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# THE DEVELOPMENT OF METACOGNITIVE COMPETENCE OF STUDENTS OF A PROFILE SCHOOL IN THE FOREIGN LANGUAGE NATURAL SCIENCE EDUCATIONAL PROCESS

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**Abstract.** In modern conditions, the government of Kazakhstan puts more emphasis on the training of specialists in the field of fundamental sciences, in the natural sciences, for the effective cooperation of Kazakhstan on the world stage. Due to profiled training, students can develop their abilities and choose the subjects they need, training in profiled classes allows the students to study majors in more depth. A person develops his cognitive activity through the formation of his personal picture of the world in his native language as the main cognitive images and forms the picture of the world of "another linguistic society" on the basis of his culture. In this article, we describe the methods and results of an experimental study to determine the development of metacognitive competence among the students of the preparatory department of Kazakh Ablai Khan University of International Relations and World Languages.

*Keywords:* foreign language education; metacognitive processes; natural science direction; profiled training

## 1. Introduction

In the era of internationalization and globalization of the education system, factors of tolerance and sociability are becoming increasingly important in the Republic of Kazakhstan, in this regard, the ranges of intercultural cooperation of the Republic of Kazakhstan with other countries are expanding significantly. With the active development of economic and political ties, and increasingly growing competition, there is a need for a systematic improvement of the professional qualifications and mobility of employees. And as a result, there is a need to develop modern innovative approaches in education.

In the Republic of Kazakhstan, the content of education is being updated in accordance with the State Program for the Development of Education and Science for 2011 – 2020[1)]. The priority area of secondary education is the introduction of profiled education in senior grades of secondary schools, which is aimed at in-depth pre-vocational training of schoolchildren. According to this program, profiled training in secondary schools involves the preparation of schoolchildren in grades 11 and 12 by branches; the branches for profiled training of students can be humanitarian, mathematical, natural science, technical and others. Students independently choose the direction they need in accordance with their interests and inclinations for a more in-depth study of a subject and with an orientation towards their future professional activity.

In accordance with the "Beyindik Mektep" program in Kazakhstan, "the integration of the university component" into a profiled school is necessary, which implies factors such as the need to establish a connection in the content of secondary and higher education and the need for continuity of the content of general subjects of 1 – 2 courses of a bachelor's program with a profile education program[2)].

The main goal of profiled training is to provide students with an adequate assessment of their abilities when choosing their profession later, now high school students have the opportunity independently direct their efforts toward the choosing profile that suits them. Due to profiled training, students can develop their abilities and choose the subjects they need, moreover, training in specialized classes allows them to study majors in more depth. Furthermore, the modern education system puts forward the personality-centered approach as the main principle of the educational process, that is, the main orientation of the learning process is the development of the personality, his active position in the educational process, providing the student with such methods of action that will contribute to his productive activities in the future, educational needs and cognitive interests will be realized for the development of future professional activities.

Profiled education focuses students on meta-subject learning outcomes, on key competencies that help students learn the whole system of universal knowledge, experience and abilities, value orientations that provide an opportunity for independent solving of life problems and favor the formation of personal abilities for self-determination, socialization and self-realization[2)].

At the present stage of the development of education in the Republic of Kazakhstan and constantly expanding economic and political ties, it is necessary to train highly qualified competitive specialists who possess the necessary competencies and are in demand on the international labor market. In modern conditions, the government of Kazakhstan puts more emphasis on the training of specialists in the field of fundamental sciences, in the natural sciences, for the effective cooperation of Kazakhstan on the world stage.

Nowadays professionally-based teaching of a foreign language provides for focusing on the professional needs of students in choosing educational content, defines as its goal to teach intercultural communication during business negotiations with representatives of a different culture to achieve the planned professionally valuable result and a communicative effect.

Along with culturally-oriented models, which imply students' mastery of linguistic-cultural and sociocultural competencies subject oriented models are of particular importance when a foreign language becomes a means of studying a subject (chemistry, biology, geography, etc.). At present, the issue of integration of some subjects in certain areas of knowledge is relevant in the education system, which contributes to the achievement of high results in the study of these disciplines. In connection with the globalization of education and the expansion of the cultural, economic and political borders of Kazakhstan and entry into the international educational space, it becomes necessary to study a foreign language, namely, English, to prepare specialists who are ready for intercultural communication. "Foreign language" as a discipline has the ability to integrate into different school subjects and promotes the development of motivation and interest in the study of selected specialized subjects in the school, as well as the foreign language itself. Modern requirements for the preparation of highly qualified competitive specialists who possess highly developed professional and moral qualities determine the tasks of the development of modern education. Consequently, the training of such specialists, demanded by the modern requirements of the state and society, must begin in a profiled school. A foreign language as an educational discipline is studied in all secondary schools of Kazakhstan, and it can be integrated into any profile for a more in-depth study of both the subject and the foreign language itself. In this case, a foreign language will be not only a goal, but also a means of studying a particular subject area. Learning a foreign language in the framework of a profiled discipline helps to master it and bring the student closer to the level of B2 in compliance with the CEFR (Common European Framework of Reference).

The goal of foreign language education in a secondary school is to acquire a threshold level of foreign language proficiency that facilitates communication in oral and written forms; in specialized classes, foreign language education promotes foreign language proficiency at a level that exceeds the threshold and is sufficient for communication in the context of a future profession.

## 2. Literature Review

The foreign-language natural-science educational process in a profile school involves the development of personality traits that characterize him as a subject of activity in the field of his future profession. "Foreign language" as a discipline

has a developing effect on the intellectual, emotional and motivational spheres of personality development.

Nowadays modern scientists recognize the close connection of foreign language teaching methods with cognitive psychology. Cognitive psychology is a modern area of psychology that studies cognitive processes. Cognitive psychology studies cognitive processes – thinking, perception, speech, imagination, pattern recognition, etc. Thus, relying on cognitive psychology in the methodology of foreign language education, it is possible to determine strategies for students mastering a foreign language in the learning process and find appropriate methods to support them in mastering these strategies.

In the process of teaching foreign languages and cultures, a sequence of cognitive actions takes place: 1) acquaintance with the fact of another culture, 2) transfer it to native culture and awareness of its features, 3) reevaluation of the fact of native culture, 4) comprehension of the phenomenon of a different culture from these positions, 5) a reassessment of the fact of another culture, a look at the fact of culture from the perspective of a native speaker (Tareva, 2014: 53). With this consideration, it can be concluded that intercultural competence is being formed, which is focused primarily on students personal development and represents the formation of abilities and readiness for intercultural communication with representatives of different cultures on the basis of an awareness of the orientation system characteristic of native culture and awareness values of cultural factors in the process of communicative interaction.

At the same time, we note that the student also needs knowledge about his cognitive system, the ability to manage it in the process of intercultural communication. On the one hand, we are talking about such knowledge as: 1) knowledge about yourself; 2) knowledge about the features of one's own worldview; 3) knowledge of how to interact with representatives of another culture; 4) knowledge of one's own (foreign) communicative style; 5) knowledge of one's prejudices, even one's own ethnocentrism; 6) knowledge of one's own personal qualities; 7) knowledge of the degree of exposure to stereotypes. And on the other hand, about the skills to use this knowledge to organize effective intercultural interaction.

Metacognitive processes are deliberate, planned (aimed at achieving a specific goal) and controlled. These processes are based primarily on knowledge of cognitive and personal determinants of cognition, and it is believed that metacognitive knowledge can relate to acquired knowledge. A.V. Karpov and I.M. Skityaeva (Karpov & Skitjaeva, 2005) in their study note that metacognitive processes mediate communication, influence the choice of communicative strategies, and provide a reflection of the procedural and productive aspects of communication. Ultimately, all these processes are aimed at developing a system of internal guidelines for effective interaction with the so-

cial environment. Note that the regulation of metacognitive processes involves monitoring one's own cognitive activity and include processes such as: 1) the planning stage of the cognitive process; 2) awareness of the ability to realize it; 3) its implementation; 4) an assessment of the effectiveness of monitoring processes and selected cognitive strategies (Litvinov & Ivolina, 2013). At the same time, the conclusion that these processes make it possible to regulate not only internal mental processes, but also external processes associated with the management of knowledge and the performance of a certain type of activity is very important. Accordingly, the mechanisms of self-regulation are primarily aimed at achieving a specific goal.

With the development of metacognitive competence of students of a profiled school in a foreign-language natural science educational process, it is of great value to consider professionalization as the result of not only external indicators and achievements in professional activity or during its development, but also some psychological changes in the worldview of a person, motivation for lifelong education and self-development, in values, thinking (Kashapov et al., 2015).

Studying chemistry, students generate knowledge about the properties of substances, understand the laws of chemical processes that occur in nature and human life; the student is able to learn the essence of chemical phenomena and the relationship between the composition, properties and structure of matter; the student can conduct experiments and develops the skills of the safe use of household chemicals. For the development of natural science competence, it is necessary to form natural science and technological literacy. Consequently, with the formation of this competency, students form primary constructs, knowledge, skills in the natural sciences in their native language. For the formation of natural science competence in a foreign language, it becomes a prerequisite for the formation of secondary constructs, knowledge, abilities and skills on the basis of the native language, that is, through mastery in the native language, the knowledge in the foreign language is reconceptualized.

The main theoretical provisions of the cognitive approach to language learning are the basis of the choice of teaching and training procedures. Interactive patterns, learning practices, and learning behaviors take into account the psycholinguistic and cognitive processes involved in language learning.

E.S. Kubryakova (Kubryakova, 1994) notes that at the present stage there is a tendency toward rapprochement between cognition and language learning, that is, there is a systematic study of the language and activity of human consciousness, and all this is connected with the cognitive system that provides this activity. When learning a foreign language, there is an active activity of consciousness, that is, of the entire cognitive system of the brain, while the language acts as the main component of cognitive activity. All types of cognitive activity of a person occur with the direct participation of the language, since the language forms a

speech-cognitive basis. In this situation, it is very important for the teacher to determine what language expressions, language units and categories relate to the perception of the world and how they will reflect the student's knowledge. Thus, language forms a person's cognitive world.

Modern cognitive approaches to learning determine that learning is an active, constructive, cumulative and self-directed process that depends on the student's mental activity (Shuell, 1986; Sternberg, 1996). Cognitive orientation focuses on the student's mental activity, which leads to successful learning. This clearly confirms the role of metacognitive processes and the use of various learning strategies. Memory and learning require the student to actively build new knowledge and strategy (Rumelhart, 1980). Transferring information to permanent storage is facilitated by rehearsing information (especially if the information is developed consciously), by organizing (for example, categorization), information by using meta-memory strategies (for example, writing a list or notes). Students tend to remember better when knowledge is acquired through distributed practice through various study sessions, rather than through mass practice, although the distribution of time during any given study session does not seem to affect transfer to long-term memory (Anderson, 1985). L.S. Vygotsky (Vygotsky, 1982) noted that learning should be based on "awareness and mastery," and this also applies to a foreign language. The processes of "awareness and mastery" in foreign language education show their unity and they are equally important for language. Therefore, at present, the cognitive approach is truly leading and necessary in the process of teaching foreign languages.

Human activity takes place in a society where everything is displayed and understood through language. You can understand a language only from its carrier – a person who speaks and thinks in a language. The main role of man in the formation and speech perception was put forward by the concept of anthropocentrism, where the linguistic personality becomes the main element. I.G. Ruzin believes that "language is considered in its immersion in life, in the reflection of reality. The idea that it is possible to understand the nature of language only on the basis of a person and his world as a whole is becoming stronger ... All this testifies to the most important methodological shift that has been outlined in modern linguistics - the transition from immanent to anthropological linguistics" (Ruzin, 1993: 48).

The didactic foundations of the foreign-language natural-science educational process in a profiled school are the development of personality traits as a subject of activity. In this regard, it is necessary to consider a variety of approaches in relation to the development of personality through a foreign language, to identify the degree of its influence on the motivational and intellectual field of personality. L.S. Shcherba (Shcherba, 1964) discovered the

possibility of personality development. He substantiated the idea of the unity of imagination, thinking, memory and speech activity. The scientist noted the importance of speech imitation and voluntary memorization and stated that it is mandatory to take into account the creative basis of speech activity, create abstract thinking and improve the intellectual work of students during the learning process in a foreign language.

V.S. Vygotsky (Vygotsky, 1982B) substantiated the essence of the development of creative speech-thinking activity of a person from the psychological side. The scientist determined the most important provisions of the developing influence on the personality, and emphasized that, in an environment where no suitable tasks arise, new needs are not taken out, the development of intelligence is not stimulated through new goals, in such environment, thinking does not develop all the possibilities that are really embedded in it, does not reach higher forms or reaches with extreme delay.

I.A. Baudouin de Courtenay emphasizes "language exists only in individual brains, only in souls, only in the psyche of individuals or individuals that make up a given linguistic society ... no language "exists at all, that there are only individual languages, or rather, individual language thinking, as psychological realities" (Baudouin de Courtenay, 1963: 48). The scientist in his works uses the concepts of individual speech, national language, and also focuses on the social difference of the language. I.A. Baudouin de Courtenay notes that "language can only be realized in society and ... the mental development of a person is generally possible only in communication with other people" (Baudouin de Courtenay, 1963: 140).

Thus, the relationship between the development of students' thinking and psychological and pedagogical conditions was determined, which contributed to the modernization of teaching a foreign language for developmental purposes. For this it was necessary to create the necessary conditions, such as the installation of certain cognitive tasks, their further complication and increase in the requirements for cognitive activity.

I.V. Privalova (Privalova, 2004) believes that the images of linguistic consciousness of the mother tongue are combined with the assigned foreign-cultural images of consciousness, constantly being included in the comparative informational introspective reflection in the perception and production of speech messages in intercultural communication. The scientist believes that the units of cognitive space are mental formations that categorize reality, such as concepts, frames, cognitive prototypes, etc. The operating units of the cultural space, the author believes, are considered to be cultural objects, rituals, cultural stereotypes, symbols, standards, etc.

Language and culture is a single complex that forms a natural part of the cognition process and forms secondary mental constructs that create a per-

son's new linguistic conceptualization of the world which is used in world perception in the process of familiarizing with a new linguistic culture (Kunanbaeva, 2010: 84).

According to S.S. Kunanbaeva the formation of personality as a "subject of intercultural communication" means "conscious and purposeful activity of the individual in the formation of new cognitive-linguistic and cultural complexes". The researcher notes that the formation of these complexes contributes to the development of a person's cognitive thinking in the study of a foreign language and foreign culture, the "linguistic and cultural space of the personality" is increasing, as the new linguistic culture penetrates the system of mental knowledge / consciousness of the person. Further, the author believes that the personality forms a "secondary cognitive consciousness" and the personality is re-socialized through "concepts of other linguistic and social culture". Thus, the formation of the personality of the "subject of intercultural communication" occurs through the "cognitive-conditioned activity" of the personality, which is aimed at "linguistic and cultural reconceptualization of the world when introduced to a new linguistic culture" (Kunanbaeva, 2010: 85).

**3. Methods**

We consider in our study how students of a profiled school develop their metacognitive competence in the foreign-language natural science educational process on the example of the subject "Chemistry".

To determine the development of the metacognitive competence of students in a profiled school, we conducted English classes with preparatory course students who studied at Kazakh Ablai Khan University of International Relations and World Languages from September 2018 to July 2019 (10 months) under the state program for further admission to Kazakhstani universities and pedagogical specialties for teaching subjects of the natural science cycle in English. The total number of students was 45 people, three groups of 15 people each. In one group of students, which consisted of 15 people (Group A), in addition to studying the basic foreign language, they were offered supplementary materials to complete assignments in English in the specialized direction "Chemistry". The other two groups (B and C), which consisted of 15 students in each group, conducted lessons without the use of additional materials in the specialized direction "Chemistry". Classes in English were held 6 hours a week in each group.

To master the students of group A with metacognitive competence, we prepared training materials on chemistry in English, 30 authentic texts of the natural sciences selected from the Internet were offered, students watched 10 videos of the natural sciences on YouTube, selected specialized vocabulary on topics, terminology and metalanguage. Besides, for the development of metacognitive competence, it was very important to create problem situations

and questions during the whole educational process. Using a cognitive approach, a teacher creates a problematic situation for students so that students can find new knowledge and solutions on their own, so that students develop the capacity for mental perception, as well as develop critical thinking. In addition to the tasks listed above, in English classes, we used modern innovative teaching methods, such as the case study method, design technologies, the incident method, pragma-professional tasks, and real situations. For this purpose, we prepared training materials, selected the necessary content for the subject, made a selection of special vocabulary, terminology, and identified a metalanguage. We also compiled a trilingual electronic school dictionary in chemistry (Russian, Kazakh, and English). This dictionary has been tested by students of group A. When working with the dictionary compiled by us, the students noted great convenience, since the dictionary is terminological, specialized, which facilitates the search for the necessary vocabulary and greatly helps them in their work. For the development of metacognitive competence, it is very important that the student masters the terminology of the studied discipline, both in his native and in a foreign language, and consciously applies this terminology in speech.

One of the common and widely used innovative teaching methods in modern education is the case study method. The introduction of this method into the educational process in the education system is very relevant, since the application of the case study method is oriented towards the development of thinking and personality abilities. In addition, this teaching method contributes to the development of the learner's ability to conduct appropriate behaviors in various situations, and to solve extraordinary problems. The basis of the application of this teaching method is a specific situation from real life. Students need to find the right solutions using their complex of knowledge, practical skills.

To develop the metacognitive competence of group A students, we offered them various case studies. For example, you went shopping at the grocery store. Look at the composition of the substances that make up these products, and determine their chemical composition, what benefits or harm they cause to human health. Or, you are going to wash things, add washing powder to water, what kind of chemical reaction occurs when water and washing powder come in contact. Such tasks are taken from real life, these are real situations, and the student begins to think about situations and consciously make decisions, his metacognitive competence develops. Since, knowing the solution in his native language, he begins to look for an answer in a foreign language, to select the appropriate words and terms. In this case, the teacher plays the role of a facilitator, generates questions and fixes answers, and is a moderator in maintaining the discussion. The case study method develops the students' value system, their professional positions and the sense of their future profes-

sional activity. This teaching method favors the development of students' own independent thinking, they learn to work in a team, find optimal ways to solve non-standard situations.

We also applied the project method. The statement of the project task must have a problem, it is necessary to set goals and objectives to solve the problem. The solution of project problems contributes to the formation of the following abilities:

– reflect (understand and analyze the problem);
– set goals and achieve them;
– to plan;
– to model (make diagrams, models);
– analyze;
– express one's own point of view and be able to defend it, arguing;
– evaluate the point of view of others;
– summarize the conclusions.

Naturally, in the formation of the above abilities, students develop metacognitive competence. For example, group A students were offered the project "Chemical analysis of the composition of chocolate and its effect on human health". This work is relevant at any time, since chocolate is a favorite treat for both children and adults. The popularity of different kinds of chocolate on the shelves of our stores and their wide assortment make it difficult to choose the right one before buying. Does the price indicated on the package correspond to its quality, which brand of chocolate bar is more useful, which is more natural? Is chocolate harmful to young children? Is it necessary to limit its consumption? Is chocolate good for health? Pupils must find a solution to these and many other questions by completing this research work.

Group A was also offered such problematic tasks as, for example,

1. Chloroethane is a gas that easily turns into a liquid. If a little of this substance is fired on the hand, there is a rapid evaporation of the liquid and strong local cooling; it is used in medicine for local anesthesia for simple operations. Draw up the equation for producing chloroethane from ethylene.

2. Many plastics are found in nature, not only in the form of human waste products, but as natural products. Thus, the Liuamber orientalis tree growing in Asia Minor emits an odorous resin called styrax, which was used 3000 years ago by the ancient Egyptians to embalm the dead. Styrax is polystyrene. Write down the equation for the formation of polystyrene from styrene (vinyl benzene).

**4. Results**

At the beginning of the study in order to determine the level of knowledge of a foreign language, all students of the preparatory department completed the standard level test (Tab. 1).

**Table 1.** The level of foreign language proficiency in groups A, B, C

| Groups | Number of students | English grade point average |
|---|---|---|
| Group A | 15 | 86,6 |
| Group B | 15 | 88,2 |
| Group C | 15 | 87,4 |

This table shows that the level of foreign language proficiency in groups A, B and C is almost the same, even the average score in group A turned out to be slightly lower than in groups B and C, which proves the reliability of further data from the experiment.

During the English lessons with group A using the educational content of the natural sciences, we noted that this group of students consciously approaches the solution of the tasks assigned to them. These students could freely use the terminology of chemistry in English, could independently carry out project work, independently solve the case problems, they developed critical thinking, and they learned to work in a team. In addition to the fact that students in this group studied the basic foreign language, they studied extra specialized English in chemistry. After 9 months from the start of training, we conducted a final control test to determine the level of English proficiency among all students in the preparatory department. The final control test consisted of four activities: reading, writing, listening, speaking. Students of group A showed high results when performing the test, since their vocabulary was much enriched, they consciously approached the implementation of the proposed tasks.

The results of the final control test are shown in the following table (Tab. 2).

**Table 2.** The Results of the final control test

| Results / Grade Level | Number of students | | | Result, % | | |
|---|---|---|---|---|---|---|
| | Group A 15 stud. | Group B 15 stud. | Group C 15 stud. | Group A | Group B | Group C |
| Excellent | 7 | 1 | 0 | 46,7% | 6,7% | 0% |
| Good | 6 | 5 | 6 | 40% | 33,3% | 40% |
| Satisfactory | 2 | 9 | 9 | 13,3% | 60% | 60% |
| Unsatisfactory | - | - | | 0% | 0% | 0% |
| Total | 15 | 15 | 15 | 100% | 100% | 100% |
| Average | Group A 4,3% | | Group B 3,5% | | Group C 3,4% | |

The average indicator of the final control test in groups B and C is almost the same, but lower than in group A. In group B, it was 3.5%, in group C - 3.4%,

which is 0.8% in group B and 0.9% in group C below the indicator of the final control test in group A.

Thus, it can be seen from Tab. 2 that the dynamics of the formation of metacognitive competence in group A and groups B and C are markedly different. Students of group A showed good results in all tested parameters, while students of groups B and C did not show significant growth in these parameters.

So, due to the use of additional material in the profile direction "Chemistry", students of group A significantly improved their knowledge not only in English, but also in their profile direction, the vocabulary of students in English was enriched, their horizons expanded, the students developed the ability to mental perception, and also developed their critical thinking and their metacognitive competence has developed.

The results of this work show that the development of metacognitive competence in the foreign-language educational process provides a much greater didactic effect compared to the traditional methodology. For all indicators there is a steady positive dynamics of the result.

**5. Conclusion**

In a foreign-language natural-science educational process in a profiled school, it is necessary to develop students' metacognitive thinking, since through the primary conceptualization of knowledge in their native language, through a professional metalanguage, a secondary reconceptualization of the branch of knowledge is formed, a "secondary cognitive consciousness" and interlanguage conceptualization are formed.

A person develops his cognitive activity through the formation of his personal picture of the world in his native language as the main cognitive images and forms the picture of the world of "another linguistic society" on the basis of his culture; he masters new knowledge and culture of a foreign country. Thus, new cognitive constructs, frames, concepts that show understanding and perception of another language and culture are formed in the personality's consciousness; the personality builds his cognitive system, "secondary constructions", and secondary knowledge about the representatives of the target language.

In this article, we wanted to show how it is possible to develop students' metacognitive competence in a profiled school in a foreign-language natural-science educational process.

In conclusion, we consider it appropriate to pay attention to the fact that metacognitive processes are studied indirectly, mainly through their final manifestations: monitoring activities; planning one's own actions; search and application of cognitive strategies in information processing; self-esteem and self-control, etc. Therefore, their targeted development is also possible indirectly. The use of

interactive methods in foreign language lessons is focused on solving specific practical problems.

In modern studies of the development of metacognitive competence, much attention is paid to metacognitive features, or rather, the assessment of intellectual characteristics, such as the level of development and understanding of the material. The development of metacognitive competence in the foreign-language educational process has a positive effect on academic performance and professional development.

**NOTES**

1. State Program for the Development of Education of the Republic of Kazakhstan for 2011 – 2020 – Astana, 2010.
2. Features of pre-profile and profile education in a 12-year school. Astana, 2013, A, p. 46.

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