ISSN: 0976-3104
ISSUE: Multidisciplinary Social Science & Management

ARTICLE

THE DEVELOPMENT OF COGNITIVE INTEREST OF HIGH SCHOOL STUDENTS IN THE PROCESS OF TEACHING GEOMETRY

Elena R. Sadykova*, Olga V. Razumova

N.I. Lobachevsky Institute of Mathematics and Mechanics, Kazan Federal University, 5 Kremlievskaia st., Kazan, RUSSIA

ABSTRACT

The urgency of the problem under investigation is due to the fact that the current situation in modern education poses one of the most important tasks for the school: the formation of a personality capable of effective and productive activity, who is ready to carry out a rapid search for solutions of various socially important situations. All this can require new approaches and techniques in the organization of the learning process, which are aimed at creating conditions where the student's personality is at the forefront. In this regard, the important problem in the complex of learning tasks, both in mathematics and in other disciplines, is the problem of developing the cognitive interest of students. The development of cognitive interest promotes the growth of a conscious attitude toward learning, the development of cognitive processes, the ability to manage them, and consciously regulate them. The problem of the development of cognitive interest has repeatedly become the subject of pedagogical and psychological research. Scientists from different positions determine cognitive interest, emphasizing the different facets of this phenomenon and mutually enrich it. The features of modern school education have determined the research problem: what are the means of developing the cognitive interest of high school students in the process of teaching geometry. Structural features of cognitive interest are considered in the article, means of development are defined, also formation levels of cognitive interest of high school students in the process of teaching geometry are revealed. In the study, the following methods were used: theoretical (analysis of philosophical, psychological and pedagogical literature on the research problem, study and generalization of mass and advanced pedagogical experience, pedagogical modeling); empirical (pedagogical observation, conversation, questioning, interviewing, testing).

KEY WORDS
cognitive interest, cognitive activity, levels of cognitive interest, stereometry, information technologies, electronic educational resources, polyhedral.

Received: 17 Aug 2019
Accepted: 10 Sept 2019
Published: 21 Sept 2019

***Corresponding Author**
Email:
sadikova_er@mail.ru
Tel.: 89172866617

INTRODUCTION

In the concept of the education modernization the main purpose is the preparation of a versatile personality who is capable of self-determination and self-realization, independent decision-making, and a reflexive analysis of one's own activity [11]. The task is not so much to increase the volume of knowledge, but rather to acquire a variety of experiences. As a result, there is a change in the methods and forms of organization of lessons, focuses on learning through practice, conditions are created where the pupil's personality, his capacity for self-expression and self-reliance are paramount. Priority is given to free access to information resources, self-study and research activities. The approaches to evaluation are changing: the evaluation procedure includes reflection, observation of students' activities. There is one way to achieve it is to form and develop students' cognitive interest.

At the present time, educators, psychologists and methodologists pay attention to children's cognitive interests and search activity, which play the role of valuable motives in the formation of personality [12], [22]. Cognitive interest is one of the most significant motives of the teaching. Theoretical and methodological substantiation of issues related to the development of students' cognitive interests is contained in the works of Dalinger et al. [5].

Changes in the content of education, in particular, and mathematical, require new methods, techniques, tools for the formation and development of students' cognitive interest [14].

The purpose of the investigation is the definition of effective means of developing the cognitive interest of high school students in the process of teaching geometry. The study is based on a number of important positions: native and foreign cognitive theories [18]; concepts of the teacher's personality formation [23]; concepts of the person-oriented approach to the organization of the pedagogical process [24]; modern concepts of mathematical education [25].

In this article the means of development of cognitive interest of students are experimentally tested: the use of research tasks in geometry and electronic resources in the study of the topic «Polyhedra». To reveal the levels of formation of students' cognitive interests a criterion-evaluation apparatus was used, including motivationally-demanding and effectual parameters.

MATERIALS AND METHODS

The solution of the tasks was carried out by the following methods:

Theoretical methods: study and analysis of philosophical, pedagogical and psychological scientific-methodical literature (analysis, systematization, classification, generalization and comparison);
Empirical methods: observation, questioning, testing, pedagogical experiment, methods of mathematical statistics.

IIOAB JOURNAL
ISSN: 0976-3104

The study was conducted with high school students of schools of the Republic of Tatarstan.

RESULTS AND DISCUSSION

Stages of development of cognitive interest and its structural features

A significant number of studies have been devoted to various aspects of the development of cognitive interest. At different times, the problem of the formation and development of cognitive interest was addressed by many researchers [1, 3, 4, 5, 7, 18, 20].

Cognitive interest is the interest in educational and cognitive activities. It is considered to be a powerful engine in learning. The presence of cognitive interest in the learning process is ensured by the self-executing counter process in the activity of the student, the effect of upbringing, development, and training is enhanced. Interest has long been regarded as an important motivational component in the study of mathematics. Cognitive interest is one of the most important motives of the teaching. In the general structure of the motivation for cognitive activity this motive is realized earlier than others by a student, who without hesitation can point to an interesting and uninteresting school subject or lesson.

Cognitive interest is the most important formation of a personality that is formed in the process of human life activity. It is formed in the social conditions of its existence and it is not inherent in a person from birth. Cognitive interest is the most important area of the general phenomenon of interest. Its subject is the most significant property of man: the cognition of the surrounding world not only for the purpose of biological and social orientation in reality, but for the most essential man's attitude to the world in the desire to penetrate into its diversity, reflect the essential sides, cause-effect relationships, patterns, contradictions in the consciousness [18].

Various researchers understand cognitive interest, as an individual's special selective focus on the process of cognition, the selective nature of which is expressed in one or another subject area [15]; the person's desire to pay attention to something and learn some objects and phenomena [8]; an individual's special attitude towards his objects, phenomena, processes around him and the world, which is filled with an active intention, strong emotions and aspirations [18]; emotionally colored need, which was at the stage of motivation and gave a fascinating character to the person's activity [10].

There are several stages in the development of cognitive interest: curiosity, inquisitiveness, cognitive interest, creative interest and theoretical interest.

Curiosity is the elementary stage of selectivity. According to Ananiev [1], this stage of interest is emotive, since its selective orientation also disappears along with the elimination of external causes. At the stage of curiosity, the pupil is content only with the orientation connected with the amusement of that or other subject, situation.

Inquisitiveness is a valuable state of personality. It is characterized by the person's desire to penetrate beyond what he has seen. At this stage of interest, there are quite strong expressions of emotions of surprise, joy of cognition, satisfaction with activity. Dobrynin [6] called this stage the significance of the action, the stimulation of curiosity by activity, when the difficulties cause a person to look for the reasons of failures and the way out of the situation that has arisen.

The activity itself becomes attractive to the student. Constant immersion in activity presupposes the possibility of independent work. The student becomes the subject of activity. From the level of inquisitiveness cognitive interest goes to a higher level of actual cognitive interest.

Cognitive interest in the way of its development is usually characterized by cognitive activity, a clear selective focus of educational subjects, a valuable motivation in which the main place is occupied by cognitive motives. This stage is characterized by the progressive movement of the cognitive activity of the student, the information search. An inquisitive student devotes free time to an object of cognitive interest and has fairly high achievements in the learning.

Creative interest is a level of cognitive interest, when the student seeks to carry out an independent, creative, search activity. This is, actually, a narrow interest in a particular branch of knowledge, turning into a professional interest. In different periods of life, a preferred level of development of cognitive interest can be singled out, although the transition from a lower level to a higher one is very individual.

Theoretical interest is associated both with the desire to cognize the complex theoretical issues and problems of a particular science, and with the use of them as an instrument of cognition. This stage is characterized by man's active influence on the world, on his reorganization, which is directly related to the person's worldview, with his beliefs in the power and capabilities of science. This stage characterizes not only the cognitive beginning in the structure of the personality, but also the person as a doer, subject, personality.

Analysis of the literature shows that in the process of learning cognitive interest is considered as: an incentive, a means of learning; motive of educational activity; stable personality trait. Cognitive interest

IIOAB JOURNAL
ISSN: 0976-3104

arises as an external means of activating of the student's cognitive activity. It is used by the teacher to attract involuntary attention. The presence of situational interest is a prerequisite for its further development. The most important prerequisite for the emergence of interest in the school subject is the personality of the teacher, the teacher and the student's relationship in the process of communication, the organization of the relationship between students at the lesson.

As a motive of learning, cognitive interest has a number of advantages over other motives, such as the motive for self-affirmation, the desire to be in the collective. According to sociological research students give the preference to this motive. It becomes meaningful and motivating for real actions. Therefore, cognitive interest should be considered not only as a means of learning, but also as the purpose of learning.

With the development of cognitive interest all aspects of the psyche develop: perception, thinking, memory, will, imagination. Cognitive interest manifests itself and develops in the process of the student's cognitive activity, in the process of development of thinking.

The highest manifestation of cognitive interest is the manifestation of it as a quality of personality. When cognitive interest interacts with the ways of behavior and different aspects of the personality, it becomes a character trait. This character trait determines the search, creative direction of any kind of cognitive activity, the desire to know the inner essence of the surrounding processes.

Measures of impact on the cognitive interest of this level are not to let it fade away, support cognitive activity at the highest possible level of difficulty, in the person's «zone of proximal development».

Considering the structural features of cognitive interest in mathematics, in geometry, scientists distinguish: cognitive interest in mathematics, cognitive activity, cognitive independence, educational-cognitive activity, educational activity, cognitive activity [3, 5, 7].

Means of development of students' cognitive interest in the process of teaching geometry

The development of cognitive interest promotes the growth of a conscious attitude toward learning, the development of cognitive processes, the ability to control them, and consciously regulate them.

Yakimanskaya [21] considers all the education in the form of a chain: «I want - I can - I carry out with interest - personally-significant to everyone» and she puts interest at the center of this construction. In fact, «everything is clear for the student when it's interesting». Therefore, in the process of teaching the teacher should use the basic means of developing interest in the subject, various forms of organization of educational and cognitive activities.

In such forms and means of the cognitive interest, extra-curricular work, elective courses, the use of entertaining tasks lessons of non-traditional forms (lesson-play, conference, integrated lesson, laboratory work) are considered. According to the teachers themselves, the students' development of cognitive interest is facilitated by the inclusion of students in search and research activities, the creation of problem situations, success situations, the use of a variety of teaching methods.

As the research has shown, one of the main means of developing of high school students' cognitive interest in the process of teaching geometry is the use of research tasks, as well as tasks that encourage students to the research activity. According to Klimenchenko [9], this is facilitated by the process of solving problems that require analysis of the condition and the drawing. Sukari [19] argues that the organization of the solution of such problems is carried out in the process of additional work on the task of comparing, comparing, contrasting tasks similar in one or another respect, and drawing up tasks mutually inverse to this. In problems of this type, students should identify the law, identify the hypothesis, analyze, draw an analogy, draw a conclusion.

Geometry has enormous potential for developing the cognitive interest of students with the use of research problems.

Another means of developing of cognitive interest in the teaching of geometry is information technology. Modern educational process is inconceivable without a combination of traditional teaching methods with the means of information and communication technologies. Internet technologies provide students with self-confidence, create more comfortable conditions for self-realization and creativity, increase motivation for learning and the circle of communication between schoolchildren and provide a great variety of educational resources. The use of electronic educational resources gives teachers the opportunity to explain a theoretical question more deeply, helps students to bottom into processes and phenomena, that could not be studied without the use of interactive models.

Experimental assay of the effectiveness of using research tasks and an electronic educational resource «EdgesN» in geometry lessons

We undertook a diagnostic examination of the existing state of the process of development of cognitive interest, as well as the real level of the formation of the cognitive interest of high school students. For this

IIOAB JOURNAL
ISSN: 0976-3104

purpose, an ascertaining (diagnosing) experiment was conducted with pupils of 11 classes. Experimental work covered 48 students. The preparatory stage of the experiment included: the study of the mathematics curriculum; conversations with teachers and students; development of criteria for measuring and assessing the level of formation of cognitive interest, according to the features of the study; selection of diagnostic tools; the development of questionnaires and assignments for students.

With the purpose of measuring and assessing the level of the formation of the students' cognitive interest, according to the structural features, the following criteria have been identified: motivationally-needful, which reflects readiness for the fulfillment of study assignments, conscientiousness of fulfillment, aspiration for independent activity; efficient - taking part in the discussions of the solution search, upholding the opinion, bilateral activity.

The next stage in the diagnostic examination was determination of formation levels of cognitive interest. The first level is the high level. The student is ready to fulfill the proposed assignments. He is ready to improve his personal level. He shows independence working with materials of the electronic resource. The student demonstrates bilateral activity on the actions of the teacher, he is involved in research activities. Also he takes part in finding solutions to problems. The second level is the medium level. The student shows interest in the proposed assignments, but it is difficult for him to perform them independently. He shows one-sided activity on the actions of the teacher. The third level is the low level. There is no readiness to fulfill the proposed assignments. The student hasn't a conscious approach to fulfillment, a desire for independence, an increase in his personal level. He does not show interest in the studied topics. To study the first component, the methods of questioning and quiz are used. Measurement and evaluation of the efficient component required the use of methods of included observation, as well as students' solutions of research problems on the topic «Polyhedra».

The effectiveness of the experimental work was checked by a comparative analysis of the results of the initial and final diagnostics of the formation level of students' cognitive interest. To ensure the reliability of the diagnostics results, a sample was done to ensure the representativeness of the study-the correspondence of characteristics, which was obtained as a result of selective study, to indicators characterizing the entire complex.

As a result, two groups of pupils of 11 grades were formed - a control and an experimental group based on Kazan Gymnasium No. 75 (24 students in each groups).

The results of the initial diagnosis showed that a high level of cognitive interest was demonstrated by 2 people in the control group, 1 in the experimental group; the average level - 8 people in the control group, 8 - in the experimental group, and the low level - 29 people (14 and 15).

At the next stage, as a means of developing cognitive interest, we used research tasks in geometry, as well as an electronic resource - the author's site «Edges N» (http://zemfiraharisova.wixsite.com/mnogogranniki), developed on the basis of the public platform «Wix». The resource was developed in the classes on the method of solving problems in elementary mathematics with third-year students Kazan Federal University, N.I. Lobachevsky Institute of Mathematics and Mechanics.

At the stage of using research problems in geometry, students were offered tasks of various types. The tasks of the first type are the tasks of formulating the consequences, the proofs, the finding of regularities, the construction, the finding of missing elements, the task of determining the form of the geometric figure. To problems of the second type we have singled out problems whose falsity of statements is obvious and it is necessary to find an error in the proof; tasks in which the student independently establishes the truth, both statements and his evidence. The wording of such problems can be as follows: a) the problem of detecting errors (find the error in solving the problem of computation, find the error in proving the problem, determine whether the statement is true); b) the task of evaluating the process and the result (whether the problem is rationally solved, whether the problem is solved correctly). For example, students were asked to find an error in proving theorems on the topic «Polyhedra» (conclusions of formulas for the volumes of polyhedra, areas of lateral surfaces of polyhedra).

The tasks of the third type are tasks for planning and developing the goals of the activity, for rational use of time and means of activity. The formulation of tasks for activity planning can be as follows: how (to find, build, prove), if (condition); make a plan for solving the problem. For example, to formulate the goal of the problem: is it possible to calculate the volume of a regular quadrilateral pyramid if elements are known (different sets of pyramid elements are proposed: the dihedral angle between the lateral faces, the side of the base). To problems of the fourth type, we proposed problems in the formulation of which it was proposed: to divide the problem into subtasks, to distribute the solution of subtasks among themselves; solve the problem in the indicated (different) ways and choose the most rational; consider different cases of mutual arrangement of figures. For example, students were asked to prove in several ways that in a rectangular parallelepiped the square of the diagonal is equal to the sum of the squares of its three dimensions. When solving this type of problem, students used both algebraic and vector methods.

To identify the formation of the motivational-need component at this stage, we used observation maps, which were compiled during the work [16].

IIOAB JOURNAL
ISSN: 0976-3104

At the next stage of the experimental work for the students of grades 10-11, the electronic resource «Edges N» was proposed. This resource is intended for students of 10-11 grades. The presented materials enable students to compare the different authors' formulations of definitions and theorems of school geometry textbooks [2], [13], [17], understand their essence, contribute to the formation and development of such qualities as intellectual receptivity and the ability to assimilate new information, flexibility and independence of logical thinking. The resource also contains a practical component. Pupils were offered to study the topics «Prism», «Pyramid» as the homework assignments and draw up a summary using the materials of the site, solve problems on the topics under consideration independently. Homework was performed by all students, no one had any difficulties using the resource. According to the students' opinions, this work aroused greater interest than work with the textbook. After studying the theory, the students were offered geometric tasks from the Unified State Examination. Working with the materials of the site, the students themselves decided that they were interested and relevant at the moment.

Diagnostics of the formation level of students' cognitive interest was carried out after the completion of the second stage, when the students mastered the program of studies. So, after the measures, a high formation level of cognitive interest was demonstrated in the control group of 2 people, in the experimental group - 4 people; the average level - in the control group - 10 people, in the experimental - 13 people, and the low level - 12 and 7 pupils.

In the process of experimental work we can note the positive dynamics of development of students' cognitive interest.

The study allowed us to draw the following conclusions: starting diagnostics showed a clear predominance in the learning process of the geometry of students in 11 grades with a low level of cognitive interest (62.5% in the experimental groups and 58.3% in the control groups). As a result of the experimental activities the number of students with a low level of formation decreased in the control groups on average from 58.3% to 50%, in the experimental groups from 62.5% to 29.2%. The number of high school students with high and medium levels of cognitive interest has increased. In the experimental groups: a high level - from 4.2% to 16.6%, the average level - from 33.3% to 54.2%. In the control groups: a high level - from 8.4% to 28.3%, the average level- 33.3% to 41.7%.

CONCLUSIONS

Diagnostic examination of the development of students' cognitive interest in the process of teaching geometry has shown the need for organization of purposeful, systematic and consistent work. The results obtained in the course of purposeful work have shown that the formation level of students' cognitive interest meets modern education requirements. The students demonstrated their readiness to fulfill the proposed non-standard and research tasks, aspiration to improve their personal level. They showed independence working with the materials of the site, bilateral activity on the teacher's actions, took part in finding solutions of problems. The materials of the article can be useful for practical professional activities of higher education institutions and secondary school teachers.

CONFLICT OF INTEREST

There is no conflict of interest.

ACKNOWLEDGEMENTS

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

FINANCIAL DISCLOSURE

None.

REFERENCES

[1] Ananiev BG. [1959] Cognitive needs and interests. Scientific notes of Leningrad State University. Psychology. 16(265):342.
[2] Atanasyan LS. [2010] Geometry. Grades 10-11: basic and profile levels. Moscow: Prosveshchenie. 255.
[3] Bogdanova M. [2017] Cognitive science: from multi disciplinarity to interdisciplinarity. International Journal of Cognitive Research in Science, Engineering and Education. 5(2):145-150.
[4] Carmichael C, Callingham R, Watt HMG. [2017] Classroom motivational environment influences on emotional and cognitive dimensions of student interest in mathematics. 3(1):449-460.
[5] Dalinger VA. [2011] Students' cognitive interest and its development in the process of teaching mathematics Bulletin of the Vyatka State Humanitarian University. 3(1):131-137.
[6] Dobrynin NF. [1970] Psychology. Moscow: Uchpedgiz. 256.
[7] Fridman LM. [1998] Theoretical Foundations of the Methodology of Mathematics Teaching. Moscow: Publishing house Flint. 224. doi:10.12973/eurasia.2017.00727a.
[8] Gonobolin FN. [1973] The Psychology. Moscow: Publishing House Prosveschenie. 340.
[9] Klimenchenko DV. [1972] To bring up research skills. Mathematics at school. 3:26-27.
[10] Kharlamov IF. [1999] Pedagogics. Moscow: Gardariki. 520.
[11] Kulikova VA. [2010] Formation of students' cognitive interest in mathematics (from work experience) Education and science. 6:132-142.
[12] List, Alexandra. [2017] Cognitive Affective Engagement Model of Multiple Source Use. Educational Psychologist. 52(3):182-199.
[13] Pogorelov AV. [2014] Geometry. Grades 10-11: basic and profile levels. Moscow: Prosveshchenie. 175.

[14] Razumova OV, Sadykova ER, Yarullin IF. [2017] Modern educational technologies in vocational training of the future teacher of mathematics. Revista Publicando. 4(13):419-428.
[15] Rubinstein SL. [2000] Fundamentals of General psychology St Petersburg. Publishing house Piter. 712.
[16] Savenkov AI. [2006] Psychological foundations of the research approach to learning. Moscow: Axis. 89:480. doi: 10.4236/ce.2012.31001.
[17] Sharygin IF. [2013] Mathematics: algebra and the beginning of mathematical analysis geometry. A basic level 10-11 grades: textbook. Moscow: Drofa. 236.
[18] Shchukina GI. [1988] Pedagogical problems of formation of students' cognitive interests Moscow: Pedagogika. 208.
[19] Sukari AI. [1999] Methodical bases of teaching mathematics in the secondary school with the use of creative thinking. Novosibirsk. 430.
[20] Vinogradova LV. [2005] The method of teaching mathematics in secondary school. textbook Rostov-on-Don: Phoenix. 252. doi: 10.2307/3608542.
[21] Yakimanskaya IS, Wilson, Patricia S, Davis, Edward J. [1990] The Development of Spatial Thinking in Schoolchildren Softcover, Natl Council of Teachers of. 235.
[22] Zhakupova Y, Dolgova VI, Kryzhanovskaya NV, Kondratieva OA, Kapitanets EG. [2017] Gifted adolescents: Special qualities of the cognitive activities' motivational component. Espacios. 38(40):45. doi: 10.1177/001698620404800304.
[23] Ibragimova EM. [2002] Continuous pedagogical training of future teachers: theoretical and experimental study. Kazan: Publishing house.
[24] von Eye A. [2010] Developing the person-oriented approach: theory and methods of analysis. Dev Psychopathol, 22(2):277-285.
[25] Lange D. [1996] Using and Applying Mathematics in Education. in "Kluwer International Handbooks of Education", 4:49-97, Springer, Dordrecht, doi.org/10.1007/978-94-009-1465-0_3