Jan Długosz University of Częstochowa
Scientific Issues, Mathematics XII, Częstochowa 2007

CONSTRUCTION PROBLEMS AND THEIR PLACE IN SECONDARY SCHOOL MATHEMATICS

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Abstract. A pilot study concerning construction problems in mathematics teaching at grammar schools and universities is described in this paper.

Currently, plane constructions are getting towards the centre of teaching again. It is very useful and necessary because they show a clear target to a student (e.g. what is to construct), they develop abilities of dialectical perception of relationship between theory and practice. They also serve as a convenient test method allowing a teacher to diagnose a quality of informal knowledge of students.

To determine the knowledge level of construction problems, three construction problems were submitted to students of the 2nd year-class of the grammar school, to another group of students of the 4th year-class and finally, to university students of teaching mathematics. The aim of this pre-research was to determine the level of students' abilities of solving construction problems and point to possible mistakes.

All three problems belong to the standard secondary-school plane geometry problems.

Problem 1: Construct a triangle ABC: $a : b : c = 2 : 3 : 4, v_a = 5$ cm

Problem 2: Construct a triangle ABC: $a = 7$ cm, $b + c = 12,5$ cm, $v_c = 6,5$ cm

Problem 3: Construct a triangle ABC: $c = 5$ cm, $t_a = 5$ cm, $v_a = 4,5$ cm

The results of the research were interesting in the point that no student of the three tested groups complied with all parts of the construction problem solution (analysis, construction, proof, discussion). Thus it was convenient to evaluate the test by means of the phenomenal analysis.

The results of the research are summarized in the following tables in which these symbols are used:

+ ... a part of analysis given, construction completed, number of solutions given (missing proof tolerated)
/ ... problem solved (constructionally), missing one ore more of prescribed parts of solution (most commonly analysis, discussion)
- ... problem solved but incorrectly
0 ... problem not solved)

Problem 1	2nd year-class of grammar school	4th year-class of grammar school	4th year-class of teacher training courses
+	16 %	0 %	7 %
/	80 %	4 %	67 %
-	4%	28 %	13 %
0	0 %	68 %	13 %

Problem 2	2nd year-class of grammar school	4th year-class of grammar school	4th year-class of teacher training courses
+	20 %	4 %	27 %
/	56 %	24 %	40 %
-	16 %	52 %	33 %
0	8 %	20 %	0 %

Problem 3	2nd year-class of grammar school	4th year-class of grammar school	4th year-class of teacher training courses
+	8 %	8 %	7 %
/	72 %	72 %	73 %
-	4 %	16 %	20 %
0	16 %	4 %	0 %

It is clear from the table that the most successful in all three problems were students of the 2nd year-class of the grammar school. They took the test immediately after going through plane geometry in mathematics lessons. The university students took the second place in the order and the graduates were the worst.
It follows from the results that even if the best group was formed by students of the 2nd year-class of the grammar school, their solutions were not complete (although we could expect the best results).
The students of all examined groups did not know the prescribed parts of solution, they did not state a discussion, they did not discern between construction analysis and construction procedure. Their graphics denotation was poor on numerous occasions.

We assume (and we will verify hereafter) that the reasons of incorrect solutions consist in the following factors:

[1] Insufficient preparation of students from basic schools.

[2] Geometry lessons are reduced by the teachers of mathematics or the presentation is intuitive.

[3] Unsatisfactory motivation of students by the teachers.

[4] Insufficient number of practice problems available.

[5] Number of geometry lessons reduced.

[6] Geometry lessons are shifted to marginal periods of the school-year.

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