practice, are maintained in the formation of an effective system for independent work. The main principles of carrying out the work have their own peculiarities:

The formulation of the given independent work task should be clear and precise so that the student's actions in carrying it out are systematized, and the effectiveness of the work increases when the purpose of the task is clear.

1. It is necessary to remind the students of the need for time management in order to complete their independent work. The differential perception of the student during the group discussion of the theoretical material can be fully realized, and meaningful assignments can be performed.

2. The responsibilities assigned to individual work are determined by its novelty, significance, and complexity. In accordance with its practical importance, the work examines the necessary materials and approaches (Ptashinskaya, 2016). Personal work has a significant impact on the breadth and depth of students' knowledge in a particular field, as well as on the development of their cognitive abilities and the ability to acquire new information. Personal work that is purposeful and systematically organized, such as research projects, problem-solving exercises, chemical reactions, assignments, laboratory work, and experimental studies, provides an opportunity for the teacher to analyze and evaluate the knowledge acquired by the student in comparison to their initial knowledge and to achieve significant progress in their learning.

The study aimed to organize the independent work of students and develop their abilities to analyze, research, and learn in the process of education, by exploring the theoretical foundations of pedagogical knowledge. Students were encouraged to fully engage in the process of analyzing, planning, and conducting research activities and methods related to their own work, which resulted in the organization of their individual work. The structure of the lesson for research consists of three stages:

1. Preparation stage. In accordance with the main didactic requirements imposed on the educational process, the requirements necessary for increasing the effectiveness of the lesson are preserved and the levels of achievement (expected results) for mastering the topic of the lesson are determined, the purpose is defined.

2. Main Stage. During the explanation of the new lesson, electronic materials were used to facilitate understanding. To achieve the goal of mastering the topic and organizing one's own work, the DEAL method was presented in the form of questions (Table 1) along with guidelines for a brief and effective interpretation.

3. Consolidation stage. Information on the topic was reviewed through the method of designing to reach conclusions.

I. Preparation stage: The objectives of the study in conducting the lesson topic are:

- to demonstrate the conduction of substances by electricity;
- to identify the types of chemical bonds in substances that conduct electricity;
- to differentiate electrolytes and nonelectrolytes and provide examples;
- to understand the chemical basis for the electrolytic conduction of substances in their molten or aqueous states. With a focus on the importance and applications of "Electrolytes and Non-electrolytes" in chemistry, the main aim is to facilitate practical implementation of theoretical knowledge by establishing a foundation for understanding the significance and intricacies of this topic.

- During the lesson, the following teaching methods were used for organizing independent work:
- Using pre-prepared electronic resources, presentations, slide materials, i.e. active use of ICT;
- Implementing the "DEAL" method and reflection during practical classes;
- Conducting project work through the method of summarization during the finalization of the lesson.

In the study of B.S. Polat, the use of project-based learning is seen as an indicator of a teacher's higher professionalism, as this method is a leading approach in teaching and developing students. Project-based learning is a technology aimed at increasing the self-confidence of students in organizing their own learning activities. Based on the project-based learning technology, opportunities are created to develop the practical skills of students through familiarity with their own topic. During the project-based learning process, students play various roles and interact with each other based on their knowledge objectives.

The result of the team's actions is the timely completion of the task, mutual assistance, and responsibility. By participating in the research work, students can identify their own abilities and opportunities. It is necessary to select innovative (investment, developmental, research) projects that will ensure future changes in the form of new directions for organizers of project-based learning, to understand their uniqueness and necessity, to introduce changes in practice that are significant, and to evaluate opportunities. In addition, it is necessary to develop a description, formalize and prepare documents, as well as carefully analyze the algorithm for carrying out the work (Bakhisheva, 2011). As a result of the research work on team-based research, there is an increase in familiarity with teamwork and self-directed learning activities within the group.

II. Main Stage: In order to illustrate the concepts related to the lesson objective, a video was provided to the students. The material presented was related to the topics covered in previous lessons and included terms, chemical reactions, and questions aimed at reviewing connections and clarifying details. In addition, questions were asked to promote interdisciplinary connections:

What do you know about electrical conductivity?

What causes metals to conduct electricity?

What are conductors?

The significance of metal ions in the human body.

Natural occurrence of metals and nonmetals.

During the question-and-answer session, students explained the physical properties of materials and highlighted their buoyancy and strength properties. The criteria for evaluating knowledge was developed beforehand. After thoroughly discussing new topics, students were assigned individual tasks. During a practical lesson on the "DEAL" method, students worked together to understand how different parts of a conductor respond to electricity and the reasons why materials conduct electricity when placed in water.

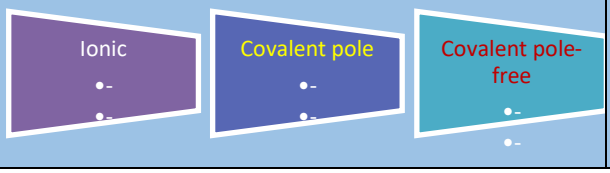
Table 1: The "DEAL" Method

D	E	A	L
narrative	explanation	analysis	communication
Report what you saw in the video recording	Describe the chemical and physical properties of electrolyte and nonelectrolytes	Why did the solution conduct electricity?	What predictions can be made after watching the video recording?

During the discussion, students utilized posters they had prepared and models of crystalline solids. The concepts were reinforced through reading materials and presentations prepared in advance. This method encourages students to engage with new information, relate it to prior knowledge, and develop their own opinions. By examining the information, drawing conclusions, and discussing their findings, students were able to actively participate in their learning process. If the algorithm of the assignment is provided to students, it facilitates their familiarization with the subject matter. The primary responsibility of the teacher in this process is not to impose their own views on the students, but rather to guide them in finding solutions based on the evidence. Students learn to understand common objectives, divide responsibilities correctly, and learn to communicate and monitor each other properly (Buribekova, Zhanatbekova, 2014).

In the next stage, after the completion of the task, assignments are given that develop the logical thinking of the students (Table 2).

Table 2: "Semantic Map"

№	Tasks	Descriptor	Points
1	Classify things in a column by looking at the formula. NaCl $C_{12}H_{22}O_{11}$ H_2O S CO2 Na_2SO_4 $CaSO_4$ $CaCl_2$ $(NH_4)_2SO_4$ C_2H_5OH 		5 Points
2	Write the equation for the dissociation reaction of these compounds:$Zn(OH)_2$, $Ca(OH)_2$, H_2CO_3,H_2S, $Sr(OH)_2$, NaOH, $Al(OH)_3$, H_2SiO_3, H_3PO_4	Writes the dissociation reaction equation.	6 Points
3	Classification of given substances according to the type of communication. NaCl K_2HPO_4 $C_{12}H_{22}O_{11}$ H_2O CO_2 H_2 Na_2SO_4 $MgSO_4$ $CaCl_2$ $(NH_4)_2SO_4$ C_2H_5OH 	Determination of the type of chemical bond in electrolyte and nonelectrolyte substances.	7 Points

According to the learning theory of self-regulated learning, students performed the following tasks to develop their ability. The tasks were categorized into three levels: level A (high) represented by red, level B (medium) represented by yellow, and level C (low) represented by green. By separating electrolyte and non-electrolyte substances, students could identify the type of chemical bonding in electrolyte and non-electrolyte substances. To utilize and revise their acquired knowledge, students completed level-based assignments written on revision papers. Students reviewed each other's work and established mutual connections.

Through individual work in the learning process, students not only accumulated knowledge but also internalized new scientific methods, legal frameworks, and scientific concepts. In the study conducted by S. M. Markova, it was suggested that students' engagement in independent work promotes the acquisition of new skills, understanding of effective methods of working with scientific knowledge, and the development of a continuous interest in scientific activities (Markova, 2018).

During a lesson, moving forward with the material by engaging in a specific activity or sharing information and discussion enhances students' ability to engage in their own work and respond correctly to questions (Ambreen & Conteh, 2021). John Flavell's theory of metacognition, which focuses on the development of an individual's self-awareness, was used to shape this process. During the learning process, students engage in metacognitive work at a personal analysis

level through reducing the support of metacognitive support, leading to a more independent or intellectual performance (Verschaffel, 2019).

"Thinking about thinking" is the most common and broad definition of metacognition. John Flavell's theory of metacognition includes the sum of a person's knowledge about their own cognitive processes, as well as their psychological strategies and ability to manage cognitive action. He named the three components of metacognition:

Metacognitive knowledge – what one knows about learning and thinking processes, such as how much time can be spent processing information, what teaching methods are effective in the learning process, etc.;

Metacognitive regulation – the ability to regulate one's own learning process;

Metacognitive experience – an individual's experience in the learning process (John H. Flavell).

In order to adapt their own work, learners complete the steps of the task, and in the lesson, the KWL method (three-column chart) was used (Metody metapoznaniya, Access date: 10.03.2023.)

Table 3: KWL Schedule

What do I know	What I want to know ?	What learned ?
1.Negatively charged electrode. 2.Decomposition of molecules into ions during dissolution or melting. 3.A substance that does not conduct electricity. 4. Positively charged 5.A substance that conducts electricity when melted or melted. 6. Charged particle. 7.Positively charged 8.Negatively charged ion.	1.Where else are electrolytes and nonelectrolytes used in everyday life? 2.What conditions must be created for the conversion of chemical compounds(base, acid,salt) into electrolytes? 3.The concept of electrolytic dissociation. 4.What type of chemical bond does electrolytes have? 5.What class of compounds do these substances belong to?	

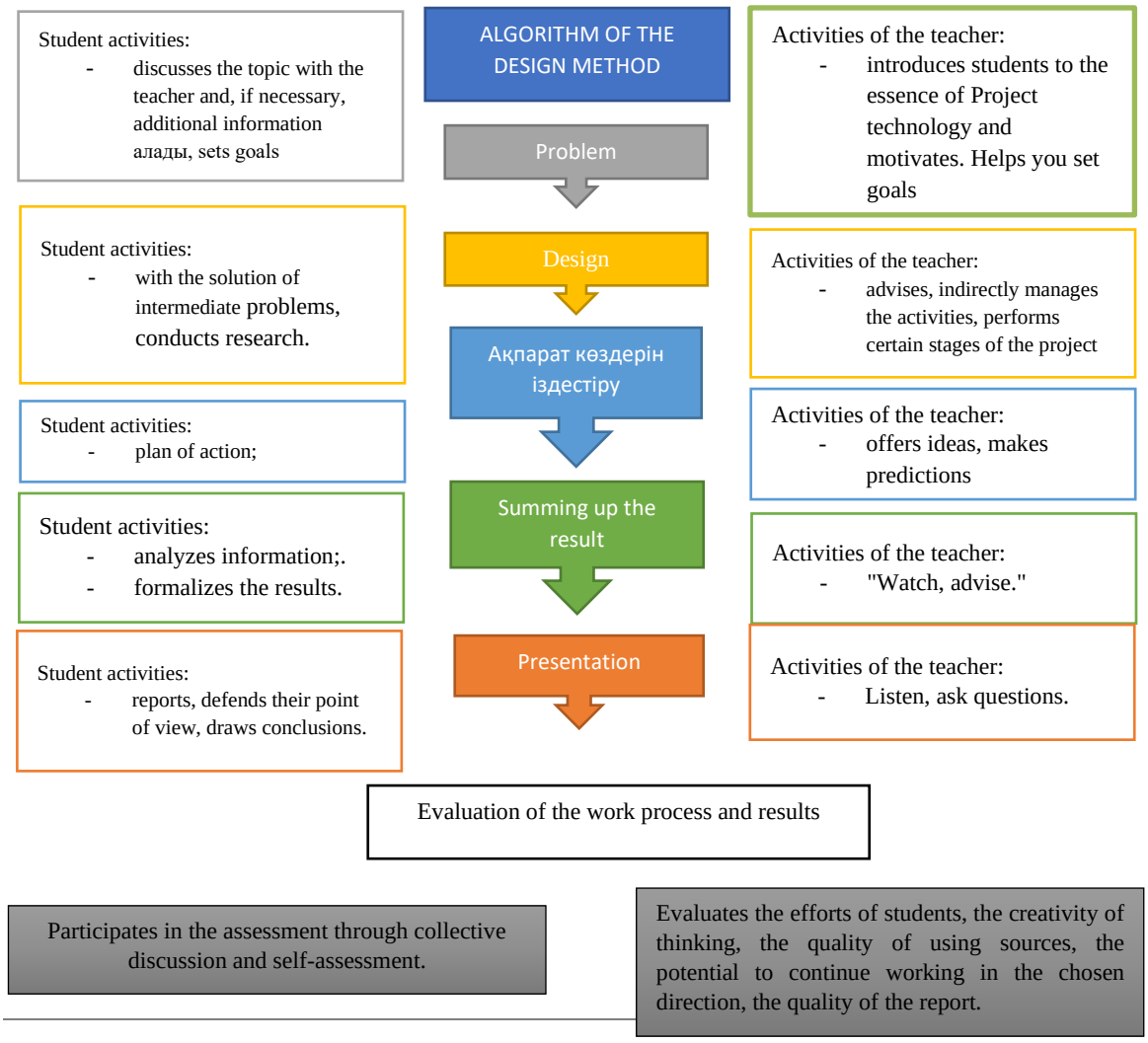
Topic-related ways to choose the correct answer to a question and solve problems can be used as a tool to develop familiarity with the subject matter and problem-solving abilities. By completing the fill-in-the-blank exercise, a learner can answer questions such as "Do I know?" (know), "Do I want to know?" (want to know), and "Have I learned?" (learned).

Responding to the second question can provide the opportunity to understand the topic more deeply and search for additional information on the topic. The "Have I learned?" section is completed after reading the topic or completing assignments. As a result of the discussion, students can obtain answers to their questions. During the process of making their own choices,

each student understands the importance and objectives of the lesson, conducts research, and reaches conclusions. In mastering the concepts, students engage in productive work, reflect on their knowledge, and identify their mistakes. At the end of the exercise, students engage in reflection.

III. The final stage. The purpose and objectives of the lesson on the topic" electrolytes and nonelectrolytes " were determined and specific research topics were proposed to consolidate the knowledge gained.

1. Electrolytic dissociation mechanism;
2. Electrolytes and nonelectrolytes ;
3. Dissociation of chemical compounds;
4. Electrolytes in batteries;
5. Electrolyte imbalan
6. The role of the theory of electrolytic dissociation in the development of basic chemical concepts.



The students were assigned a comprehensive project to be completed within their class based on selected research topics. The students were divided into several groups, each group familiarized themselves with their assigned research topic and task content.The purpose and objectives of the project were clearly defined within the group. Additional guidelines and explanations were provided during the process.

As the project was research-oriented, the students searched for supplementary materials in literature to expand their knowledge of the subject matter. Scientific and practical materials that demonstrated the project's relevance were gathered during the preparation phase.

The project was presented in the form of a presentation that corresponded to the content of the research topic. The students were encouraged to explore new aspects of applying the materials presented in practical situations, and new strategies were provided to solve issues. The projects were evaluated and assessed, and feedback was given.

RESULTS AND DISCUSSION

During the implementation of tasks provided through the project method, students are trained in critical thinking, self-planning and decision-making, and are taught the culture of work. By completing the project task with their own efforts, students learn to plan their work, solve the tasks set by the project, and work independently with information. The project work performed in accordance with the content of the lesson on "Electrolytes and NonElectrolytes" was evaluated, and the lesson was improved accordingly. In the process of project implementation, each student's level of knowledge, analytical skills, metaphysical ability, research skills, creativity, and communication skills were assessed.

The summary of the work of four teams that performed the project work is evaluated as follows:

- team 1 received a score of 27 for their work on "Electrolytic conductivity."
- team 2 received a score of 17 for their work on "Dissociation of Chemical Compounds."
- team 3 received a score of 20 for their work on "Electrolytes in Batteries."
- team 4 received a score of 22 for their work on "Electrolytes and Nonelectrolytes."

The evaluation of the research project work of the students was conducted based on the following criteria: 0 points - "unsatisfactory," 1 point - "satisfactory," 2 points - "good," and 3 points - "excellent." The points were summed up according to the criteria and evaluated on a scale of 10 to 30. If the total score of a team is around 13 or less, their work is evaluated as "poor." The evaluation scale is as follows:

- "Average" - scores between 14 and 17.
- "Good" - scores between 18 and 23.
- "Excellent" - scores between 24 and 30.

The results of the study on the high and low-scoring groups were analyzed regarding the topic of "Electrolytic imbalance." Information related to the topic was presented systematically. The problem under investigation was that the consumption of low-quality food leads to an excess or deficiency of electrolytes in the human body. To solve this problem, the study aimed to prove the correlation between the electrolytic imbalance of these substances and the deterioration of human health. The study demonstrated that the electrolytic imbalance is caused by the insufficient consumption of natural resources in modern diets. To solve the problem, the study proposed the use of natural resources to balance electrolytes. The study also compared the levels of magnesium ions in two different types of mineral water through accurate measurements and quantitative analysis. The theoretical material related to the topic was investigated, and experimental studies were conducted to provide practical significance for the study. The study answered the research questions, generated hypotheses, and made conclusions.

In the work on the topic "Dissociation of chemical compounds", the number of references was limited and the similarities of chemical reactions were rarely mentioned in the experimental section. The presentation did not provide accurate conclusions and summaries.

The purpose of the project was to help researchers understand the processes that contribute to the ionization of electrolyte solutions in aqueous solutions, through their own investigations. The method of the project involved analyzing the achievements of students by assessing and evaluating their performance, and conducting a survey to identify their successes within the team, and to identify the effectiveness of their own work (Table 3). The results of the survey showed that 85 percent of the correct answers are given in the diagram, which indicates that the project can be successfully implemented.

Table 4: Questionnaire for Determining The Effectiveness of Using The Design Method

Question	Yes	No
1. Have you managed to reach your interests and needs?		
2. Have you ever heard of Group study classes?		
3. Are you having problems with your research work?		
4. Did you manage to work on your own?		
5. Was it acceptable to work with the team members?		
6. Can you give your opinion?		
7. Did you manage to develop your abilities?		
8. Can you prove your arguments?		
9. Is it necessary in the future to develop the design method in the lessons?		

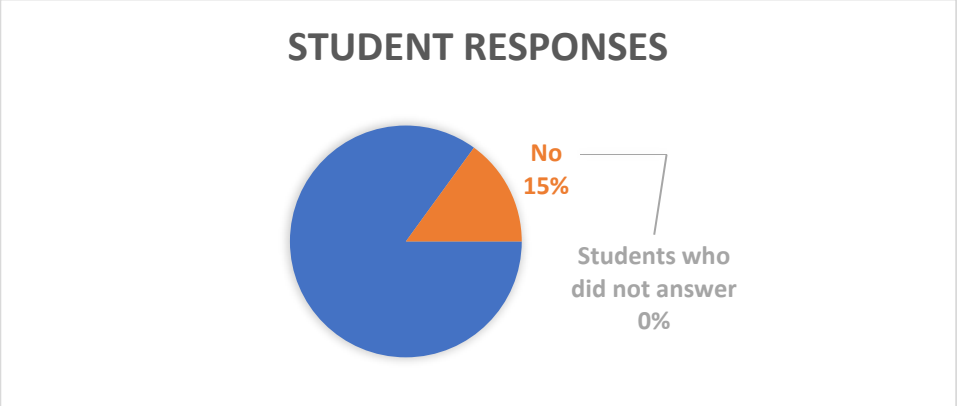


Table 5: Survey Result

The effectiveness of using metacognitive and project-based learning methods in organizing individual work for students was demonstrated during lectures on the topics of "Electrolytes and Non-Electrolytes" and "Mechanism of Electrolytic Dissociation". The practical work process improved the students' stability, and specific results were demonstrated in the teamwork, as well as in the use of the "DEAL", "KWL" methods, and the "Semantic Map" technique for learning. Additional materials related to the topic were collected, experiments were conducted, and the results were analyzed during the independent research projects related to the topic covered in the lecture. In general, the organization of individual work in chemistry classes helps students to develop their abilities, stimulate creativity, improve communication skills, achieve results, increase motivation for learning, and learn to solve problems independently.

CONCLUSION

The effectiveness of the use of the metacognitive, design method for classes on the topics of the chapter of electrolytic dissociation "electrolytes and nonelectrolytes", "mechanism of electrolytic dissociation" was shown to students in organizing independent work. In the course of practical work, there was an increase in the activity of students, real results were shown in working in groups, as well as in independent work, using knowledge in the "DEAL", "KWL" method and "semantic map" approach. In accordance with the topic of independent project research on the topic proposed to summarize the lesson, additional materials were collected, experiments were conducted, and the results were summed up.

In general, through the organization of independent work in a chemistry lesson, the skills of developing students ' abilities, creative thinking, the ability to see contradictions, achieve results, increase learning motivation, work independently, make decisions by analyzing the acquired knowledge are formed.

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