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Formation of students' research interest through action learning

Kamila Adilzhan[1*], Nuripa Bekalay[2], Khamitova Makpal[3], Tashkeyeva Gulmira[4], Kobenkulova Zhanar[5]

[1,3,4]*Al-Farabi Kazakh National University, Almaty, Kazakhstan.*
[2]*Kazakh National Women's Teacher Training University, Almaty, Kazakhstan.*
[5]*International Educational Corporation, Almaty Kazakhstan.*

Corresponding author: Kamila Adilzhan (*Email: kamilaadilzhan@gmail.com*)

Abstract

This study explores the idea of Action Learning as a teaching method based on doing. Where there is action, there is interest. This approach to the development of individuals does not focus on what people need to learn, but on solutions to real problems. Thus, "Action Learning" means learning from action or concrete experience, as well as taking action as a result of this learning. The study began by exploring university students' and teachers' perceptions of student interest in science in order to design an instructional strategy for stimulating student interest in learning and pursuing science. The study is experimental in nature and shows cross-sectional results in control and experimental groups of action learning, which allows us to prove the effectiveness of the theoretical assumptions made in the literature review. Data for this study included responses from 114 students to an online science survey and interviews with eight science teachers. Therefore, in the given work, effective methods were used and compared with a traditional method, that is, students were divided into several groups. Studies were conducted using traditional methods for control groups and effective action learning methods for experimental groups; consequently, the comparative results of control and experimental groups showed significant indicators.

Keywords: Education, Higher education, Interest research, Science, Teaching methodology.

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1. Introduction

Nowadays, interest in research plays a vital role in all the fields of our daily lives, ranging from the world economy, professional careers, higher education, and almost all spheres that are deeply impacted. The development of educational interest among learners and their education in general is one of the most important issues today. Curiosity is the source of all life. From the moment a child begins to speak, all his achievements up to the present day are the result of his interest. We have come here through general and personal interest, and it is common to everyone on Earth. Each new generation not only admires the achievements of a previous generation but also adapts to a new situation, matures, and uses these achievements in its own way.

A timeless challenge for education research is how to improve the academic performance of individuals [1]. Motivation is a key to understanding [2] as it often decreases over time in education programs [3], and that this decrease in the worst case can lead to student dropout [4]. Further research results show that content-specific interests can be seen as an important factor in college students' academic choices and performance [5]. The importance of interest is supported by other academic disciplines. For example, neuroscientists have detected interest as a motivator that influences learning and achievement and thus suggest that educators should focus on how they can best support their students' interest development [6]. A reason is that well-developed individual interests can help individuals overcome a lack of ability and/or perceptual disabilities in math or reading [7]. Can we improve the student's performance and interest in science because of interest, i.e., can we create scientific interest in the student? What can affect this?

This article considers each adult learning theory about creating students' scientific interest through action learning. The peculiarity of the article is to use action learning to form the scientific interest of students. I want to remind you of the importance of a teacher in a person's life. That is, it promotes success, interest, motivation, and self-learning to gain experience. The coach guides people to do good things. In our work, the role of the teacher is combined with the role of the coach. The teacher not only explains a new topic but also works together with the students through different activities (story, excursion, seminar, problem-solving, laboratory work, etc.) to form new knowledge and scientific interest in the students. If the student is only a listener, there will be no effectiveness in the knowledge gained. In order for the students' acquired knowledge to be effective, the teacher must keep them interested by inviting them to different activities.

In the course of interesting teaching, we can focus students' attention on one environment. To look at it in more detail, interest is seen as a crucial dimension within motivation theories that influences learning. Scientists have shown its impact on attention, goals and levels of learning [8]. Furthermore, teachers who recognize the potential benefits of increased academically relevant interests may be best positioned to enhance their students' learning. Research data from educational psychology further supports this claim [6].

To find out the importance of the formation students' scientific interest, we surveyed students before the experiment and after the experiment. Therefore, we conducted the test using the functional learning method. In this regard, we used action learning method and observed the students' performance and interest. As a result, the scientific interest of students was formed.

In the course of the experiment, in order to continuously monitor the level of students' scientific interest methodology in the experimental groups, we conducted three monitoring's and compared the information. For this purpose, students were surveyed with special questions and assignments.

According to the results of the indicators from the second control monitoring of the level of formation of research interest among students, there was an increase in those who reached a high level compared to the zero control monitoring. The number of students in the experimental group (EG) rose from 8.6% to 32.5%, while in the observation group, the number of students who reached a high level increased from 7% to 14.6%. In the experimental groups, the number of students with a low level of research interest development decreased by the end of the experimental experience.

Clearly, some students learning theories apply more than others in the analysis and description of action learning, and these limitations appear as one analyzes the distinct elements of action learning. However, it is our purpose to highlight the combined usefulness of each of the adult learning theories in explaining the potency of action learning. Because action learning utilizes theories, principles and practices of each of the five major adult learning orientations, it bridges these meta-theories and offers a compelling learning opportunity for individuals, teams, and organizations [9].

2. Literature Review

2.1. Essence of and a Model for Action Learning

Since Reg Revans first introduced action learning in the coal mines of Wales and England in the 1940s, there have been multiple variations of the concept. However, all forms of action learning share the elements of real people resolving and taking action on real problems in real time, and learning through questioning and reflection while doing so. The attraction of action learning is its power to simultaneously and resourcefully solve difficult challenges and develop people and organizations at minimal costs to the institutions. Revans never operationalized action learning into a standard approach [10], but over the years, a number of individuals have developed approaches and models that capture the essence and critical elements that make action learning successful [11]. We selected the Marquardt approach because it captures the essential components of the process originally proposed by Revans. We want to expand his method by applying it in the field of education. We support his approach and would like to add the importance of curiosity to the six components below.

Marquardt's approach to action learning is built around six components:

1) A problem or challenge of importance to the group;
2) A group of 4-8 members, ideally from diverse backgrounds and/or parts of the organization;
3) A process that emphasizes questions and reflection;
4) The power to take action on strategies developed.
5) A commitment to learning at the individual, team, and organizational levels;
6) An action learning coach who focuses on and ensures that time and energy are devoted to capturing the learning and improving the skill level of the group [12].

Theories and Schools of Adult Learning Adult learning (andragogy), concerned with how adults learn, recognizes and acknowledges that a number of factors influence how adults learn differently from children (pedagogy). Knowles [13] and Knowles [14] identified several factors that distinguish andragogy from pedagogy; namely, (1) the adult learner is self-directing, (2) adults' experiences make them rich resources for one another, (3) their readiness to learn can be triggered by effective role models, (4) adults enter an educational activity with a life-centered, task-centered, or problem-centered orientation to learning, and (5) the more potent motivators for adults are internal, such as self-esteem, recognition, better quality of life, self-confidence, and self-actualization [9].

Action learning is based on the idea of growth and development of individuals and the organization, and the effective operation of the group in order to find solutions to problems through experience sharing, reflection, and inquiry. Action learning is based on the notion of the relationship between action and reflection. Reflection is an important aspect of action learning, as reflecting on future actions makes it clearer to learn from experience [9].

In the process of reflection, experience and theory are transformed into knowledge, which undoubtedly increases the effectiveness of learning. The action learning approach provides a combination of theory and experience; it creates positive change in motivating participants to actively engage in the learning process and also acquires more effective skills. Learning is not just about gaining knowledge from formal sources, but also from actions and experiences.

Action learning, in contrast to action research, focuses on the learning and the action does not require the extension of new knowledge in a theoretical sense. In action learning the participants select some issues, analyze them, take some action and reflect on that action.

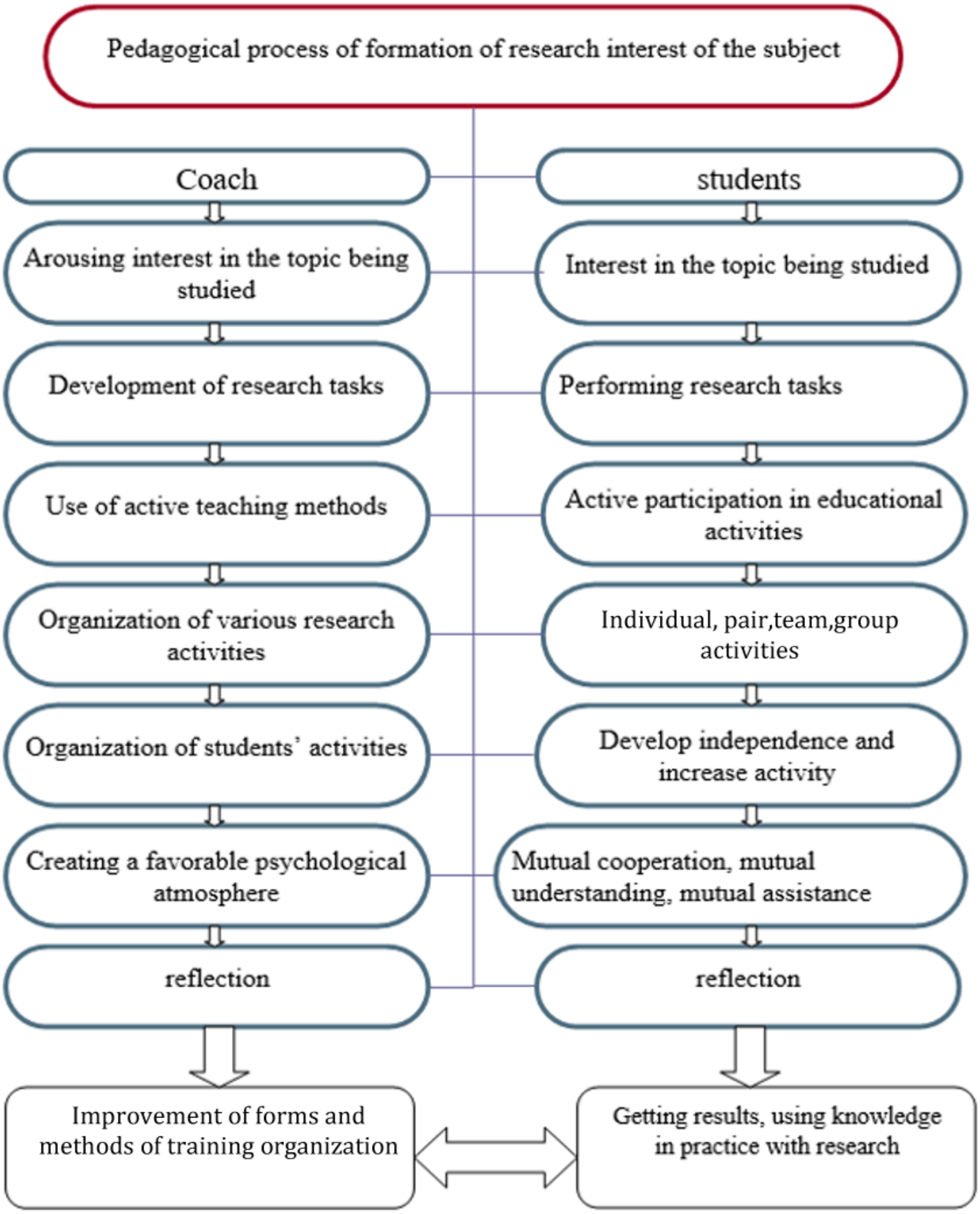

Figure 1.
The meaning of the concept of formation of students' research interest is shown.

Research indicates that individuals learn better from each other and also from the experience gained by working together in the group. Collaborative methods based on empirical and action-oriented strategies make the newly created knowledge the basis for new activities that are intended to bring change. As a result, there will be cognitive interest in the work you are doing.

Cognitive interest is a special manifestation of a learner's desire to study, learn, and develop his spiritual soul. In order to form cognitive interests, students' cognitive interests are developed on the basis of the need to understand the social meaning of education and to accelerate the pace of service to society.

Improving the theoretical knowledge of educators in the development of cognitive interest in students, it was determined that the main goal of education in modern times is focused on a specific field of profession. This occurs from the standpoint of searching, analyzing, and rationally using information, preparing young people who are able to live and work with dignity in today's rapidly changing world. Furthermore, preparing for work takes place from the standpoint of the formation of creative abilities. In addition, during the learning process, educators can arouse students' interest and encourage them to pursue what they are searching for.

In this overview, therefore the relevant theories and experimental data from these fields will be presented and a separate section to the methods used in interest research will be considered. From the viewpoint of science education, theoretical models, which clarify the conditions behind interest development are particularly important. Thus, the focus will be on exemplary research approaches and conclusions about the research interest in science, which play a vital role in the current scientific debate.

2.2. Power to Take Action

In action learning, the most valuable learnings occur when action is taken, for one is never sure the idea or plan will be effective until it has been implemented Raikov [15]. Revans [16] states, "responsible experience alone is the true motivator, the impartial witness, and the final judge of meritorious learning." Members of the action learning group must have the power to take the action themselves or be assured that their recommendations will be implemented by the organization or the individual presenting the problem.

Action learning is a science in which the group members (all "scientists" in an objective search for the truth) learn about everything that they can that is connected to the problem and can help solve it. The learning is acquired through questions asked by the coach as well as by individual group members requesting feedback from each other. Significant learning occurs through the process of the group discovering together new insights and ideas.

2.3. Action Learning Coach

It is important that the action learning group regularly pauses from working on the task to reflect on their experience in order to capture and apply their learnings. It has been discovered that if one of the group members (referred to as an action learning coach) focuses solely on the group's learning and not on the problem, the group will more quickly become effective both in problem-solving abilities and in group interactions.

The person serving as the action learning coach may be a working group member or an external participant. Through her questions, she helps group members reflect on how they listen, how they may have reframed the problem, how they give each other feedback, how they are planning and working, and what assumptions may be shaping their beliefs and actions. The coach also helps participants focus on what they are achieving, what they are finding difficult, what processes they are employing, and the implications of these processes. The action learning coach must have the wisdom and self-restraint to let the participants learn for themselves and from each other.

For the humanists, the action learning coach is present to facilitate and accelerate the full development of the whole person. The coach does not judge, but asks the members to determine for themselves what they have done well, what they have learned, and how they can improve as a team and as individuals [9].

Some of the advantages of action learning are flexibility, respect for the knowledge and experience of participants, involvement, collegiality, empowerment and ownership. The challenge for schools is to engage students in the activity and the development of skills necessary to function in today's society.

Significance which is based on involving meaningful learning that connects learning to prior experience, multiple perspectives and contexts beyond the classroom. It is comprised of the following elements: background knowledge, cultural knowledge, knowledge integration, inclusivity, connectedness and narrative.

These elements are incorporated into three dimensions relating to classroom practice. Action learning allows students to work in a team and create a new foundation to solve problems. Students with the ability to express themselves are more motivated to take action. This method focuses on improving and changing the current situation. To achieve the desired educational goals, we should improve the quality of implementing and promoting conscious and critical thinking, leading to the formation of many effective and efficient ways of doing things.

3. Materials and Methods

One of the ways to solve the problem of successful formation of cognitive-analytical skills in a young student can be the use of the method of research activity in the educational process. Obukhov [17] determined it as a method of making new judgments from specific facts independently observed by students or reproduced by them during the experiment, Raikov [15]. Obukhov [17], under the term of "research activity" understands the joint work of student and teacher in the discovery of new knowledge. This activity is always creative and informative, as a result of which a student masters the ability to see problems, formulate and ask questions, and find answers to them independently [17]. In the course of working on academic research, students go through the main stages inherent in research in the scientific field [18]. Savenkov [19] defines students' research activities as one of the forms of intellectual work that includes elements of creativity. This work is always based on the search activity of a student [19]. A person's knowledge of the world is awakened from childhood and world knowledge is formed by searching, learning and taking action.

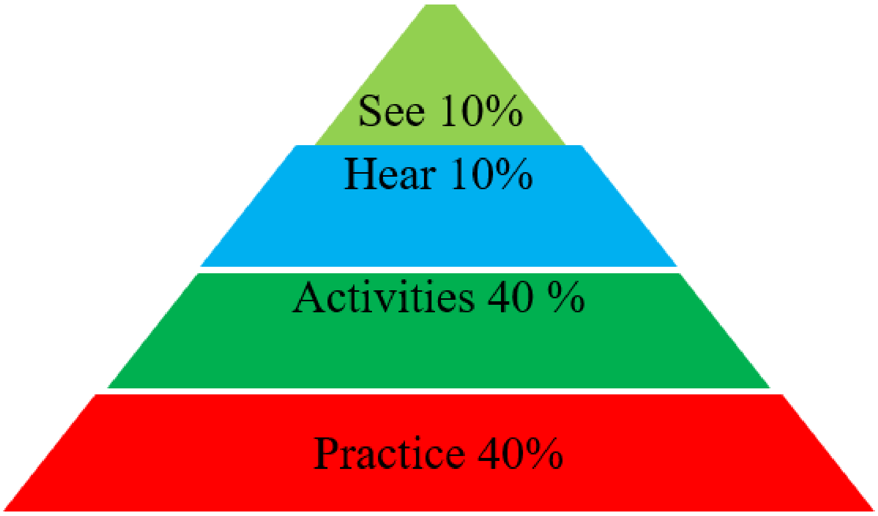

Figure 2.
Model of formation of research activity skills in a higher education student using cognitive activities.

Many researchers have considered the possibilities of applying the research method in the educational process; however, there is no work on the study of the relationship between educational research interest and the effectiveness of the formation of cognitive-analytical skills among students. We can create students' research interest using the most effective methodologies.

3.1. Research Interest in Science

Research is a process of obtaining new knowledge and a type of cognitive activity. Research is a test carried out to identify a new phenomenon, characteristic, or dependence. There are many types of research; a type related to our field is scientific research. Scientific research is a process of developing new scientific knowledge and is also a type of cognitive activity.

Simply put, research is the process of discovering new knowledge. This knowledge may be the development of new concepts or the advancement of existing knowledge and theories, leading to new insights that were not previously known. The goal of research is to develop scientific theories, concepts and ideas, to develop society by increasing the quality of education (Figure 1). The purpose of research is to achieve results by forming predictions and conclusions, collecting data, analyzing the results and applying them to specific applications, and forming new research problems [20].

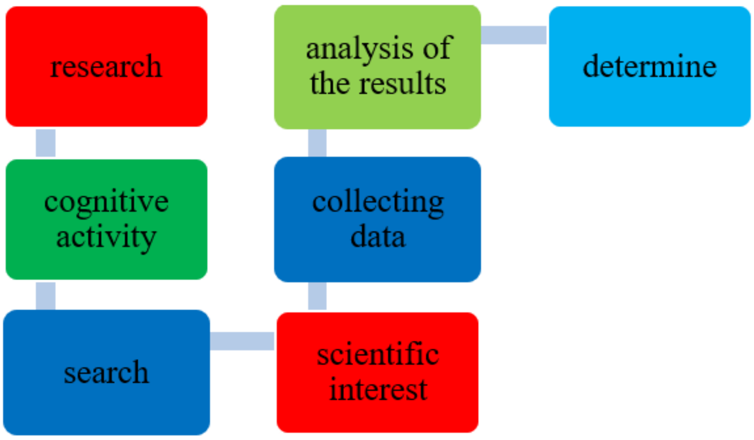

Figure 3.
Structural logical description of the research concept.

In the process of explanation, scientists also use the concept of 'research culture' in scientific and research works. From this point of view, an outstanding scientist, Sh.T. Taubaeva, based on the conclusions that include the content, methodology, mechanisms, and stages of the formation of the teacher's research culture, considers it from a theoretical and methodological perspective. The methodology of pedagogy in the continuing education system defines the methodological basis by proposing a theoretical model of the process of forming the teacher's research culture, which allows for the demonstration of the content of scientific knowledge, as well as philosophical and methodological knowledge.

There are some ways to increase interest in research. The simplest way to develop an interest in research is to "learn," which helps to feel the importance of research and increases students' interest. If you are interested in a topic you are researching, you will enjoy reading and learning about it. In some students, interest is unstable, so I believe that it is necessary to move to action immediately. We will talk about the action below.

Research ability is the ability of students to perform theoretical and practical tasks in a short period of time, precisely and correctly, based on the scientific and educational experience gained by students.

When an individual engages in reflection on their actions or experiences, it is typically for the purpose of better understanding those experiences or the consequences of those actions to improve related actions and experiences in the future. Reflection in this way develops knowledge around these actions and experiences to help us better regulate those actions in the future. The reflective process generates new knowledge regularly for classroom teachers and informs their classroom actions.

Table 1.
Stages of formation of research studies.

Action	Description
See	Excursion, thinking, seeing, feeling responsivity, being able to draw conclusions
Hear	Theory, lecture, providing information, discussing the topic, exchanging opinions, watching video lessons
Activities	Analyzing the article, performing small laboratory works, working with literature, independent learning and research
Practice	Laboratory work (manually and with the help of a computer program), participation in conferences, writing an article and thesis, involvement in a scientific project, preparation of course and diploma work, participation in research contests, Olympiads and conferences.

In order to form a student's research interest based on Astrophysics, it is necessary to awaken their cognitive interest. This interest will be further developed through actions by seeing and hearing. If the knowledge gained in theory is not applied in practice, it will be forgotten. Therefore, the knowledge obtained is used in practice and forms a research interest.

3.2. Experimental Section

To form student's research interest there were used the proposed methods in the course of experiments and set the goal of determining their effectiveness.

3.2.1. Our Hypothesis was Formed

During the study, we formulated the following hypotheses.

$H_{1:}$ The research interest of students in astrophysics is directly related to cognitive interest, since this gives the actualization of all representative systems of students.

$H_{2:}$ If teachers design action learning taking into account the motivational and sensory-cognitive components, then cognitive interest will be increased and stable.

3.3. Participants

The participants of the experiment were 114 Kazakh students, of which 69 were students of al-Farabi University and 45 were students of North Kazakhstan University. A total of 114 students from the control (CG) and experimental (EG) groups were included in the sample population. We carried out the quantitative characterization of the levels of formation of research interest in students according to three criteria: motivational, cognitive-activity, and reflexive. Therefore, the following diagnostic tools were taken:

1. Questionnaire of Ch.D. Spielberg (Modification of A.D. Andreev) "Diagnostics of Learning Motivation and Emotional Attitude to Learning" (motivational criterion) [21];
2. Diagnostic test works on an evaluation of such indicators as knowledge of the main types of text, as well as the knowledge of the structural parts of abstract, logical operations, stages of solving problems (cognitive criterion);
3. Methods of A.Z. Zack "Anagrams" and "Diagnosis of the Features of the Development of Search Planning" (reflexive criterion) [22].

There are indicators of interest level in which full research skills were developed. Three levels of development of these skills were identified: low, medium, high.

3.4. Low Level

Students show a research interest in Astrophysics and are interested in determining its results. However, this interest is not permanent. They perform research work only according to the plan proposed by a teacher. Students make mistakes during research work and correct them under the guidance of a teacher, working for a long time. They do not search independently and do not work with additional literature.

3.5. Medium Level

Students understand the need and importance of forming research interests; they are active in the learning process and know Astrophysics theoretically and perform research work with the help of their teacher. They can use the knowledge gained in Astrophysics only in situations they are accustomed to, but they find it difficult to apply it in new situations. However, they are less likely to develop their research interests and present proactive and creative research results.

3.6. Highlevel

Students can regularly and systematically conduct research activities, and their interest prevails. They independently understand the importance of research interest and demonstrate high activity and initiative in the implementation of research work. Their knowledge of Astrophysics is complete, stable, and allows them to apply it effectively in new situations. This level allows students to use their theoretical knowledge correctly in research work. Students can set specific goals, make decisions, and draw conclusions on a given task.

4. Results

The experimental results are presented in four sections. First, the construction of various measures included in the analyses is outlined. In the second section, the analysis of relationships between research interest in science and interest factors is presented. In the third section, the model of research interest formation is presented. In the final section, tables and histograms are created based on the survey results and analyzed accordingly. In addition, the processes that mediate the effects of interest on learning are described.

In this study, the formation of students research are observed. Various criteria for evaluating the learning outcomes are proposed in many literatures, one of the most important is the positive effectiveness of training and the time spent on its organization [23]. The criteria for evaluating the level of formation of research activity, proposed by science teachers were analyzed, as well as various opinions were considered. V.P. Bespalko in his work defines the criteria for evaluating the level of formation of research activities; ability to choose the right actions in performing educational tasks as the degree of automation of activities Bespalko [24]. Usova [25] considers it as a sequence of actions [26] and according to Nekipelova [27] it is the goal of research work and the level of scientific base of activity; the research plan and the level of implementation [27]. Curiosity arises when there is research activity. Interest in science is the driving force behind research.

Analyzing the works of these science teachers, the criteria were divided into the following stages, which allow us to unambiguously determine the effectiveness of the methodology for the formation of students' research interests:

- Criteria of cognitive interest in formation of students' research interest;
- Indicators of research interest and the level of scientific and theoretical knowledge in Astrophysics;
- Indicators of activity level of a full-fledged research interest.

Let's look individually at these recommended indicators:

The first indicator is a defining stage of cognitive interest, which includes indicators of the formation of students' research interest; it is motivation. To increase students' interest in Astrophysics, make excursions to the observatory and awaken their cognitive interest as a result of observing the planets and stars with a telescope. Curiosity motivates students, and it is a need, enthusiasm, responsibility, goal, and value attitude towards obtaining a quality education, independent search, and assimilation of new information for them.

The goal of motivation is the result of conscious actions of students.Motivationis defined as an interest and desire for effective action. Andreeva [21] offers a five-level typical characteristic of increasing the motivation to develop students' research activities (Table 2).

Table 2.
Levels of increasing students' motivation to form research interest (according to Andreeva [21].

Increasing the motivational component levels	Description
Very low	Students do not express a desire to carry out research works independently, to look for new concepts, phenomena, processes and explanations for the development of stars. They do not look for information on an obscure question or problem in the supplementary literature.
Low	Students often show a desire for reproductive activity and, with interest, complete tasks to study the features of the development of stars. There is a desire to independently explain new materials, concepts, phenomena, and processes, and to use additional literature, but without a system.
Medium	Motivation of students to develop research activities is noticeable, but not at a high level. Tasks for studying the development of stars are often carried out with the help of a teacher.
High	Students are highly motivated to develop research interest, independently perform tasks to study the features of the development of stars in the classroom and outside of school hours.
Very high	Students have a very high interest in research, they enthusiastically complete tasks to study the features of the development of stars of different levels with creative content.

With the help of observation method, the motivational component in the formation of students research interest is determined. That is, during a research work, observations are made of the motivational-emotional state of students, such as: interest in the process of action, joy, satisfaction. According to Shchukina [28] interest, student satisfaction and other measures of emotion control are described as indicators of cognitive interest [28].

The level of students' motivation to develop research interest was determined by monitoring the results of survey and analyzing the pre-experimental and post-experimental performance of students in the experimental groups. According to the results of a comparative analysis, the dynamics of increasing the motivation of students at the level of formation of research interest was revealed (Table 3, Figure 4). Survey questions are created on the basis of the work of science teacher V.I. Andreev.

Table 3.
Indicator of the motivational component of the method for forming students' research interests.

Levels	Before experiment		After experiment	
	CG	EG	CG	EG
Level 1 (very low)	14.5	14	11.5	3
Level 2 (low)	28.5	30	27	14
Level 3 (medium)	36.3	34	34	26
Level 4 (high)	16	18	19	33
Level 5 (very high)	4.7	4	8.5	24

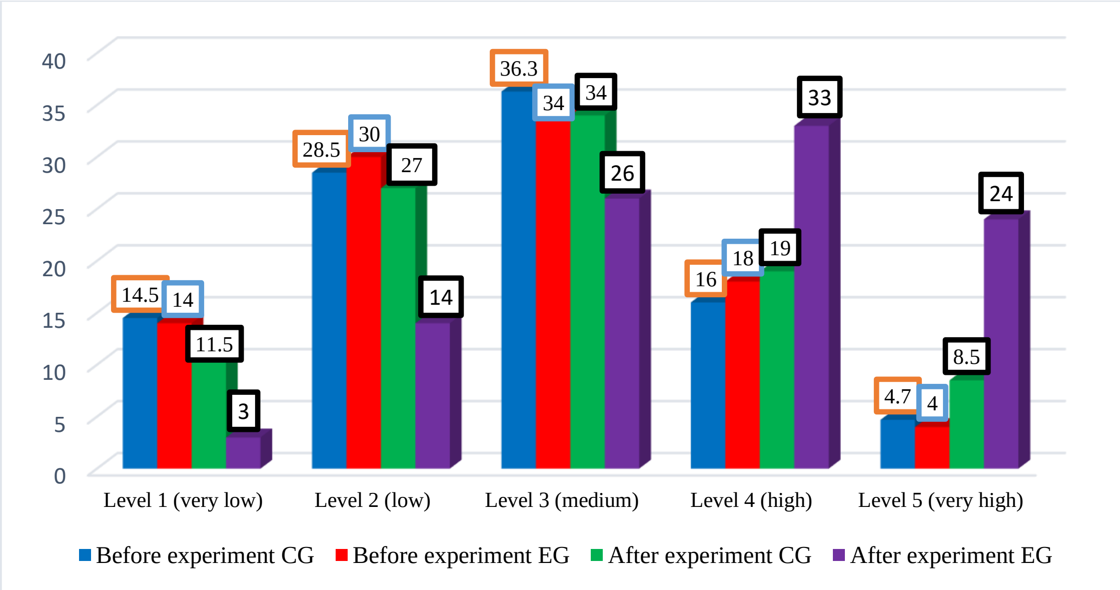

Figure 4.
Indicator of development level of motivational component of the methodology for students' research work formation (%).

This research work shows that the level of increasing students' motivation to form research interest increased in both groups after the experiment, however, there was found that there are percentage differences in growth rates. After the experiment, the number of students who showed a very high level of motivation for the need to form a research interest in order to gain deep knowledge and improve their skills in their future profession increased by 3.8% in the control group and by 20% in the experimental group.

The second indicator is the research interest of students, which describes the criteria of the scientific-theoretical level of knowledge about astronomical and physical features of stars and celestial objects based on the Astrophysics discipline. The component of the second criterion for the formation of research interest is the content component, characterized by the level of skill required for the subject and profession [29].

We have used the total coefficient to determine the indicator of acquired knowledge in researching examples of the physical features of the Sun. This coefficient indicates the completeness of knowledge acquisition due to the content component of research interest proposed by V.P. Bespalko [30] and was determined using the following formula based on the method:

$K(p) = n/N$

Here: n - is the amount of acquired astrophysical knowledge; N - is the amount of astrophysical knowledge required to be mastered by this time.

The level of knowledge that students should master, i.e. knowledge and skills about astronomical, astrophysical features, classification of stars, development, composition, practical significance and methods of their study, was determined by analysis, that is, based on the points scored so far in the content of the discipline of Fundamentals of Astrophysics and in the process of teaching the optional discipline of General Astronomy. The pre-experimental and post-experimental indicator of the development level of the methodology content component for forming the research interest of students (on the example of studying astronomical, astrophysical development features of stars) is shown in the form of a table and diagram in Table 4 and Figure 5.

Table 4.
Indicator of development level of the forming method of students' research interest by content component.

Levels	Before experiment				After experiment			
	CG		EG		CG		EG	
	Number of people	%	Number of people	%	Number of people	%	Number of people	%
Low	17	58	16	47	13	20.1	4	0
Medium	9	35.3	8	49	12	67.5	14	69.8
High	1	6.7	1	4	2	12.4	7	30.2

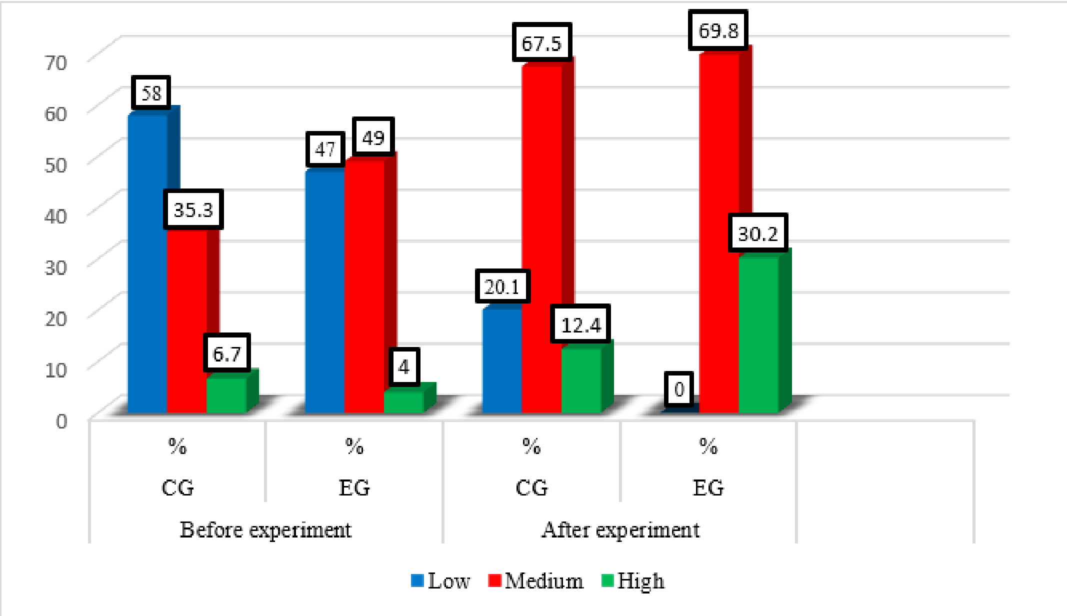

Figure 5.
Indicator of development level in terms of content component of the methodology for forming students' research interest.

On the basis of the established criteria and its components, three levels of formation of students' research interest were considered separately (Table 5):

Table 5.
Three levels of research interest formation.

Levels	Description
Low	Students have a research interest in Astrophysics and an interest in determining its results. However, this interest is not permanent. They perform research tasks only according to the plan proposed by a teacher. Moreover, students make mistakes in the course of research work and correct them under the guidance of a teacher, working for a long time, as well as they do not search independently, do not work with additional literature.
Medium	Students understand the need and importance of forming a research interest, actively participate in the educational process and know Astrophysics theoretically. They perform research tasks with the help of a teacher. However, they can use the knowledge gained in Astrophysics only in the situation they are used to, but they find it difficult to apply it in a new situation. In addition, they are less enthusiastic about developing their research interest and presenting proactive and creative research results.
High	Students are able to regularly and systematically conduct research activities, their interest prevails. They understand the importance of research interest on their own, as well as the y demonstrate high level of activity and initiative in performing research work. Knowledge of Astrophysics is complete, stable and students can effectively apply this knowledge in a new situation. This level allows students to correctly use their theoretical knowledge in performing research tasks. They are able to set specific goals, make decisions and draw conclusions on a given task.

As determined by the comparative indicator of development level of activity component of the methodology for forming students' research interest, after the experiment, it was found that the number of students who showed a high level of interest formation increased by 3.7% in the control group, and by 24% in the experimental group. Action learning methods used during the study gave positive results (Table 6, Figure 6).

In the course of the experiment, in order to continuously monitor the level of students' scientific interest methodology in the experimental groups, we conducted three monitoring sessions and compared the information. For this purpose, students were surveyed with special questions and assignments. The zero monitoring was conducted at the beginning of the experiment, and the primary indicator of the level of formation of scientific interest was determined.

Table 6.
Comparative (zero monitoring) indicator of the level of methodology of formation of scientific interest of students.

Groups	Number of people	Levels						OK	$K_{effective}$
		Low		Medium		High			
		Number of people	%	Number of people	%	Number of people	%		
CG	75	42	55	29	38.6	5	7	1.54	0.9
G	93	52	56	33	35	8	9	1.51	1.01

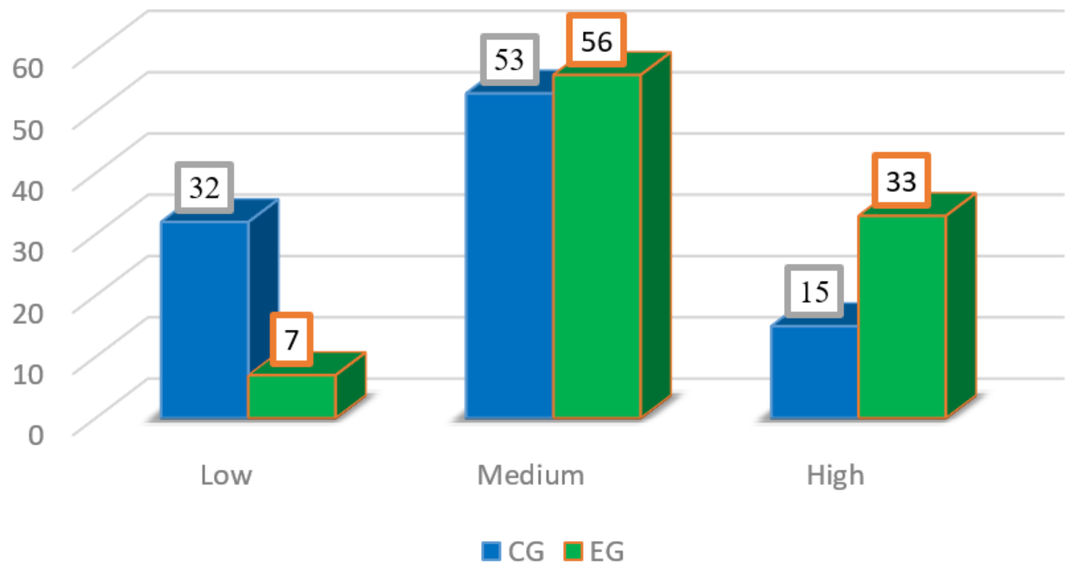

Figure 6.
Comparative (zero monitoring) indicator of the level of methodology of formation of scientific interest of students.

As a result of the observations, in both the experimental and observation groups of students at the beginning of the experiment, there is no significant difference in the levels of formation of scientific interest. As a result of determining the value of the indicator, which shows the level of effectiveness of the organization of the educational process in relation to the average indicator and scientific interest, there is no significant difference in the levels of students in the experimental and observation groups. Thus, it turns out that the qualitative indicators of both groups are the same. This result provided us with the opportunity to precisely define the further direction in the organization of the experimental experience. According to the content of the student method, as a result of the performance of assignments and research works for astrophysical research, we observed the level of formation and research interest of students. Students were repeatedly given tasks to determine the zero level, and during the experiment, we conducted the first monitoring and determined the indicators (Table 7, picture 7).

Table 7.
Comparative (first monitoring) indicator of the level of methodology of formation of scientific interest of students.

Groups	Number of people	Levels						OK	$K_{effective}$
		Low		Medium		High			
		Number of people	%	Number of people	%	Number of people	%		
CG	75	40	53	30	40	5	7	1.54	0.81
EG	93	36	39	44	47	13	14	1.89	1.22

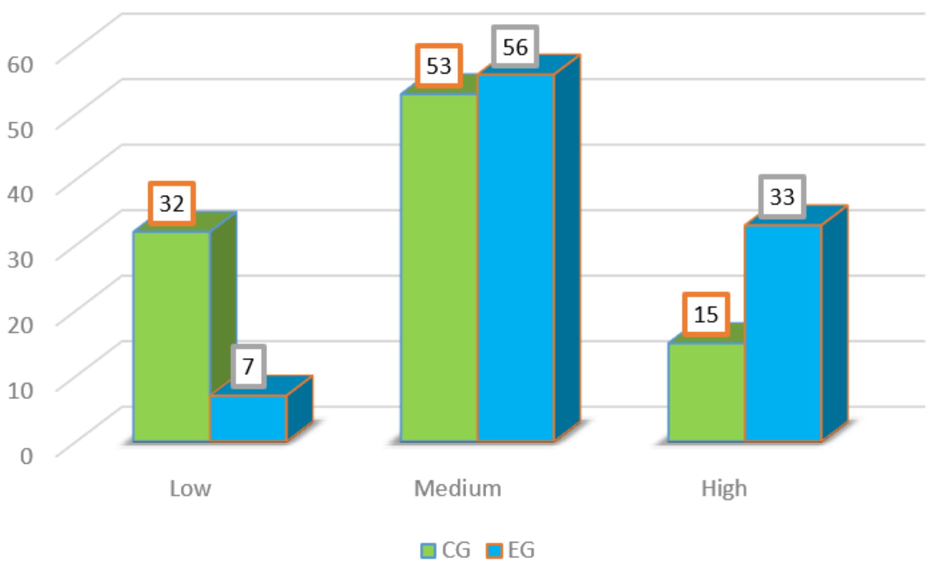

Figure 7.
Comparative (first monitoring) indicator of the level of methodology of formation of scientific interest of students.

Analyzing the indicators of the first control section, we found out how the level of formation of students' research interest changed in comparison with the indicators of the zero control section in the experimental and observation groups: in the experimental group (EG), the number of students with a high level of formation of research interest increased by 5.4%, while in the observation group (OG), the number of students at this level did not change. Due to the fact that the majority of students have risen to the average level, the number of students with a low level of formation of research interest increased in both groups. In the experimental group (EG), this increase was 11.6%, while in the observation group (OG), it increased by 1.4%. The number of students with a low level in EG was 17%, whereas in the observation group (OG), it decreased by 3%.

As a result of qualitative analysis, which was determined during the first control monitoring of the experiment, we found that in the experimental groups, compared to the observation group, the level of formation of research activity has increased.

At the end of the experiment, according to the methodology of formation of students' research interest, to determine the effectiveness of the formation of the learning process, the indicators of the second control monitoring were determined (Table 8, Figure 8).

Table 8.
Comparative (second monitoring) indicator of the level of methodology of formation of scientific interest of students.

Groups	Number of people	Levels						OK	$K_{effective}$
		Low		Medium		High			
		Number of people	%	Number of people	%	Number of people	%		
CG	75	24	32	40	53	11	15	1.83	0.48
EG	93	7	7.5	56	60	30	32.5	3.76	2.05

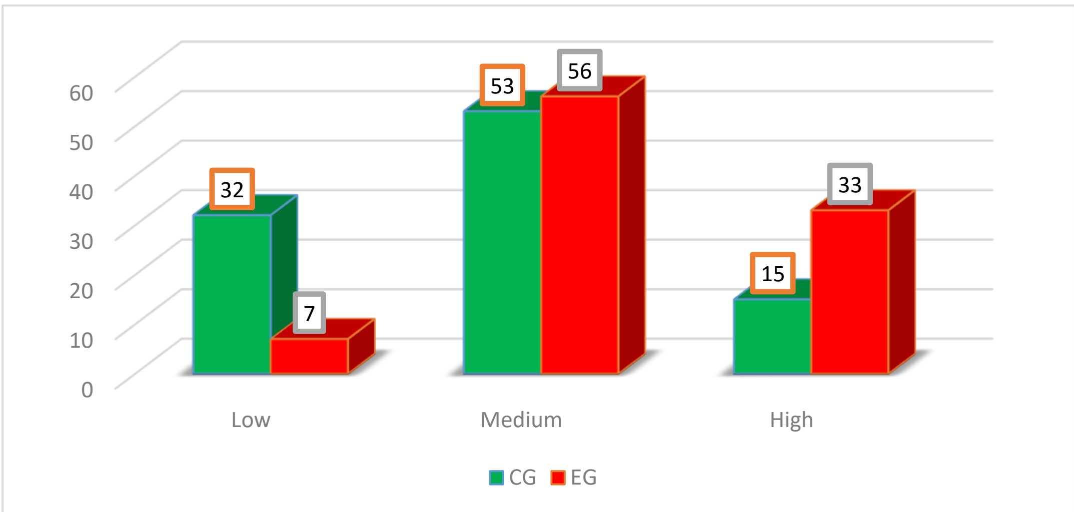

Figure 8.
Comparative (second monitoring) indicator of the level of methodology of formation of scientific interest of students.

According to the results of the indicators from the second control monitoring of the level of formation of research interest among students, there was an increase to a high level compared to the zero control monitoring. The number of students in the experimental group (EG) rose from 8.6% to 32.5%, while in the observation group, the number of students who reached a high level increased from 7% to 14.6%. In the experimental groups, the number of students with a low level of research interest development decreased by the end of the experimental experience. The results of the analysis of qualitative indicators from the final control prove the effectiveness of the methods we proposed for forming the research interest of students in the educational process.

5. Discussion

We clarified through assessment abilities to work on methods for researching works doing tasks to form researching interests by doing experiments. As a result of the interest component of the methodology, in determining the level of formation of research ability, we took as a basis the indicator that conscious connections are constantly formed in the process of interest of the ability, and based on this, the student should be able to successfully perform the given research tasks by effectively using research interest, and took into account when creating a survey to determine this indicator [31]. In determining the indicators of this criterion, we use V.A. Usova's postoperative analysis method [25]. The method of post-operational analysis allows to continuous monitoring of the implementation of traditional, algorithmic procedures of research interest during the performance of research tasks by students. We calculated the determination of the coefficient of stability of the acquired research ability as a result of the formation of research interest using the following formula:

$K= n/N$

where n - is the number of successfully implemented research interests; N - is in the algorithm of targeted research interest service number of actions.
As a result, the following indicator was determined (Table 9).

Table 9.
Indicator of formation of research qualification.

Levels	Coefficient of total formation of research qualification
High	$0.9<\kappa<1.0$
Medium	$0.8<\kappa<0.9$
Low	$0.7<\kappa<0.8$

As a result of the research interest formation method, which is purposefully planned to develop students' research interest, we have observed that the index of the coefficient of total formation of the acquired research ability has increased. In the course of this experiment, we conducted the experience using the traditional method with students in the observation group, while students in the experimental group utilized the method of action learning. As a result of the experiment with this method of action learning, we successfully developed the research interest of students. Thus, the effectiveness of this method was established.

Many works have been written about the formation of scientific interest in the students through practical training [32-34]. Students have shown better results in practical training, in applying the theoretical knowledge they have acquired in practice, than in traditional training [35-38].

It follows that, the indicators that allow to clearly show the effectiveness of the method of formation of research interest of students: Based on the results of the practical experiment conducted to determine the level of goal-motivational, content and interest components, the conclusion showed that the proposed methodical system has a high possibility to be used in the educational process.

5.1. During the period of practical-experimental control, the checking of the results of the research work was performed.

- For the control period, the tasks were placed:
- By the experiment, we analyze, generalize, compare, and process the given details;
- Checking the corresponding purpose and tasks of the research work.

The practical experiment work stage was organized and carried out in the actual learning process. In the course of this experiment, we aimed to determine the effective ways of forming students' research interest through action learning. Therefore, the dynamics of research interest formation were continuously monitored from the beginning to the end of the experiment. Eventually, the development levels of the students' knowledge and research interest in astrophysics and general astronomy in the experimental group were continuously monitored as the stages of students' research interest formation occurred. Such controls are necessary to analyze the level of education of the students participating in the experiment, the level of formation of research interest, and to continuously monitor the efficiency and the implementation of the experiment according to the forecast.

6. Conclusion

Therefore, in the given work, effective methods were used and compared with a traditional method, which involved dividing students into several groups. Studies were conducted using traditional methods for control groups and effective action learning methods for experimental groups. Consequently, the comparative results of the control and experimental groups showed significant indicators.

Even though the details of findings do not always concur, overall, they clearly indicate substantial differences between students' reported interest in the discipline, which are often operationalized by comparative ratings of experienced or expected interestingness.

A model of formation of research activities was created for the formation of research interest of students based on the Astrophysics discipline. Accordingly, the stages of formation of research interest were determined in the form of a table.

As a result of work on the first and second criteria, significant results were obtained. Based on the identified criteria and their constituent components, three levels of students' research interest formation were considered: low, middle, and high. In the control group, after the experiment, the low level decreased by 37.9%, the middle level increased by 31.7%, and the high level increased by 5.7%. There was a significant result in the experimental group; that is, after the experiment, the low level decreased by 47%, the middle level increased by 20.8%, and the high level increased by 17.8%. According to these indicators, it is proven that the research interest of students is forming.

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