Annales Academiae Paedagogicae Cracoviensis
Folia 16 Studia Mathematica III (2003)

Jaroslava Brincková

Projects in teaching mathematics

Abstract. The aim of contemporary education is to build a partner relationship between teacher and pupil while picking up new subject matter. Project education gives enough possibilities for forming this relationship. A teacher with pupils suggest topics of real projects in the classroom. The pupils make an effort on formulation and choice of the problems themselves expressively. Pupils' approaches to work change and the contents of social tasks change, too. We regard realization of own responsibility and requirement to collaborate as the most important thing.

We can comprehend the project as a transition from thought to action, as a transition from speculation to organized intention. It comes out from pupil's knowledge and aims to application of it in practice. The role of the teacher changes in contemporary process of humanization. The stress on transition from transmitted teaching to constructive teaching raises. Creative teachers respond to these changes. They are able to create sufficient space for support and development pupils' will to discover something new and to get to see beauty in mathematics. They do not only teach veritable facts, but they are the facilitators, who help their pupils to find active approach to learning. They know how to create such situations in education, which give pupils wide space for creating their own learning strategies.

There is the public view that only gifted pupils can understand mathematics. If the others want to receive good marks they have to learn it without understanding. This feeling arises mainly where pupils do not look at mathematics as a suitable method for solving problems in other subjects, problems of everyday life in particular. They do not try the method of experimenting and modeling in mathematics, do not look for optimal strategies of solving problems, collection, classification and elaboration of information and data themselves. It is necessary for this work to know and to use relations among subjects, not to be afraid of mistakes and failure in the solution course. We should be up to them. We should have to develop our ability to defend own view in discussion, to collaborate with others at school and out of school while looking for information required for learning mathematics, because not only textbooks are the source of knowledge, but also various life situations in which mathematics is a supportive apparatus. At present time the teacher has many available

methods, tools and forms of work, which create space for him to make pupils be active and develop pupils' competence and potential. The project method and integrated thematic instruction (ITI) belong to these methods. ITI uses deep knowledge of relations among subjects.

1. Contemporary tendencies in teaching mathematics

We can observe that transmissive and constructive education are realized in contemporary education as opposite poles of a wide spectrum of teaching methods. The real educational process in practice passes between them.

During **transmissive teaching** the teacher's aim is to transmit information to pupils clearly, so as they pass exams successfully. The teachers teach solving typical problems, the most reliable methods and "tricks" very often. They teach theorems, definitions, formulae, algorithms and rules and do not expect pupils' independent work, finding various solution strategies, experimenting, proposing new mathematical problems. This coherent style we call traditional education. Experience with overloaded contents of syllabus and pupils' obligation to pass exams successfully cause the majority of teachers go this way.

Constructive education is a counterpart of transmissive teaching. The subject matter is not in focus of this educational space, but it is the development of pupil's personality. The main goal is to enable and facilitate pupil's cognitive and metacognitive growth. The teacher tries not to present veritable products to pupils, but to show them the way how to construct knowledge on the basis of their own experience. He lets them more liberty to manage their learning. This approach is meant at present time as modern education. The difference of acquiring the subject matter between traditional and modern education, is presented in scheme No 1 (see [2]).

2. Possible changes of teaching

There are a lot of ways to turn teaching over to the desirable tendency. Those ones which we regard important in possible application of the project method in teaching are embraced in the middle of the next scheme. These changes can be concentrated on the development of child's personality or their common life and common learning.

Various modifications of teaching

- Common teaching children of different ages;
- Investigation of topics surpassing the traditional classification subjects according to that of knowledge;
- Releasing curriculum and syllabus;

- Schedule releasing;
- Putting various holidays and celebrations into the life of school;
- Verification of the various ways of teaching in groups;
- Creation of various hobby groups;;
- Development of physical activity and creativity in music, fine arts, ...

3. Project teaching in mathematics

We can find in the literature a lot of different interpretations of the concepts of a project, project method, project teaching. For example:

1. It is a proposal or a plan for an activity.
2. A set of documents.
3. A proposal how to finish selected topic and also a decision to realize it. It is a transition from an idea to carring out action and that is what distinguishes it from real work. It is an intention considering different alternatives carefully.
4. It is a model of selected work.
5. It is a plan how to realize a research.

Originally the project method in teaching was understood by its founders as a solution of problems of several subjects by means of mathematics. In contemporary understanding this may be called an interdisciplinary project. According to M. Kubínová's conception (2) mathematics has become a core of pupil's project, which consists of different activities, during which pupils discover mathematical concepts and laws. They learn about possibilities of using mathematical concepts out of mathematics through realizing projects. These projects are called **mathematical** ones.

The aim of contemporary education is to build a partner relationship between teacher and pupil during learning a new subject matter. Project teaching gives enough possibilities for building this relationship. The teacher and pupils suggest the topics of their own projects. They participate in formulating and choosing problems in many cases. In this way pupil's approach to work changes and the contents of social tasks change, too. We regard consciousness of their own responsibility and necessity of collaboration as the most important thing.

We can understand the project as a transition from an idea to an action, as a transition from speculation to organized intention, too. It comes out from pupil's knowledge and aims to its application in practice accordingly.

Pupil's project:

- makes part of the learning aims and some objectives of the subject matter;
- it is open in the teaching process;
- it is built in such a way, that the program of learning is not firmly determined in all its parts before starting the project; so the pupils will not pass through a fixed, determined program;
- arises and is realized on the basis of pupils' responsibility;
- is connected with out-of-school reality; comes out from pupils' experiences;
- leads to concrete results.

Preparation of a project starts in the classroom:

1. by reflection on previous knowledge and experience (it ought to come out from pupil's knowledge);
2. by considering different possibilities (it ought to be prepared in such a way as to allow pupils to express their own approaches and deviations from "model" elaboration);
3. it should be materialized (at least on the paper).

We integrated the project teaching method into the preparation of future teachers of mathematics in 1997. At the beginning we focused mainly on preparation of projects in seminars and their realization during students' pedagogical training course. Our practice primary school joined the international project Comenius 3.1. It led to the need of putting a bigger impact on pupils' evaluation of work results in projects and the teachers' evaluation, too. Analysis of project results after the pedagogical training course was the springboard for improving the quality of contents and notices of projects in the next term. Requirement has been shown to determine the role of the teacher and the pupils more exactly and to narrow aims of taught project, too. It has shown that the project cannot be considered as an isolated element in teaching. It must make part of certain educational structure, in which it has a concrete task in harmony with other parts. They influence each other, because all elements of educational system create the whole. Each change of one of them causes changes (positive or negative)in other parts of the system. That is why pupils' projects cannot be inserted into education accidentally, to fill up a gap. It is necessary to monitor longitudinally the concrete educational system in the concrete class or school and by means of aptly selected project or a group of projects support transition of the system from transmissive to constructive teaching with an impact on pupil's development of competence and abilities, on building inclusive school, too.

4. Student's project: The school of my dreams

1. Preparation of project

1.1 Determination:

- *Aim of project:* motivating and integrating;
- *Duration of project:* longlasting;
- *Place of realization in teaching:* TVD and out of school;

1.2 Choice of topic: — determined in advance.

1.3 Map of topic:

- testing knowledge level of alternative educational conceptions from the study of pedagogical-psychological disciplines,
- integration of the mathematics syllabus at primary school into alternative conception of education,
- budget for the staff's work,
- budget for arrangement of building and ground,
- modeling in geometry — model of school building and plan of using the ground in corresponding gauge,
- information sources — education offices, methodical centres, real school, internet, magazines about teaching.

1.4 Formulation of project determination as an open problem:

Determination: You have just passed leaving state exams in mathematics successfully and the teacher position is waiting for you at primary school. The offer of free places at your profession is scarce and you want to return to the place of your dwelling. You have imagined an ideal school during your study. We found out on internet that the third sector offers a two-storey building with the area of 200 m^2 on each floor with the ground of area of 2 ha, for education of youth and spending free time effectively at your dwelling. The building needs minor repairs of school rooms. On each floor there are toilets and 4 classrooms with 2 cabinets. The sector offers a sum of 10 million crowns to the winning project for realization of the educational intention and arrangement of the building with area. The condition of successful project is its originality and exploitation of the building and surrounding ground for education in mathematics, too, of pupils' age up to 16, collaboration with people from surrounding area in the afternoon and evening time, too.

Let you imagine that you have a chance to be the head teacher of this school or educational institution.

1. What kind of school is missing in this category in your surroundings?

2. Is there any building of similar character with ground on outskirts of your town, which could have been arranged into educational institution for teaching mathematics and the Slovak language?
3. If yes, suggest a project for that area.
4. Choose alternative teaching program, tell what subjects are to be taught at your school.
5. Work out a budget for arrangement of the building with ground.
6. How many pupils in maximum can your school accomodate if the height of all rooms in the building is maximum 3 m?
7. Determine the number of necessary staff, their necessary qualification and supposed monthly wage costs.

Realization and results of the project will be shown in the lecture.

Conclusion

Student projects showed that pupils can acquire very much of mathematics by using the project method. Students are future teachers of mathematics and they carried out their projects during their pedagogical training course. Projects that are suitably compiled and integrated into the education system can help:

- to develop pupil's ability
  - to work independently,
  - to work and collaborate in a group,
  - to communicate in the mathematical language with other schoolmates and with teacher,
  - to organize own work with certain aim,
  - to find out necessary information,
  - to analyze the information critically,
  - to classify information,
  - to prepare a report about own work,
  - to determine obstacles and overcome them,
  - to determine your own mistakes and instruct oneself from them,
  - to evaluate own work and learning critically.
- to motivate pupils to find interest in mathematics
- to praise every pupil for each little contribution into realization of the project

- to increase pupils' self-confidence in mathematics
- to show connections between mathematics and other subjects
- to show connections between mathematics and every day life
- to teach certain parts of syllabus in a "hidden" way
- to enable pupils to construct mathematical knowledge themselves
- to give experiences with "doing real" mathematics (mainly in pure mathematical projects).

References

[1] M. Kubínová, J. Novotná, *Projekty ve vyučování matematice na ZŠ*, Pedagogické centrum, Plzeň 1998.

[2] M. Kubínová, N. Stehlíková, *Projects for pupils in school mathematics*, EMTISM Course Comenius – 2.2, Prague, PdF UK 2002.

Department of Mathematics
Pedagogic Faculty
Matej Bel University
Ružová ulica 13
974 11 Banská Bystrica
Slovakia
E-mail: brincka@pdf.umb.sk