IRSTI 14.35

Zh.K. Yermekova[1], N.M. Stukalenko[2]
Zh.M. Salikhoja[1], A.S. Magauova[3]
Zh.T. Makhambetova[3], G.E. Sagyndykova[1]

[1]L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakstan
[2]Branch of the joint-stock company «National Center for Advanced Training «Orleu» Institute for Advanced Training in the Akmola region, Kokshetau, Kazakhstan
[3]Al-Farabi Kazakh National University, Kazakhstan, Almaty
(E-mail: zhadyra-ermekova@mail.ru, mms.nina@mail.ru sali.zhm64@yandex.kz magauova@mail.ru, gibrat75@mail.ru, mzhamilya@mail.ru)

Training future physics teachers to develop critical thinking of students

Abstract. *Training future teachers of Physics for the development of critical thinking of learners is a key point to properly orientate in their future professional activities, to adapt flexibly in the world of science, in the new system of education and management, and only the transition to new information and communication technologies of training can achieve this goal. The aim of the research was to study the features of critical thinking at students (future physics teachers) in the conditions of working in a team and to find ways to develop it within the educational process. The researchers used the following methods: theoretical (analysis, synthesis, classification, generalization, deduction, induction, analogies, modeling); empirical (observation, survey, questionnaire, interviewing, conversation); experimental (experiment-ascertaining, forming, diagnostic), statistical (statistical data processing, qualitative and quantitative analysis of research results).*

Keywords: *teachers of Physics, critical thinking, educational process, professional training.*

DOI: https://doi org/10.32523/2616-6895-2021-134-1-52-59
Received: 19.06.20 / Accepted: 28.07.20

Introduction

"The Strategy for the development of education in the Republic of Kazakhstan until 2020» defines the development of critical thinking at future specialists in the conditions of professional training as a priority task [1].

The most important factor influencing the implementation of these tasks is training based on the development of students' critical thinking. Because of this, the relevance of the research topic is primarily dictated by the need to solve the social problem of educating a well-developed personality capable of actively working in various areas of public and state life, science, and culture. The solution to these complex tasks depends entirely on the teacher and the quality of his training. (Bryushinkin V. N. (2003), Koneva V. S. (2002).

Physics is the fundamental science of nature, its fundamental nature is that by studying the simplest and most general properties of the material world, it also studies very complex phenomena and objects, establishing universal laws, the validity of which is confirmed not only in earthly conditions, but also in the entire universe.

The current stage of development of all natural sciences is characterized by a particularly intensive development of «borderline» sciences

that occur at the «crossroads» of different disciplines: radio astronomy, biophysics, physical chemistry and physics etc., is also crucial for the development of the dialectical-materialist ideas about processes and phenomena occurring in nature, on the General laws of its development and existence, which is the basis for the formation of the scientific worldview, i.e., natural-scientific picture of the world.

Thus, the ways of development of many Sciences, especially natural ones, and any branch of modern production are closely intertwined with Physics. its laws and research methods are widely used by chemists, biologists, in astronomy, in courses of heat engineering, electrical engineering, material resistance, in Cybernetics, in various technological courses, etc.

It is necessary for all mankind to realize the role of natural science in the modern world, since the development of natural Sciences, in addition to the above, is the basis of scientific and technical progress of the entire world civilization, determining the political, economic, and military power of any people, any state. Therefore, when teaching Physics and other natural Sciences, the development of critical thinking of learners is extremely necessary and is associated with the scientific picture of the world.

The authors aim to study the features of critical thinking at students (future physics teachers) in the conditions of working in a team and to find ways to develop it within the educational process.

The Object of research: critical thinking of learners.

The Subject of research: features of the development of critical thinking in students (future teachers) in the educational process of the University.

Methodology

Various methods were used during the research: theoretical (analysis, synthesis, classification, generalization, deduction, induction, analogies, modeling); empirical (observation, survey, questionnaire, interviewing, conversation); experimental (experiment-ascertaining, forming, diagnostic), statistical (statistical data processing, qualitative and quantitative analysis of research results).

The hypothesis of the research was the assumption that if professional training of future specialists is organized using interactive teaching methods aimed at developing their critical thinking and considering identified features in the conditions of working in a team, it can help to increase the level of critical thinking of students in the educational process of the University.

The scientific novelty of the research consists in finding a solution to the problem under study through the development, scientific justification and experimental verification of a set of interactive teaching methods aimed at developing students' critical thinking within the educational process of the University, based on the identified features in the conditions of working in a team.

The theoretical significance of the research lies in the fact that the analysis of the problems of critical thinking of students in the educational process of the University; based on the analysis summarizes the characteristics of the concept of «critical thinking skills», developed and scientifically substantiated range of interactive teaching methods in terms of teamwork of students aimed at the development of critical thinking.

The practical significance of the research is that the methodological support for a complex of interactive teaching methods in the conditions of teamwork of students aimed at developing critical thinking has been developed.

We conducted experimental work with students of the specialty «Training of future teachers of Physics», «Social pedagogy» of the L. N. Gumilyov Eurasian National University and Sh. Ualikhanov Kokshetau State University. The reliability of the results obtained was ensured by using a set of methods that correspond to the subject of the study and the tasks set, and by combining qualitative and quantitative analysis of the results.

Results and discussions

Modern psycho-pedagogical research shows that the problem of studying critical thinking in learners in the educational process is extremely

multifaceted (Korzhuev A.V., Popkov V. A., Ryazanova E. L. (2001), Bakhareva S. (2005).

Each learner uses meanings, ideas, concepts, analogies, metaphors, models, theories, and explanations to express the course of their thoughts, to understand, reason, and manage their thoughts. It also uses meanings and concepts to deny, contradict, distort, stereotype, etc.

Critical thinking is defined by the American Philosophical Association as «a purposeful, self-regulating judgment that culminates in interpretation, analysis, evaluation, and interactivity, as well as an explanation of the obvious, conceptual, methodological, or contextual considerations on which this judgment is based»(Ellis A., Lange A.,1997).

D. Klooster in the article « What is critical thinking?»in the journal «Peremena» [7] highlights the following parameters of critical thinking:

1) critical thinking is independent thinking;

2) information is the starting point, not the end point, of critical thinking;

3) critical thinking begins with asking questions and figuring out the problems that need to be solved;

4) critical thinking tends to make a convincing argument; critical thinking is social thinking (Klooster D.,2001).

To effectively solve the problem under consideration, we consider it appropriate *to model the process of developing critical thinking at students*, bringing this process into a certain system that should ensure that the maximum possible efficiency is achieved when implementing this model.

In our research, we relied on the conclusions of the authors (Kovalev S.V. (1990), who note that more correct modeling of pedagogical systems and their effective use can be facilitated by the

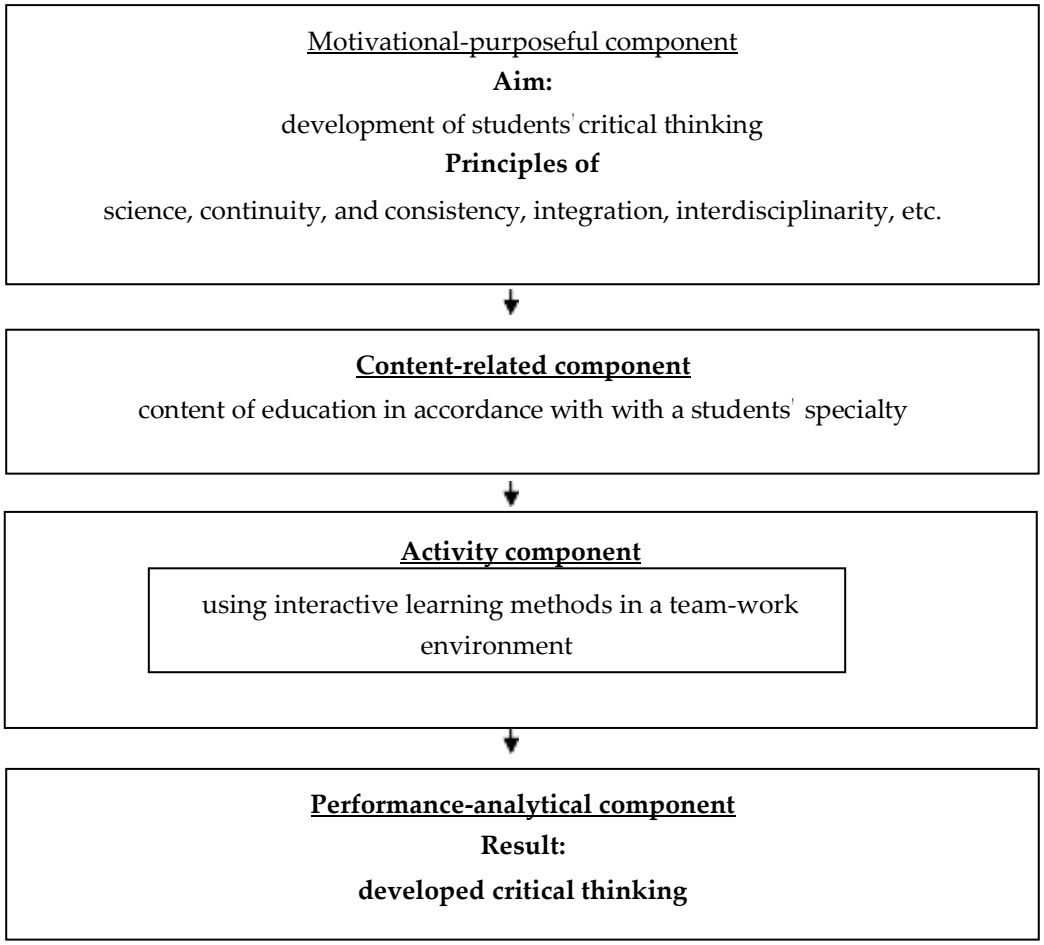

Figure 1 – Model of the process of developing students' critical thinking

features that distinguish pedagogical systems from each other: pedagogical goals (upbringing, education, training, personal development in a certain direction), the content of education, the contingent of learners (learners or students), means, forms, methods, and results.

By modeling the process of developing critical thinking at students, we mean bringing this process into a certain structure that can achieve the maximum possible beneficial effect from the implementation of this process. Based on the knowledge of modeling as a method of scientific knowledge and analysis of pedagogical reality, we have developed a model of the process of developing critical thinking at students, which is presented in this work (figure 1).

The presented model of the process of developing critical thinking at students reflects its general structure and consists of the following main components:

- *motivational-purposeful* (main goal, tasks, and principles);
- *content* (corresponding content)
- *activity* (implementation technology);
- *performance-analytical* (results of the process, their analysis).

1. *Motivational-purposeful componen*t is a set of goals and main motives of the process of developing critical thinking in students. The main goal is to develop critical thinking among students in the educational process of the University, as well as the development of positive sustainable motivation that would encourage them to persistent, systematic work not only to improve professional knowledge, skills, and abilities in the conditions of professional training, but also to develop critical thinking in this process.

The analysis of the principles of professional education allowed us to identify the most important of them for the development of students' critical thinking: scientificity, continuity, systematicity, interdisciplinarity, integration, etc.:

- the principle of scientificity;
- principle of continuity;
- the principle of consistency;
- the principle of integration;
- the principle of interdisciplinarity.

2. *The content component* of the process is a set of professional knowledge, skills, abilities and skills, as well as a certain level of theoretical and practical educational activities of future specialists.

3. *The activity component* is a set of tools for implementing the main goal of the process of developing students' critical thinking, which includes: the activities of teachers and learners, the methods used in this process, organizational forms and means of training, which together represent the technology of training.

4. Performance-analytical component

- these are the results obtained in the process of developing critical thinking at students and their analysis.

As can be seen from the presented model of the process of developing critical thinking in students, it has an integrated system of organization with a complex hierarchical structure, the purposeful action of which is carried out through the generalized functioning and development of all its components.

Development of students' critical thinking in the context of teamwork in the framework of the educational process of the University

When working as a team, you can always organize a discussion that allows students to develop and evaluate their thinking in comparison with the thinking of others. When working as a team, egocentricity is possible. Since all people are socialized, egocentricity is partially developed within the framework of sociocentricity.

It is necessary to teach each team member to think (reflect) on their conclusions and behavior; make assumptions (assumptions) unambiguous and analyze critically.

Using interactive methods to develop students' critical thinking in a teamwork environment.

Interactive learning (from English interact – interact, be in interaction, act, influence each other), i.e. learning through participation, interaction as part of changing groups (Kairabaeva A. E., Akisheva S. N. (2003)..

The main forms of interactive learning can be called dialogue, group work, educational discussion, etc. we Offer a generalized scheme of using interactive methods in the process of

developing critical thinking in students (figure 2).

The purpose of using interactive methods is to develop future teachers' critical thinking. This goal can be achieved during educational activities, because of which future pedagogues acquire the necessary knowledge, skills, and abilities. Professional training of future pedagogues at the University is a multi-sided system that combines relatively independent, but interconnected subsystems of training, i.e., its main directions: theoretical and methodological, practical, research and extracurricular. Each component of the process performs its specific tasks.

Theoretic-methodological training provides future pedagogues with the basics of scientific knowledge, social phenomena, and processes in the dialectical unity of the «man-society» system, the methodology of knowledge of the world, the phenomena of social life, and the dialectical approach to knowledge and transformation of reality. Using intersubject connections of Physics with other forms of social consciousness-philosophy, morality, art, and aesthetics.

Practical training of future pedagogues ensures the formation of practical skills in the conditions of training sessions and pedagogical practice.

Research training of future pedagogues provides for mandatory participation in scientific research, research projects, real project pedagogical developments, which contributes to the development of a creative approach to research in the context of teaching activities.

Extra-curricular training of future pedagogues is carried out using various extra-curricular organizational forms (preparation for the Olympiad, excursions, robotics, STEM technologies, conferences, debates, group work, etc.). it allows you to use all the pedagogical knowledge, skills and abilities obtained based on other components of training.

Conclusions

Thus, the components combination of pedagogical training contribute to the development of critical thinking at future pedagogues in the context of actual problems of school education and increase professional interest that contributes to the manifestation of creative abilities in teaching activities.

The results of the research made it possible to draw the following conclusions: 1. The presence of critical thinking is necessary for a graduate of

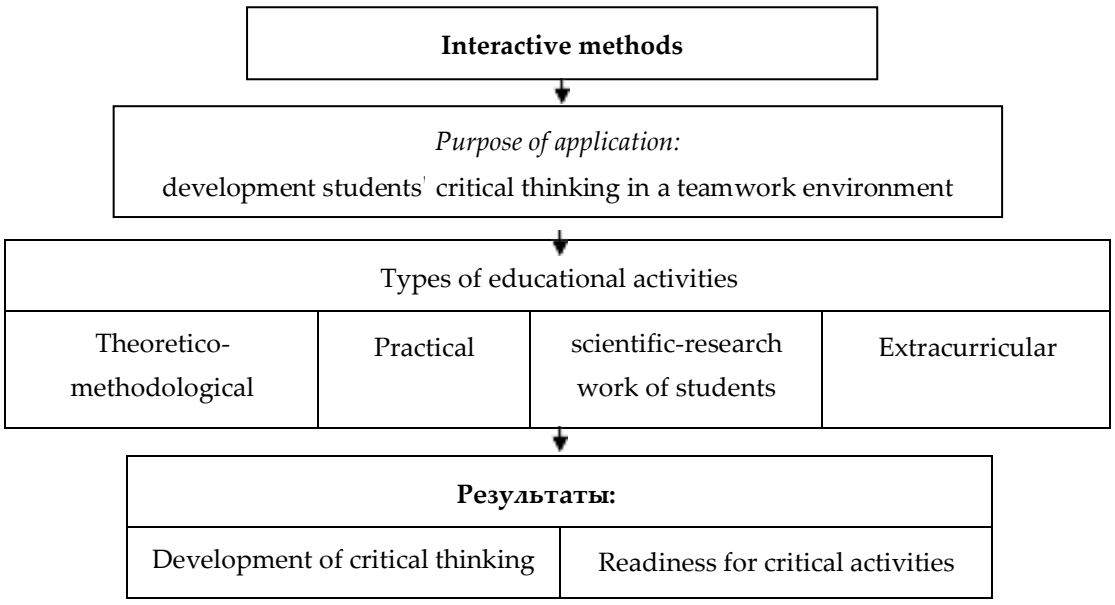

Figure 2 – Application of interactive methods in the process of developing students' critical thinking

a modern University, regardless of the specialty, but it is especially important for pedagogues of the natural cycle, psychologists, social pedagogues, etc., because in the sphere of their professional activity, critical thinking contributes to the development of effective solutions and the creation of new technologies.

During the study, the characteristic of the main concept of the process under study is generalized. *Critical thinking* is disciplined, self-directed, and self-regulating thinking that illustrates the perfections of thinking that correspond to a specific way or area of thought.

2. The task of modern understanding the modernization of professional education relates to the development of critical thinking of students as future specialists, through the expansion of the boundaries of the entire educational process using information and communication technologies, new interactive teaching methods and methods of teamwork.

The essence of the process of developing students 'critical thinking is to organize the educational process in the University, design a scientifically based model of the process under study (specifying goals and objectives, designing content, methods using modern learning technologies, monitoring, and analyzing the results achieved). For this purpose, a model has been developed that consists of four main components: *motivational-target* (main goal, tasks, and principles) *content* (corresponding content), *activity* (implementation technology – interactive training), and *performance-analytical* (process results, their analysis).

Readiness for critical activity acts as a social and professional position of the pedagogue's personality. The basis of the future pedagogue's training is the critical worldview as a system of critical knowledge, skills, beliefs, and views.

During the experiment, three levels of critical thinking were determined: *high, medium, and low*, developed in accordance with its structural components. The effectiveness of scientific and pedagogical developments of the study was confirmed by the results of the pedagogical experiment.

The results of the research allow us to offer the following *recommendations:*

- introduce a developed and scientifically based «model of the process of forming students" critical thinking in a teamwork environment', consisting of four main components: into the educational system of the University motivational-target, content, activity, and performance-analytical;

- use the proposed method of forming critical thinking among students in a team environment, based on the use of interactive learning methods.

The research prospects are to find new ways to improve the process of forming students' critical thinking in accordance with the progressive speed of development of professional education in the context of globalization.

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Ж.К. Ермекова[1], Н.М. Стукаленко[2], Ж.М. Салиходжа[1], А.С. Магауова[3], Ж.Т. Махамбетова[3], Г.Е. Сагындыкова[1]

[1]Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Нұр-Султан, Қазақстан,
[2]«Өрлеу» Ақмола облысы бойынша біліктілікті арттыру институты, Көкшетау, Қазақстан,
[3]Әл-Фараби атындағы қазақ ұлттық университеті, Алматы, Қазақстан

Болашақ физика мұғалімдерін оқушылардың сыни тұрғысынан ойлау қабілетін дамытуға үйрету

Аңдатпа. Болашақ физика мұғалімдерін оқушылардың сыни тұрғысынан ойлауын дамытуға дайындау мұғалімдердің келешектегі кәсіби қызметіне дұрыс бағдарлаудың басты бағыты болумен қатар, ғылым әлемінде, білім беруде және басқарудың жаңа жүйесінде икемді бейімделудің негізгі нүктесі болып табылады. Зерттеудің мақсаты студенттердің (болашақ физика мұғалімдері) командалық ортадағы сыни ойлау ерекшеліктерін зерттеу және оны оқу процесінде дамыту жолдарын табу. Зерттеушілер келесі әдістерді қолданды: теориялық (талдау, синтез, жіктеу, жалпылау, дедукция, индукция, аналогия, модельдеу); эмпирикалық (байқау, сауалнама, сауалнама, сұхбат, әңгіме); эксперименттік (тәжірибе жасау, қалыптастыру, диагностика); статистикалық (процестің статистикалық мәліметтері, зерттеу нәтижелерінің сандық және сапалық талдауы).

Түйін сөздер: физика мұғалімдері, сыни ойлау, оқу процесі, кәсіби дайындық.

Ж.К. Ермекова[1], Н.М. Стукаленко[2] , Ж.М. Салиходжа[1] , А.С. Магауова[3],
Ж.Т. Махамбетова[3], Г.Е. Сагындыкова[1]
[1]Евразийский национальный университет имени Л.Н.Гумилев, Нур-Султан, Казахстан,
[2]ФАО «НЦПК «Өрлеу» Институт повышения квалификации по Акмолинской области,
Кокшетау, Казахстан
[3]Казахский национальный университет им. аль-Фараби, Алматы, Казахстан

Обучение будущих учителей физики развитию критического мышления учеников

Аннотация. Обучение будущих учителей физики для развития критического мышления - это основной пункт для правильного ориентирования в будущей профессиональной деятельности, для гибкой адаптации в мире науки, в новой системе образования и менеджмента, и только новые коммуникационные технологии могут содействовать в достижении этой цели. Цель исследования - изучение особенностей критического мышления студентов (будущих учителей физики) в условиях работы в команде и поиск путей его развития в процессе обучения. Использованы следующие методы: теоретический (анализ, синтез, классификация, генерализация, дедукция, индукция, аналогии, моделинг); эмпирический (наблюдение, опрос, вопросник, интервьюирование, беседа); экспериментальный (эксперимент-констатация, формирование, диагностика); статистический (статистические данные процесса, качественный и количественный анализ результатов исследования).

Ключевые слова: учителя физики, критическое мышление, процесс обучения, профессиональная подготовка.

Information about the authors:

Ермекова Ж.К. – Л.Н. Гумилев атындағы техникалық физика кафедрасының доценті, Қ. Мұңайтпасов көш., 13, Нұр-Сұлтан, Қазақстан.

Сагындыкова Г.Е. – **корреспонденция үшін автор,** Л.Н. Гумилев атындағы техникалық физика кафедрасының доценті, Қ. Мұңайтпасов көш., 13, Нұр-Сұлтан, Қазақстан.

Салиходжа Ж.М. – Л.Н. Гумилев атындағы техникалық физика кафедрасының доценті, Қ. Мұңайтпасов көш., 13, Нұр-Сұлтан, Қазақстан.

Стукаленко Н.М. – п.ғ.д., «Өрлеу» Біліктілікті арттыру ұлттық орталығы акционерлік қоғамы «Ақмола облысы бойынша педагогикалық қызметкерлердің біліктілігін арттыру институты» профессоры, Абай Құнанбаев көш., 71, Көкшетау, Қазақстан.

Магауова А.С. – Әл-Фараби атындағы Қазақ ұлттық университетінің профессоры, Әл-Фараби даңғ., 71, Алматы, Қазақстан.

Махамбетова Ж.Т. – PhD, Әл-Фараби атындағы Қазақ ұлттық университетінің аға оқытушысы, Әл-Фараби даңғ., 71, Алматы, Қазақстан.

Yermekova Zh.K. – Associate Professor of the Department of Technical Physics, Candidate of Pedagogical Sciences, L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakstan

Sagyndykova G.E. – **Corresponding author,** Associate Professor of the Department of Technical Physics, Candidate of Pedagogical Sciences, L. N. Gumilyov Eurasian National University, Nur-Sultan, Kazakstan.

Stukalenko N.M. – Doctor of Pedagogical Sciences, Professor of the Branch of the joint-stock company «National Center for Advanced Training «Orleu» Institute for Advanced Training in the Akmola region, Kokshetau, Kazakhstan.

Salikhoja Zh.M. – Head of the Department of Technical Physics, Candidate of Physics and Mathematics, L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan.

Magauova A.S. – Doctor of Pedagogical Sciences, Professor, Al-Farabi Kazakh National University, Almaty, Kazakhstan.

Makhambetova Zh.T. – Ph.D. student, Al-Farabi Kazakh National University, Almaty, Kazakhstan.