Tuijin Jishu/Journal of Propulsion Technology
ISSN: 1001-4055
Vol. 45 No. 1 (2024)

Application of the Idea of Fusionism in a Study of Geometry Course

Gulnora Goyibnazarova
Associate Professor, Department of Mathematics and Physics at Alfraganus University

Abstract: - This article is devoted to the application of the idea of fusionism in teaching geometry. A fusionist approach to the presentation of a school geometry course. Stages of primary school students mastering geometric material. The idea of fusionism is the formation of ideas about the shape and relative position of figures, familiarization with regular polyhedra and regular polygons in a school geometry course.

Keywords: *fusionism, teaching geometry, stages of development, geometric figures, images of figures, planimetry, stereometry.*

1. Introduction

The term fusionism comes from the Latin word fusio - fusion. This is what they called joint teaching of various school subjects, for example, physics and mathematics, chemistry and biology, in the 19th century. Fusionism was also called the combined teaching of several divisions of mathematics: algebra and geometry; geometry and arithmetic; finally, planimetry and stereometry.

2. Objectives

The idea of fusionism in geometry is very attractive, non-standard in relation to the traditional established system of sequential presentation of the course of geometry from planimetry to stereometry, which dates back to Euclid's Elements. Many scientists speak about the fusionist approach to the presentation of a school geometry course as one of the effective ones. The list of these scientists include V.A. Gusev, P.M. Erdniev, G. Freudenthal, N.S. Podkhodova, G.A. Klekovkin, N.E. .Maryukova, B.P.Erdniev.

In particular, B.P. Erdniev rightly states in his article: "It is didactically advisable, already in elementary school, to invite students to simultaneously observe pairs of objects: a sphere and a circle, remembering that in the ontogenesis of thinking it was the "volumetric" that preceded the "flat", that the most instructive part in geometry is the derivation of the planimetric from the stereometric"

The main objectives of teaching geometry in secondary schools are:

1) study of spatial forms;

2) development of spatial imagination;

3) teaching of correct logical thinking;

4) instilling practical skills, including the ability to solve various geometric problems of a theoretical nature, and the ability to apply one's knowledge to solving practical issues

The structure of the geometry course itself is also important. This question includes many specific questions, such as:

1) Correspondence of the school geometry course to the age characteristics of students. How should a geometry course be structured so that the material presented is accessible to schoolchildren of both junior and senior grades; so that it contributes to the development of their personality?

2) How can studying a geometry course help students' polytechnic education?

3) How to increase the scientific value of the course? This question is closely related to clarifying the possibility of increasing the rigor of the deductive presentation of the course, with geometric transformations and elements of Lobachevsky's geometry.

4) How to build a geometry course so that it is possible to ensure the strength and systematicity of students' knowledge and create the best conditions for the development of their spatial imagination?

Other questions immediately arise. Namely:

a) Should a geometry course be structured concentrically? What should be the overall structure of the course?

b) What is valuable in introducing students to axiomatic methods? How is it advisable to get acquainted with this method?

c) A similar question arises about geometric transformations in a high school geometry course.

d) Is it necessary to introduce students to the elements of Lobachevsky's geometry and how to do this?

e) Is fusionism necessary and to what extent, or is it advisable to completely separate planimetry from stereometry?

f) Should trigonometric functions be used in a geometry course? What does this give?

And other questions.

3. Methods

Currently, the school systematic geometry course is divided into planimetry and stereometry.

This division in some respects cannot but be considered convenient: it allows a poorly prepared student to deal with simpler issues of "flat" geometry at first, which facilitates the assimilation of the material and prepares for the study of more complex issues of the course - issues of stereometry. This division is to some extent due to the influence of tradition: "like Euclid."

The current clear division into planimetry and stereometry is one of the reasons for the weak development of students' spatial imagination.

Modern teaching experience shows that most children are physiologically and psychologically not ready to perceive geometry in an axiomatic presentation. Many of them do not understand the true purpose of axioms, and to overload a textbook with axioms, as well as cumbersome theorems, so that children memorize without understanding them, means scaring students away from mathematics, destroying their positive curiosity caused by external effects. Of course, in a school geometry course there should be some axioms and theorems, but their presentation should be accessible to all students. Most importantly, a school geometry course should initially be spatial; its construction should take into account all the pedagogical experience accumulated by humanity over many centuries.

For example, primary school students' mastery of geometric material can be carried out in three stages.

At the first stage, students become familiar with:

- with examples of volumetric figures - polyhedra (cube, parallelepiped and pyramid), ball, sphere;
- with examples of flat figures - square, triangle, rectangle, circle;
- with the concepts of "length and its measurement";
- with the relative position of a point and a line, two straight lines, two rays, two circles;
- with symmetry.

The study of this material is carried out through students' direct perception of specific objects, material models of geometric bodies, and drawings of figures.

At the second stage, students improve their skills in graphically depicting figures. They learn the rules for constructing figures (triangle, square, regular hexagon, mutually perpendicular lines, right angles) using a compass and ruler, and the rules for depicting volumetric figures (cube, parallelepiped, pyramid, sphere). The stock of knowledge students have about three-dimensional figures is expanding: developments of polyhedra, figures of rotation (cone, cylinder, sphere) and projection drawings (top, left, front views) appear.

Students' measuring activities are raised to a qualitatively new level. They learn to use measurements when constructing, to measure models of figures and objects on the ground.

Students begin to identify connections between figures, common properties, and generic relationships. This knowledge is still fragmentary, but connections between students' spatial and quantitative concepts are already being consolidated, the stock of terms is expanding, and students' ability to analyze drawings of figures, discover ways to construct them, and build hypotheses about the properties of figures is being formed.

At the third stage, the formation of metric representations becomes a priority, and it is associated, first of all, with the study of area and volume, their properties, with measurement and calculation, as well as modeling of three-dimensional figures.

The formation of an idea of the shape and relative position of figures ends with familiarization with regular polyhedra and regular polygons.

4. Results

In 5-6 school grades you can study the course "Visual Geometry". The logical organization of geometric material can be based on familiarizing students with definitions, definable and indefinable concepts. In this sense, the geometry of 5-6 grades can be called "geometry of definitions." During its study, students encounter definitions that formulate the content of almost all geometric concepts discussed in elementary school, for example: line segment, ray, angle, circle, circle, triangle, polygon, cube, etc.

Along with this, some new concepts appear, such as the arc and chord of a circle, the bisector of an angle.

The formation of concepts is based on the establishment of genus-species relationships. In this regard, it is proposed to organize the content of educational material in accordance with the so-called family lines.

The main "family line", which determines the logic of studying geometry in grades 5-6, can be represented by the following sequence of connections: point → straight line → segment → ray → angle → broken line → polygon → polyhedron.

Studying a geometry program in grades 5-6 without first mastering a visual geometry course in grades 2-4 will be formal and not so effective in achieving the main goal of developing spatial thinking and imagination of students.

In grades 5-6, geometry continues to remain without proof in the sense in which one has to deal with it in systematic courses in planimetry and stereometry. But this is the geometry of intuitive conclusions. Based on the results of graphic experimentation, modeling, measurements, as well as definitions and simple conclusions from them, students can make hypothetical judgments about the properties of figures and their relationships.

In grades 7-9 it is expected to provide a painless transition in the future to the course of stereometry through a system of problems in which planimetric objects are considered in space on polyhedra and bodies of rotation.

The deductive construction of school geometry, on the one hand, is an invaluable material for the development of students' logical thinking, and on the other hand, it creates a gap between the child's psychological readiness to successfully master the world of spatial geometry at the propaedeutic level and the theory of stereometry, the presentation of which is based on planimetry.

Such a gap objectively dictates some deviation from the strictly deductive presentation of the geometry course in school. Problems on planimetry on polyhedra for grades 7-9, in our opinion, are one of the soft options for the practical implementation of this direction in the study of geometry.

5. Discussion

Thus, the fusionist approach to the presentation of a school geometry course contains a fairly high potential for developing students' cognitive interest and, consequently, their intellectual development. At the present stage, this approach is progressing, although there are still many difficulties in this regard.

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