ПЛОВДИВСКИ УНИВЕРСИТЕТ "ПАИСИЙ ХИЛЕНДАРСКИ", БЪЛГАРИЯ
НАУЧНИ ТРУДОВЕ, ТОМ 39, КН. 3, 2012 – МАТЕМАТИКА
PLOVDIV UNIVERSITY "PAISSII HILENDARSKI", BULGARIA
SCIENTIFIC WORKS, VOL. 39, BOOK 3, 2012 – MATHEMATICS

REFLECTION AND COMPREHENSION IN INFORMATION TECHNOLOGY EDUCATION

Kosta Garov, Elena Todorova

Abstract. In this paper is revealed the relation between the processes comprehension and reflection and their realization in Information Technology education in school. Examples and problems are given from the topics "Computer Graphics", "Computer Presentations" and "Computer Text Editing" from the school subject Information Technology which show the relation between reflection and comprehension.

Key words: reflection, comprehension, knowledge, skills, competences, education, information technology, computer graphics, computer presentations, computer text editing.

Mathematics Subject Classification 2000: 97D20, 97D40, 97C30, 97C90.

The dynamic development of Informatics and Information Technology over the last years is a reasonable circumstance for the development of the methodology of Informatics and Information Technology education where several methodological areas are still underdeveloped. This is also valid for the basic learning activities in the mandatory course of the school subject Information Technology. Systematizing and describing the basic learning activities of students and teachers in the Information Technology classes can be used as a strategy in the education and will allow the teachers to foresee what will happen in the learning process, how the students will take in the subject matter and what activity it will evoke in them. There are different classifications of the learning activities in education. Professor Sava Grozdev in 0, determines as basic the following learning activities: listening, remembering and comprehending. The most important among these activities is comprehension and in this paper we will attempt to reveal the relation between

reflection and comprehension of the subject matter in the school subject Information Technology.

In scientific psychological and pedagogical literature an important place is reserved for the processes comprehension and reflection, having in mind assimilating the means of the learning activities and their individual understanding for each student.

Forming skills for realizing reflection from students and teachers is an important task for the school education in all stages and through all school subjects. The reasons for this perception are to be found in the multiple manifestations and developing potential of reflection in the education process such as thinking procedure, cognitively directed (and realized) towards self-recognition. It stimulates the student's intellectual growth, enhances their personal potential and provides for their fuller realization. The reflection creates for a young person condition for individual self-developing, self-educating and self-perfecting.

In their studies different scientists 0, 0, 0 tell their opinion on the term comprehension. One point of emphasis is that if in the thinking process the end goal is creating "meaning" and the respective achievement of comprehension, the comprehension of the subject's own comprehension takes place in a different reflective contour.

From the viewpoint of cognitive psychology comprehension is treated as a subjective phenomenon. Different models were developed that explain the mechanisms for realizing comprehension mainly on written material. The accent is placed on developing the relation between schemes (the cognitive scheme is a summarized form of storing experience gained in a certain subject area) and the structure of the subject of comprehension (text, problem, situation).

Summarizing the beliefs of Russian psychologists, R. Stamatov and L. Alekseeva present comprehension as a psychological phenomenon accompanied by cognitive schemes and thought frames existing in the mind, as a process in which the subject takes "a certain cognitive position towards some text" and constructs meaning 0.

We will differentiate the processes comprehension and reflection. It is known that comprehension is aimed towards the contents of the specific object (text, activity, phenomenon) and constructs its meaning. The subject of reflection is the thought frame and the schemes that build it. Their realization is achieved via another non-reflective in the new context thought frame. The act of comprehension occurs in a non-reflective way but after its comprehension there could be reflection which will provide the realization and assessment of comprehension. It is said that each act of

reflection is an act of comprehension and understanding. But while the latter is possible without reflection, reflection cannot occur without comprehension 0.

We will point out that reflection generally includes other processes such as self-comprehension and comprehending the others, self-assessment and assessing the others, self-interpretation and interpreting the others, etc.

The relation between the processes comprehension and reflection can be linked with problems about functioning and development of the scientific knowledge in the context of education and school education.

According to L. Desev comprehension is "relating the term subject matter with what is known, including something new in the system of available, already built associations, in the structure of the thought process; making connections between different areas of knowledge, between objects and knowledge about them" 0. It is a process of extracting meaning (interpreting, forming and operationalizing meaning) and going deeper in the semantics of a certain material.

R. Mavrova and D. Boykina think that a favorable condition for realizing a certain knowledge from the students is comprehending the subject matter which will allow for developing and activating their thinking and abilities 0.

On the problem of comprehension there are papers from R. Mavrova and P. Petrov who say that "Comprehension is a component of thinking like a summarized accompanying reflection of significant functions, relations, associations. Comprehending the intermediate results from the thought process is a condition for activating thinking. On the other hand, comprehension is achieved by unfolding thinking. In that sense, they mutually complement each other." 0.

It is well known that in comprehension there is realization and acquisition of ready messages while thinking leads to new knowledge and making new conclusions.

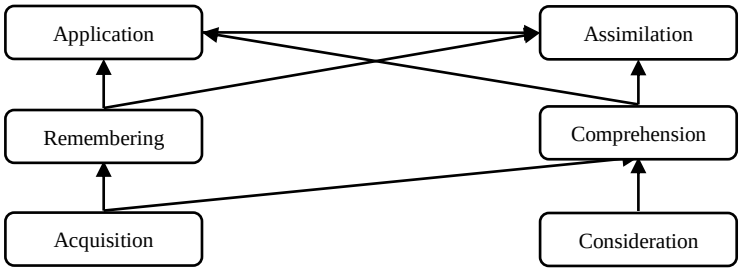
Comprehension is related to analytical-synthetic activity which is directed towards understanding available information which the learner can receive from the teacher, from the book, from the internet. The way in which this information is presented from the teacher is vital for comprehension. Information Technology education is carried out mainly on a practical (technological) basis. But when there is a necessity for a lesson for new knowledge entirely in a lecture form, the teacher has to provide active phases during which the students share their knowledge or opinion on the subject matter.

In IT education new theoretic information is acquired as well as practical skills for its application. The specific character of the subject matter suggests the finer specifics of the process comprehension. For instance, formulating problems, ideas and the stages for their solutions.

Comprehending the IT subject matter is realized in the students' ability to represent it in their own words, to apply the acquired knowledge in practical problems using a computer or in similar conditions. It is considered that a student understands a problem and its solution if they can answer aptly posed questions 0, e.g.: "What software has to be chosen for the solution of a given problem?", "What operations need to be executed and why?", "How can they be executed?", "Why can they be executed like that?", "Can they be executed in a different way?", "Why can they be executed in that way?", "Which is the more rational way?", etc.

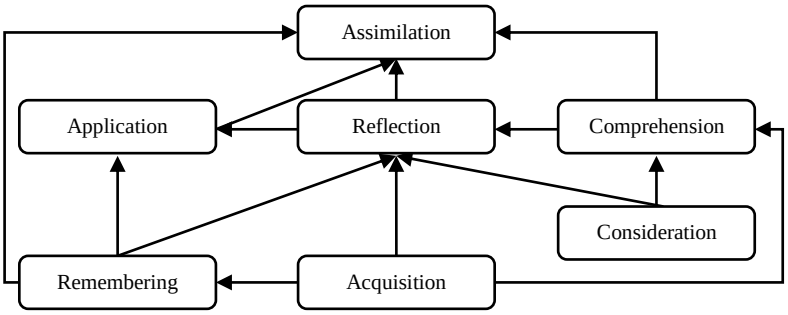
According to A. Linkov "the relation education-reflection is not direct. It is accompanied by the activity (as a form) and by comprehension (as contents). The power of reflection is increased by the richness of the learning activity and the constant shift from non-comprehension towards comprehension." 0

The relation between reflection and comprehension is illustrated by M. Georgieva in 0. She explains the relation education-reflection and displays it in scheme 1., where comprehension is in the basis of assimilation.



Scheme 1. Schematic model for the order of psychological processes preceding assimilation

Reflection is related with comprehension and consideration which can occur without it but it cannot be realized without them 0, and reflection itself is in the basis of application and assimilation of knowledge and skills, as well as in forming reflective abilities. This relation is illustrated in scheme 2.

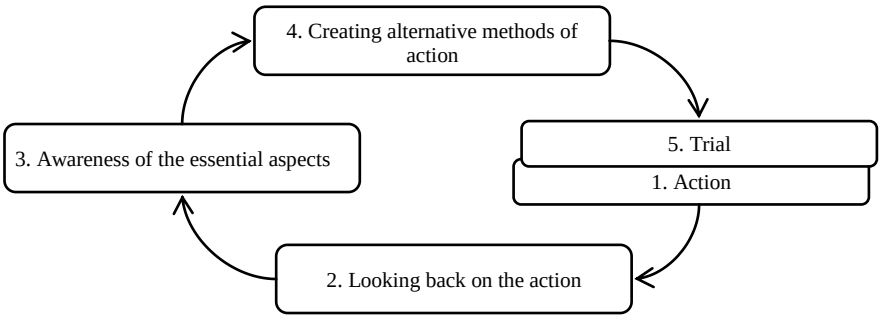


Scheme 2. Schematic model for the position of reflection among the psychological processes preceding comprehension.

We consider that in Information Technology education reflection is one of the most important mechanisms for stimulating the students' mental and cognitive abilities. Comprehending abstract knowledge in IT is tightly connected to reflection. "In the act of comprehension reflection is revealed as a process which provides for the transition from non-comprehension towards comprehension. Reflection is the organization of the activity of the conscience (self-conscience) which tries to define the meaning of its existence, the possibilities for realizing its own subjectiveness. Thus, reflection appears as a means for contemplating the transition in the different types of comprehension." 0, and comprehension is in the basis of acquiring and applying the Information Technology knowledge.

The learning activity as a form of development of the students' theoretical conscience and thinking is studied by V. Davidov 0. According to him reflection is defined as a characteristic of theoretical thinking, a method of skills for learning and a means for self-alteration and development of the student's personality.

In IT education the computer is notable by being at the same time the object and the means for teaching. The computer is a mediator in the dialog between the communicating software and the learner, and the teaching itself is done mainly on a practical basis. In this way studying skills are formed through experience. The latter is closely related to the students' skills for exercising reflection, i.e. deliberating upon the activity they completed. One possibility for making reflection is using the ALACT model suggested by the Dutch Professor in Pedagogics Franz Korthagen. In this model the process of reflection goes through five phases in one cycle.



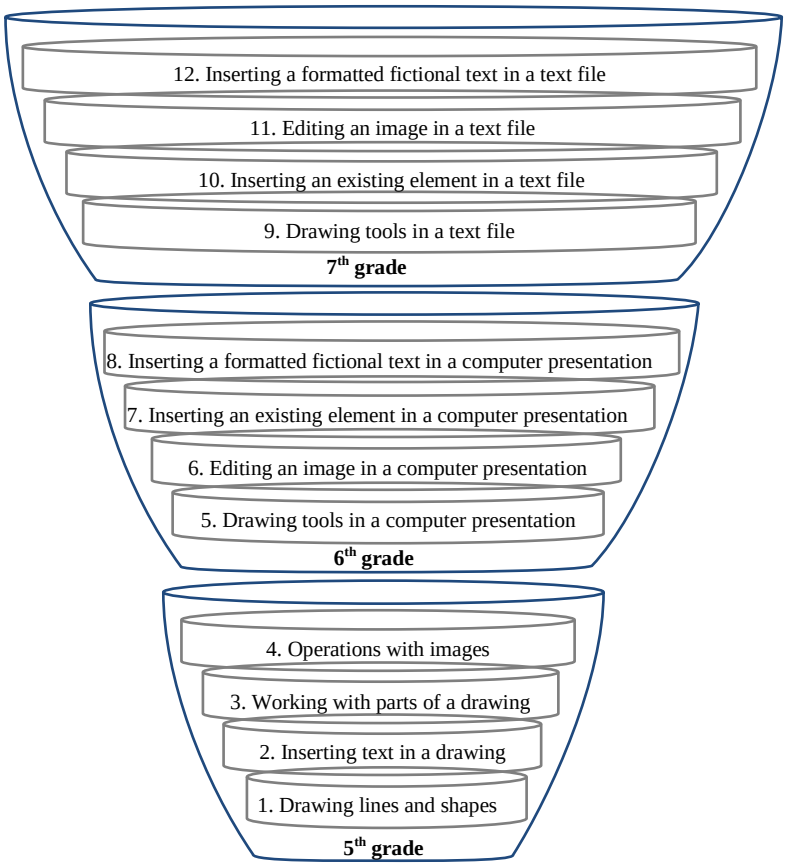
Scheme 3. The ALACT model.

Forming skills for performing reflection from the students in studying the topics "Computer Text Editing", "Computer Tables" and "Computer Presentations", we clarify in papers 0, 0, 0. In the ALACT model in phase 2 (see scheme 3), the teacher discusses with the students the way to solve the posed problem (making a computer file). The teacher helps the students reach the answers of questions that are posed, such as: "What do we want to do?", "Which information technology are we going to use?", "What operations need to be performed?", "How can they be performed?", "In how many ways can they be performed, from what has been studied so far?", etc. The posed questions and the opportunity that the students have to answer them provide for achieving reflection, and the way they answer these questions shows whether they understood the subject matter, i.e. to what extent the process comprehension has occurred. With the help of the ALACT model in Information Technology education the processes comprehension and reflection are realized in the topics studied during the Information Technology classes, which find a wide variety of practical applications.

In this paper we will share our experience on using a sample system of problems for working with graphical elements from the 5^{th} to 7^{th} grades which will help not only forming abilities for achieving reflection but also some competences in students such as digital and mathematic competence. In the 5th grade the students acquire knowledge and form abilities for working with graphical editors which they can use to draw graphical images, and in the 6^{th} and 7^{th} grades – knowledge and abilities for working with graphical elements in computer presentations and computer text editing. Studying Information Technology as early as the 5th grade as a compulsory subject creates the conditions for realizing reflection.

In figure 4 we show a system of subtopics for working with graphical elements from 5^{th} to 7^{th} grades using different informational systems. The system of problems

is developed in such a way that each following activity that is taught to the students builds upon the preceding.



Scheme 4.

In 5th grade the students learn how to work with a graphical editor. Skills are formed for drawing lines or polygons made up of straight lines with the help of the tools: line, curve, polygon, as well as skills for working with specialized tools for drawing closed shapes with one move – rectangle, ellipse, triangle, etc. After the formation of this knowledge and skills, the students were posed the problem of drawing a triangle, a square and a rectangle using the tools line, polygon, rectangle and triangle. The resulting shapes they saved as a graphical image that was later

used for forming skills for inserting text in an image where each student labeled the already drawn geometrical shapes shown in figure 1.

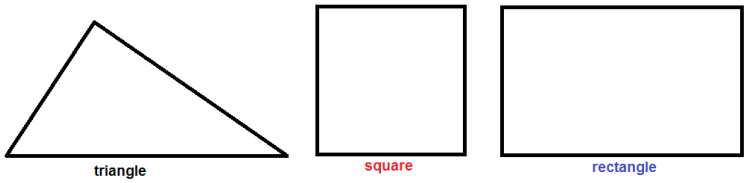


Figure 1.

For homework we posed the problem to draw more complex shapes like: snowflake, flower and star using the instruments line, curve and polygon.

After forming skills for drawing lines and closed shapes the students were posed the problem from the geometric shapes triangle, square or rectangle to make new shapes using additional constructions or removing parts of the given. One solution of the posed problems by a student is shown in figure 2.

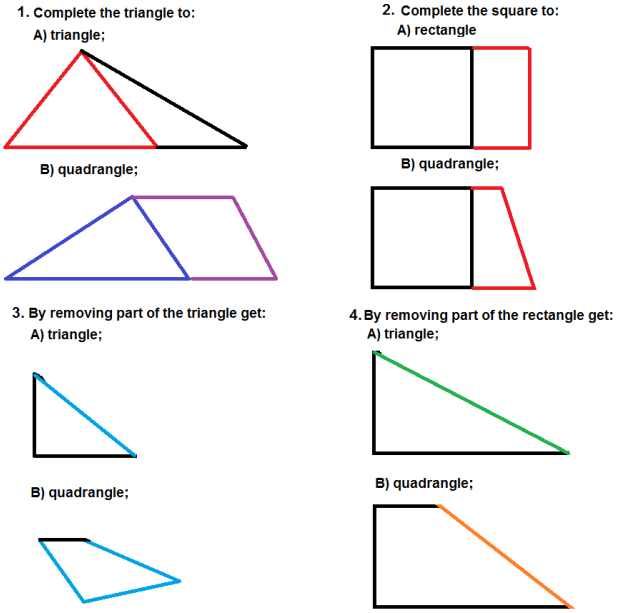


Figure 2.

For homework the students were given the following problem: Based on the graphical image that was created earlier containing the shapes triangle, square and rectangle, shown in figure 1, to introduce a clause from a problem "In the figure, determine the type and number of the resulting shapes." and using one, two or three straight lines to divide the shapes in such a way that they answer the posed clause. The created files were exchanged among students for completing the problems, one of the given solutions is shown in figure 3.

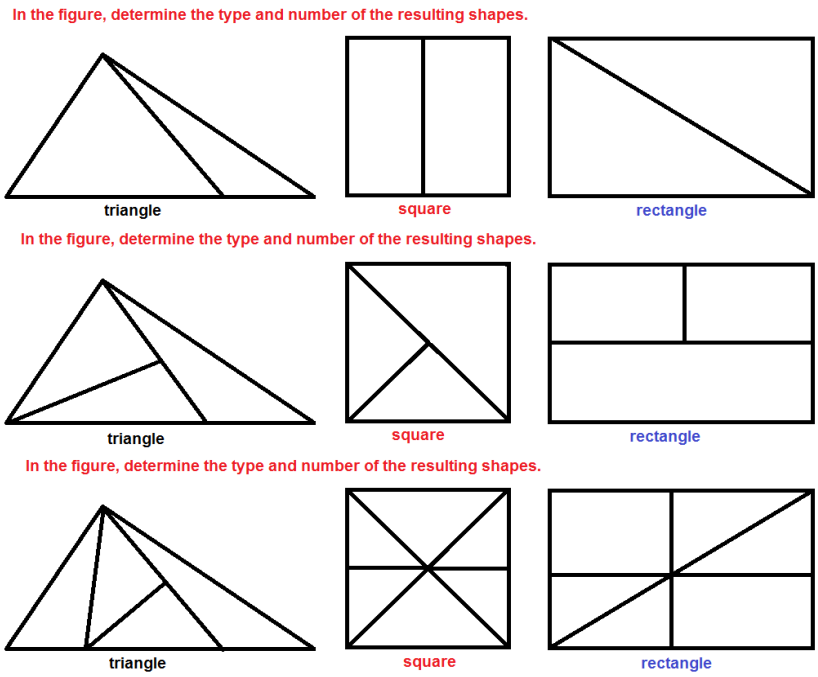


Figure 3.

Each student assessed their own solution and the solution of one of their peers by assessing not only the skills for working with a computer but also some personal qualities like imagination (in creating the problem), awareness, independency.

The next knowledge and skills that the students acquire are for working with parts of a drawing – rectangular or free marking, transparent and non-transparent moving, copying, cutting and pasting. To refine the students' skills a problem was posed to make shapes according to a given model, one of which is shown in figure 4,

by using the technique of copy-paste. After executing the problem, a discussion was held and each student illustrated their shapes and the means for creating them.

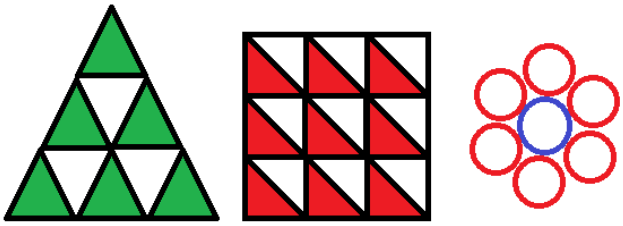


Figure 4.

Apart from these skills, the students acquire knowledge and skills for rotating a selection to 90^{o} to the left and right and to 180^{o}, vertical and horizontal flip and transforming a selection. For exercise, the students were given the problem by using the operations for flipping and the technique for moving to obtain a picture from the given parts – jigsaw puzzles.

For diversifying the students' activity we divided the class into teams and each team was given one of the following problems: obtaining separate parts of a picture of their choice by using the instruments for marking and the operations for flipping, to draw a picture made up of geometric shapes on a topic of their choice using the learned instruments and techniques. These problems they prepared alone at home and one leader chosen from each team presented the realization of the posed problems during the following class.

In the 6th grade the students are presented the opportunity to learn how to draw graphical elements in a computer presentation on the basis of the formed skills for working with graphical editors in grade 5. Here the students are placed in a new information media which allows reflection to take place. Each one of them had to make a computer presentation on the already created problems in grade 5 and make new problems, on the basis of acquired knowledge and skills in grade 6, for drawing graphical elements inside a computer presentation. For homework, after dividing the class into teams, a problem was given to make a presentation on one of the topics: types of triangles according to sides and angles; finding the perimeter and surface area of a triangle, position of the point of intersection of altitudes in a triangle. In figures 5 and 6 are shown presentations from two of the teams that chose the respective topics.

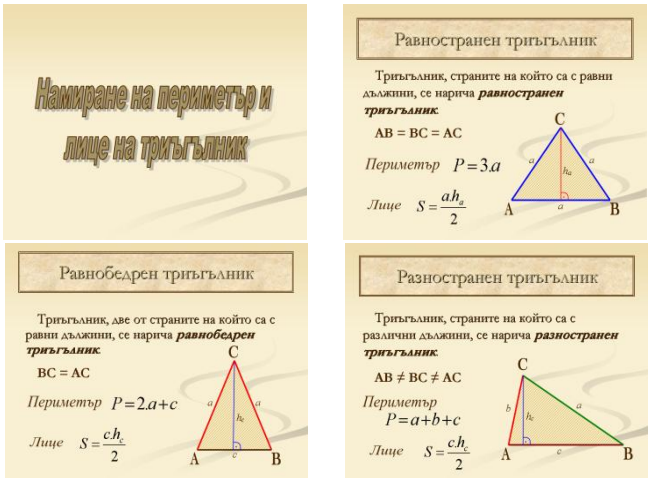


Figure 5.

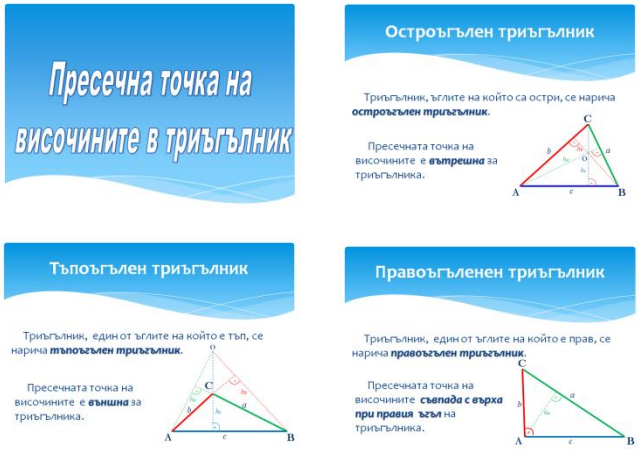


Figure 6.

In the 7th grade, i.e. in the third stage of education, the students have the conditions for acquiring knowledge and skills to insert graphical elements in a text file. After acquiring this knowledge and skills, the teams were posed the problem to look for and present information on one of the topics: finding the surface area and volume of solids and conditions for congruence of triangles. They prepared a text file on the respective topic as well as a presentation and each of the teams presented on paper the text file and the presentation on the topic.

In the process of learning the students form different competences related to finding and collecting information, skills for working alone and decisiveness, as well as displaying reflection.

As a conclusion of the system of knowledge from the 5th to 7th grade, in the last class the students were posed the problem to find and study problems given on competitions and Olympiads from the 5th to 7th grades whose clauses contain geometric shapes. After the research, the students had to make a text file and computer presentation containing the clauses of the problems in Bulgarian and English, diagrams and solutions. In figure 7 are shown the text file and part of a presentation of one of the teams.

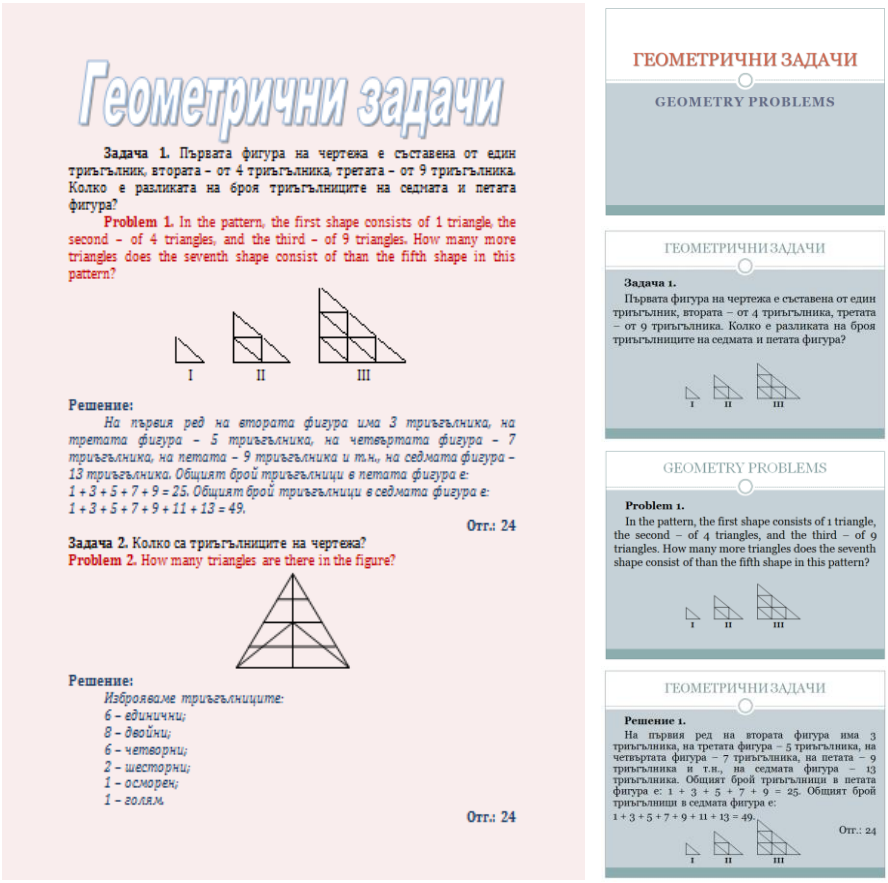


Figure 7.

In solving the problems we always went through the phases of the ALACT model for achieving reflection. Our main goal was to meaningfully educate the students to apply reflection in their education. Besides, going through the phase "Looking back on the action" we aimed to pose the questions in such a way that we would find out how far and to what extent the process comprehension is realized with the help of the posed problems.

References

[1] ALEKSEEV, I., Reflection and comprehension in science and philosophy, *Problems of reflection in scientific education, Kuybishev, Kuybishevskiy gosudarstvenniy universitet*, 1983, p. 41-45.

[2] DAVIDOV, V., *Problems of developmental education: experience in theoretical and experimental psychological studies*, Moscow, Pedagogy, 1986.

[3] DESEV, L., *Pedagogical psychology*, Sofia, "Aksoni-izdat", 1996, p. 498.

[4] GAROV, K., AND E. TODOROVA, On reflection in Information Technology education, *Collection of papers during the jubilee international conference "Synergy and reflection in Mathematics education"*, 2010, p. 398-408.

[5] GAROV, K., AND E. TODOROVA, Reflection in studying electronic tables school, *Proceedings of the Anniversary International Conference "Research and Education in Mathematics, Informatics and their Applications"*, 2010, p. 427-434.

[6] GEORGIEVA, M., Reflection in Mathematics education V-VI grades, *Veliko Tarnovo, Feber*, 2001, p. 199.

[7] GROZDEV, S., For High Achievements in Mathematics, *The Bulgarian Experience (Theory and Practice)*, Sofia, Association for the Development of Education, 2007, 295 pages.

[8] LINKOV, A., Reflection and comprehension – didactical problems, *Scientific papers of PU "Paisii Hilendarski"*, Vol. 27, Book 2, Part 2, Pedagogy and psychology, 1990, p. 83-88.

[9] MAVROVA, R., AND D. BOYKINA, *Contemporary problems of the methodology of Mathematics education – activity, independency, creativity*, Plovdiv, OI "Paisii Hilendarski", 2012, p. 154.

[10] MAVROVA, R., AND P. PETROV, Comprehension of the subject matter in Mathematics – condition for activating the students' thinking, *Scientific papers of PU "Paisii Hilendarski"*, Vol. 39, Book 2, Methodology of education, 2002, p. 33-40.

[11] PORTEV, L., AND N. NIKOLOV, *Methodology in Mathematics education*, Plovdiv, PU "Paisii Hilendarski", 1987, p. 340.

[12] STAMATOV, R., AND L. ALEKSEEVA, Models of reflection in the process of development. Reflection, activity, culture, *Scientific papers of PU "Paisii Hilendarski"*, Vol. 27, Book 2, Part 2, Pedagogy and psychology, 1990, p. 27-32.

[13] TODOROVA, E., AND K. GAROV, Reflection in studying "Computer presentations" in school, *Collection of papers during the IV national conference "Education in the information society"*, 2011, p. 286-292.

Faculty of Mathematics and Informatics
University of Plovdiv
236 Bulgaria Blvd.,
4003 Plovdiv, Bulgaria
e-mail: **kosgar@uni-plovdiv.bg**
eli_tod@abv.bg

Received 28 November 2012

РЕФЛЕКСИЯ И РАЗБИРАНЕ В ОБУЧЕНИЕТО ПО ИНФОРМАЦИОННИ ТЕХНОЛОГИИ

Коста Гъров, Елена Тодорова

Резюме. В настоящата статия се разкрива връзката, която съществува между процесите разбиране и рефлексия и реализирането им в обучението по информационни технологии в училище. Показани са примери и задачи от темите „Компютърна графика", „Компютърни презентации" и „Компютърна текстообработка" от учебната дисциплина „Информационни технологии", с които се показва връзката между рефлексия и разбиране.