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INDICATORS TO ESTABLISH A FORMED COGNITIVE INTEREST IN MATHEMATICS BY DEVELOPING PROJECTS

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Abstract. In this paper we examine the concept of interest and its stages of development. Special attention is paid to cognitive interest, its shows and the necessary conditions for its formation. Formulated and systematized are the indicators for establishing cognitive interest in mathematics, achieved by project activity. Considered are some results of project work in 21st Secondary School Hristo Botev, Sofia in the context of these indicators.

Key words: interest, cognitive interest, indicators to establish
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1. Introduction

Interest is a complex psychological phenomenon. It covers mind, will and feelings. Many famous psychologists have worked over it and therefore it has many interpretations. We will stick to the given by Rubinstein [8] definition: "Interest is selective targeting of a person, of his attention, thoughts and intentions". It is about focusing on the objects and phenomena surrounding us. This orientation is characterized by a constant quest for knowledge, to explore and study a subject closer and deeper. The interest of an individual depends on its socio-historical and individual development. They are too diverse. They can be classified in several directions: content, focus on strength, connection, level of activity.

2. Stages in the development of interest

• **Curiosity** – elementary stage of orientation. It shows the desire to know new things.

• **Enjoyable** – striving to penetrate beyond the visible. Typical for this stage are emotions, amazement and joy of knowledge

• **Cognitive interest** – It is a selective targeting of individuals, turning to the field of knowledge, to its physical side and to the process of acquiring knowledge

Cognitive interest

A characteristic feature of cognitive interest is an acquaintance of the causal relationships. The interest is directed not only to the contents of a teaching material and to the overall activities and to resolve problems. In the process of development, cognitive interest became the basis for a positive attitude towards learning. Cognitive interest is searching by character, and the search activity in the student is formed willingly, with emotional uplift, with the joy of success.

Interest in mathematics is expressed in the desire for learning, creating skills for acquiring knowledge, finding evidence and solving problems. The thoughtful interest inspires the students to pose questions and seek their answers. It provokes them to find connections of mathematics with other objects and phenomena in the world to clarify the application of mathematics in other sciences and the reality that surrounds us. On the basis of this intense activity is achieved synergy in education [4].

The cognitive interest influences positively not only the process and results of operations, but also the ongoing mental processes - thinking, imagination, memory, attention. As a result of the cognitive interest recent mental activities receive special activity and tendency. The cognitive interest is one of the most important reasons for learning. It can become resistant traits of the personality and can influence its development. So in the learning process is necessary to initiate, develop and strengthen cognitive interest in the students. It is aimed not only to the process of learning but also to its outcome. This is related to the ambition towards realizing the goal to the overcoming the difficulties and to willing tensions and effort. “Development of interest is a process, continually following the individual characteristics of age and cognition” [2, 41]. It affects positively the cognitive activity. It is wrong, however, to be identified only with activities. Not every purposeful and persistent activity of a human being occurs with interest. In that case, the leading motive is essential.

Some researchers equate the terms “cognitive interest” and “intellectual interest”. We will stick to the notion that the term “cognitive interest” is not synonymous with “intellectual interest”. “Intellectual interest” includes a mostly intellectual processes. “Cognitive interest” is a broader concept. In addition it includes intellectual processes and elements of practical activities related to the concept. The cognitive interest is a combination of intellectual, volitional and emotional mental processes that contribute to the organization, conduct and completion of work. Thus, in a kind of cognitive interests interact all the most important manifestations of personality.

Manifestations:

Intellectual Manifestations:

- Active Search
- Guess
- Research approach
- Willingness to solve problems

Emotional events:

- Amazement
- Anticipation of new
- Sense of intellectual pleasure
- Sense of success

The interest is aroused by a new, interesting, unknown curriculum material. It generates imagination and amazes the students. Astonishment is a strong incentive for knowledge, its primary element. When amazed, a man seeks to look ahead. He is in a state of expectation of something new. But the cognitive interests can not at all times to maintain with a bright facts and its attractiveness cannot be confined to astonished and raised imagination. The students should be able to see in the familiar and already known something new. All major events in the life become customary for children from birth must acquire a new sound in the learning process.

Volitional acts:

- Initiative for search and detection
- Self-learning
- Placing and development of cognitive tasks

3. Necessary conditions for the formation of the cognitive interest

1. Active mental activity of the students

Home base for the development of cognitive interest are situations actively searching, reasoning, mental tension, contradiction of judgments, taking position and expression and protection of their own opinion, collision of certain positions.

2. Conducting education process of the optimal development of students.

In Vygotsky's theory [3] to the zone of proximal development of the child is stated that students are able on the basis of their expertise, individually and creatively, and in some situations with little help to reach new ones. The teacher trains the students many skills and habits - skills for self-use of literature, a systematic study of the material to analyse and summarize the separation of major and minor, to build a logical response to the presentation of evidence, etc. These summarized skills are a basis on the complex emotional processes. The latest create ways of cognitive activities that allow for different conditions to use knowledge and of the base on old ones, to get new ones. The path of generalization, examination and discovery of regularities, which are subject to visible phenomena and processes, is a way that contributes to the development of students in the highest degree [9]. This condition provides strengthening, deepening and development of cognitive interest.

3. Emotional atmosphere of communication.

Atmosphere conducive to learning helps those experiences that make each person desire to be better. It is this desire of the pupil - to rise above reached, validate their own sense of dignity, brings satisfaction on success creates a mood in which to work faster and more productively. "Sometimes emotions impart crucial meaning"[6]. Creating a favourable emotional atmosphere for cognitive activity is an essential condition for the formation of cognitive interest. "The emotional experiences that occur in the course of our communication with students, often create a common emotional background of relationships, influencing the whole process of joint activity" [5, 43]. Favourable emotional atmosphere of communication was related primarily to two sources - business and communication. These sources are not isolated, but intertwined in the learning process. They give rise to multiciphered relationships and create a tone of personal mood of the student. In this way they have a different influence of cognitive activity and interest in knowledge.

Ways to form cognitive interest:

- Actual content of the subject;
- Organizing cognitive activity of students.

Marin Andreev consider in [1] optimum premises about attitude to learning. As that optimum premises he shows:

1. On the one hand the scientific knowledge that produce the curiosity of students, and on the other - the ability of the teacher to establish appropriate for this situation.

2. The practical utility of scientific knowledge
3. The desire of students to overcome the difficulties and trials of their own forces and the resulting emotions it.
4. The collective nature of educational activities in school, that creating a conducive atmosphere and determine the desire to occupy an appropriate place in the minds of others.
5. Pride
6. Successful coping with learning tasks stimulating further participation in training.
7. Fair evaluation of the knowledge, achievements and input labour.

Indicators

In the course of ten years working on projects with the students we arrived at empirically by the following

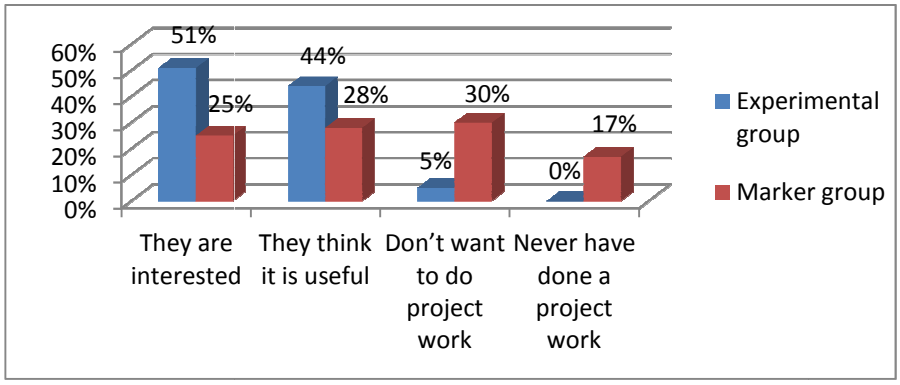
Indicators to establish a cognitive interest in mathematics

Actions that characterize the cognitive activity of students	**Emotional events**	**Indicators revealing resistance and strength of the cognitive interest**
Participation in development projects (with a desire or indifference)	Expressions (exclamations Bravo!, Super!, Cool! show a sense of pride from the established product)	Participation in compulsory elective, optional and extracurricular activities in mathematics, competitions and Olympiads
Treatment of students to the project activity (engaged or unconcerned)	Adequate responses to what is happening: laugh at humour, flashes of anger, joy, disappointment, etc.	Spend leisure
Voluntary participation in discussions (participation with desire, activity at presentation)	Specific emotional consequences - silence on submission; congratulations upon presentation; wishes, emotional exclamations, etc.	Literature that students read (mathematical journals, collections and other mathematical literature)

Issues that students address the teacher (range, depth)		Entrance examination in mathematics to university
Participation in the evaluation by the evaluation cards (how they are completed - formal or dedication)		Entrance examination for subjects which are related thematically to the developed Projects
Quality of the development project (the result of the task) - depth, originality, etc.		Creation of scientific interest in mathematics
Variety of products of the activity of the students - math projects, films, essays, stories, pictures and more.		Durability of the memory of the projects development

Development of projects in mathematics is a powerful tool for the formation and development of cognitive interest in students. In 21st Secondary School Hristo Botev, Sofia students of upper classes develop projects in mathematics as extracurricular activities, than more 10 years. In other paper ([7]) we consider the stages in developing of projects at upper classes – Introduction (8. grade), Trial and Error (9. grade), Basic (10. grade), Advanced (11. and 12. grade). **100%** of the students at the stages Trial and Error and Basic develop mathematical projects with a willingness. At 11. and 12. grades the young people choose in which sphere will continue their studies and focus mainly on the forces it. Although not all oriented towards science related to mathematics, most of those on Advanced stage continue to develop projects. We inquire 64 students from 12. grade, who are taught by the projects metod. **51%** say they develop projects because they are interesting. 44% of surveyed students develop projects because they believe that their activity is necessary and useful. Only 5% of students do not want to develop projects.

To compare the results obtained inquire and 84 students in upper not trained in methods of the project and some of them never developed project. Results in the control groups were as follows: 25% of respondents said interest, **28,6%** believe that this activity is beneficial, **29,8%** do not want to deal with this and **16,7 %** can not comment because, they are never developed project.



While developing projects, the young people spend much of their free time to research mathematical literature. Some of the students are subscribed to mathematical journals. They read magazines and books from the school library. Many young people find information on the Internet. **87%** of the surveyed students use the Internet to find information needed for their classes, and 90% – to search for information to develop projects.

Projects developed by students are varied and feature high quality. Products of students' work are purely mathematical projects applying information technologies; they have created stories, essays and poems, pictures and movies. Amateur movies with presentations of projects can be seen on YouTube at the following addresses:

http://www.youtube.com/watch?v=h2NT7t_SOCo&feature=related
http://www.youtube.com/watch?v=NozTx2_q9pE
http://www.youtube.com/watch?v=BNLBbq52YVU&feature=related

Products of the work of young people are also lessons conducted with younger students. It is studied in depth educational or additional material. In some cases, the chosen themes are related to the upcoming candidate student examinations. Often they are offer innovative solutions to make generalizations. In the course of work the young people pose questions, seek answers, to overcome obstacles. Many works have research elements. Top-performing projects in class conferences, participate in school mathematics conference. Some of the projects participate in national competitions and conferences: sessions of Students Institute of Mathematics and Informatics, competition MITE – Informatics and Design, "Young Talents".

The school and class conferences pass with high interest. The students vigorously debate projects, raise questions, give advice, share opinion and experience. They are willing and with interest participate in the evaluation of each project, fill evaluation card.

On the place for expressing opinions sometimes there are detailed comments: “The theme of the project is very intriguing and enough fascinating and entertaining served. Girls, I know how hard it is to imagine something that you have done in front of so many people, each of which is staring at you. Do not be afraid to speak loudly and clearly, as if you are explaining lesson to your closest friend. Smile and have fun! This is your starry moment, no matter how hard you think it is. Be yourself, stand at the board and speak with a clear and unpretentious tone. So what you say acquires new meaning and becomes even more interesting. Well done and good luck!” (Lia Kojuharova)

Other time they give advices: “Keep calm on the presentation! You need to interest audience rather than to present monotone. Make larger drawings and reduce the text on the slides.”

Sometimes there are emotional reactions to various projects: “Cool!” (Viktoria Dilkova), “I like it!” (Violeta Stoilova). “She made it interesting but not attractive and did not attract attention. It is clear that she has worked hard, but obviously it seems she can do better” (Djulia Vihrijska). “Very good performance! She held her audience throughout” (Maria Pancheva).

Some people make recommendations related to the technical side. In one project Iliana Kristeva offers: “Put on some music during the written part of the project. Thus the project will become more dynamic”. Ilian Georgiev advices the girls of the team to smile more and to talk higher and slower. For young people music is an important element in the presentation of projects. Sarah Stoilova gives advice on improving the final product on music: “The music is not suitable. You should grab with it the audience, not to make it sleep!”

They make observations. “Do not talk to each other while presenting the project” (Rozeta Nikolova), “Better preparation for the presentation” (Kristin Dimitrova), “She must be more serious, to focus on the project while she is presenting” (Inna Todorinova).

Considering the observations completed in the Evaluation card, we find that most of the students respond emotionally and put all their heart and soul in the evaluation of the proposed projects.

The work on a given subject influences the young people a lot. If they are asked later on what mathematical topics they liked the most in their training during the current year, the students will always indicate the topic that they have worked on.

The development of projects in mathematics creates constructive atmosphere and is a good prerequisite for the development and expression of potential possibility of the students. With their activity the young people feel different, more significant and satisfied with their achievements. So within the school was founded a little mathematical society. This mathematical society is the core, formed a

mathematical club "Sigma". The students – club members feel involved in a microenvironment, which creates a comfort to them, gives them confidence and self esteem. Common interests, mutual respect, seeking to grow and improve gather them together. Membership in the club is voluntary and desirable. In its development the club invariably includes students who are proud of their participation in it. Graduates attend the activities of the club, meet new members and converse with them, and participate in school conferences as members of the jury.

The work in a mathematical club provokes young people and about 50% of them choose obligatory elective mathematics at 11^{th} and 12^{th} grade. This speaks about durability and stability to built interest in mathematics. Subsequently, many of them apply to a university with exam in mathematics. In 2010 50% of graduates of languages classes taught by developing projects were accepted into a university by exam in mathematics. This result, compared with the results of those same children, accepted in 8^{th} grade of 21 Secondary School Hristo Botev five years ago, without any special interests and mediocre assessment in math, shows the enormous progress in the development of young people. It is the same only to 27% of Class 2009, students who have not developed projects in mathematics.

Some of the directions in which young people continue their education, are thematically related to development projects. Lora Karakoleva teaches interior design at the University of Forestry, Sofia. One of her development project was the subject "Powers of engineering and architecture in building skyscrapers". Georgi Ivanov developed several mathematical projects, including "Application of progression in other sciences", mathematical game "Become a rich person - become a mathematician", "Fibonacci numbers". Currently, George is a student at the Technical University – Sofia. Katerina Doikova is a student at Sofia University. She studies at the Faculty of Preschool and Primary School Education. When she was a schoolgirl, along with math projects, she developed and delivered in the second grade lesson on the topic of "Shorthand text tasks". We can give many other examples.

In some cases the development of projects is an activity close to the research. The contact with this kind of work leaves lasting traces in young people. Some of them, who have touched the process of research, remain for a lifetime captivated by the scientific discovery, and choose the scientific work as their job. This is the case with Victor Doychinov who chose science as his vocation.

4. Conclusion

Development of projects in mathematics in high school forms and develops high cognitive activity, sustainable and lasting cognitive interest. The activity gives burst of strong emotional events, leaving a lasting impression in the minds of the young people.

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ПОКАЗАТЕЛИ ЗА УСТАНОВЯВАНЕ НА ФОРМИРАН ПОЗНАВАТЕЛЕН ИНТЕРЕС КЪМ МАТЕМАТИКАТА ЧРЕЗ РАЗРАБОТВАНЕ НА ПРОЕКТИ

Иванка Марашева – Делинова

Резюме. В настоящата работа се разглежда понятието интерес и стадиите в развитието му. Специално място се отделя на познавателен интерес, неговите прояви и необходимите условия за формирането му. Формулирани и систематизирани са показатели за установяване на познавателен интерес към математиката, постигнат чрез проектна дейност. Разгледани са някои резултати от работата по проекти в горен курс на 21 СОУ „Христо Ботев", София в контекста на посочените показатели.