

THE REALISATION OF SELECTED ATTRIBUTES OF 'FUNCTION' USING THE PROJECT METHOD

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Abstract. The notion of function plays a crucial role in teaching mathematics. Why is this important issue so problematic for students? It is worth noticing that precise specification of this notion took place relatively late, in 19th century. This is why it is so important to attempt students' active participation in defining and understanding the notion of 'function'.

I was encouraged to use the project method in my work by Marie Kubinova's article 'The activating role of project in teaching mathematics'. This method, in a wide thematic spectrum, is realized in Mathematics and Didactics Department, which functions as part of Pedagogical Department of Charles University in Prague. The Mathematics Department of Rzeszow University has cooperated with the above mentioned Department in research on mathematics didactics for years.

The method of discussing the notion of 'functions' and their basic attributes proposed in this study is based on experimental approach to this issue. It is a method of teaching based on students' closer, every-day experience, who carry out certain ventures, wider than the traditional homework. It turns out, that by using techniques which correspond with students' world and dealing with a real problem, we can make 'function' quite a pleasant notion.

The project method I suggest to realize the above mentioned issues allows for shifting the load of recognition from the teacher as an 'informer' to the student. After research conducted in one of Rzeszow secondary schools it was possible to form a conclusion that active approach to a subject is an effective impulse motivating students to action. Such approach contributes to integral recognition and development of student's communicative skills, which perfectly harmonizes with the project method.

*You say I'll forget,
you show I'll remember,
I experience I'll understand*
(Chinese proverb)

1. Explaining the function notion using the project method

My students find mathematics extremely difficult. It is seen as a complicated, if not impossible to understand subject. Such negative opinion has been expressed by over 90 per cent of the students I worked with in one secondary school in Rzeszow. Struggle against this stereotype is a real challenge for an active mathematics teacher. Unfortunately, the teachers themselves are to blame as they present mathematics as a subject understood only by the chosen few. Teachers pay attention primarily to the knowledge students need to complete competency test and not to students' cognitive ability. I have therefore decided to help my students see mathematics as a tool for creative work, useful in the world around us.

In the school I work for it is a tradition that during the second lesson in a new school year students take a test checking the knowledge from the lower level (lower secondary school). 65 students did the test. The tasks which involved the knowledge of the 'function' notion caused the greatest problems. Only one student managed to accurately match the function $f(x) = x - 1$, $x \in N$ with the right graph and specifying the attribute (field, set of values, monotonicity, the zero of the function) given by the formula $f(x) = 2x + 1$. This result was an impulse for me to think about it and to make an attempt to change this situation.

Functions play a basic role in teaching mathematics. Why then does such an important notion cause so many problems. Based on the assumption that in learning a new issue it is vital who and how will present its content, we can claim that students' problems are a result of the fact that teachers do not always present the message in a clear way. This assumption is consistent with the rule of didactic parallelism, which should play an important role in the choice of content and the teaching methods on particular levels of education. How to effectively teach function?

I was encouraged to work using the project method by Maria Kubinowa's article *Activating role of project in teaching mathematics*. This method is used, among others, in the Pedagogical Department of Charles University in Prague, which has cooperated scientifically with the Mathematics Institute of Rzeszow University.

If we assume that the best way to learn mathematics is to discover by your own action then it is certainly worth considering working with the project method.

The choice of subject is an important aspect of the project method. The choice should be based on the ability and interest of students, the teacher's needs and, if possible the school environment. Next we set the time limit, project presentation form and the evaluating criteria. My students had the choice of two alternative subjects:

I. Write down the air temperature at a set time in the same place.

II. Every morning (right after waking up for 14 days) assess your mood on the scale from 0 (-) to 10 (+). The meaning of the scale is for you to decide.

The students' task was in particular:

1. To present the results of their observation on the right grid, graph, in a table and in the set of ordered pairs.

2. Specify (if possible):

a) domain and set of values

b) zero of a function

c) monotonicity

d) added value, negative value

e) periodicity

f) the highest and the lowest value of the function

g) parity and odd parity

From the very beginning the students knew how they will be assessed. They were given the criteria of detailed assessment, which contained the following elements:

a) accurately done single way of describing function - max. 2 points

b) correctly specified attribute - max. 3 points

c) mistakes in formal record (using mathematical symbols) - 1/3 points

as well as components of the final assessment, divided into the following elements:

a) correctness and completeness of data - 20 per cent

b) the data presentation method - 30 per cent

c) the class assessment - 20 per cent

d) the teacher assessment - 30 per cent

The Project was supposed to take 18 days (from 9th October to 27th October 2006). The table below contains the detailed work schedule:

William H. Kilpatrick believes that *The project method is a philosophy of independent learning* and as such develops very precious abilities such as. Planning long-term work, the choice of optimal method of solving problems:

a) work division

No.	The tasks	Terms
1.	Introducing students with the issue connected with the project (specifying the subject, the method of collecting information, the rules of presentation and evaluation)	9.X.06.
2.	Preparing the plan of work connected with the project in clearly specified terms: a)collecting and writing down b)consultations with the teacher c)prepare the data and preparing presentation in a hand-written or computer-typed d)presentation of the results of the work in front of the class, summing up the experience	from 10.X. to 23.X 13. i 20.X. 14.15-15.00 from 23.X. to 26.X. 27.X. (2 classes - each 45 minutes)

b) cooperation in a group, discussion, shared responsibility for the effects of work

c) using different sources of information (experiment, literature, internet, interview)

d) processing data (also using computer science technology, computer programs)

e) planning and doing experiments

f) defining, classification and creating its criteria

g) forming conclusions from data and observation

h) forming new research questions

i) presentation of results.

Carrying out projects based on function created an opportunity to make attempts connected with defining and classifying objects, argumentation and practicing the ability of preparing in writing and presenting he obtained results. The students came against numerous difficulties, even though working using this method initially seemed easy. I discovered that during consultations, when questions indicating problem with the understanding of function appeared:

a) Should points on the graph be connected?

b) How to formally record monotonicity intervals?

c) Can there be two highest or lowest values?

d) How is point placed on axis OX and earlier and the following point?

e) Above it then is the first one the zero of the function?

- f) Will the odd parity of the function result from its specification?
- g) How to record the set of ordered pairs?
- h) What should be marked on axis OX: the time or the result of the measurement?

The presentation of the attributes the students noticed caused fewer problems. The presentations were made in a variety of forms. The presentations differed in size and the technique used - there were pictorial posters, written work and multimedia presentations.

2. The basic rules of the project method

Teaching using the project method is an alternative for formal teaching. Project teaching correlates with other subjects. It helps to obtain knowledge. The teacher assumes a role of a guide or a friendly observer, hence their role is described as progressive. It is undoubtedly more difficult than a traditional role. However, it is more beneficial from a didactic point of view. To conclude, the teacher is an organizer of the teaching process, supports students in the choice of possible actions and solutions.

It has to be stressed that the project method has numerous features which distinguish it from other teaching methods. Mostly interdisciplinary nature, independence, the possibility of forming conclusions, extending research mathematics and predicting the future. The project method facilitates subjective treatment of the student, it takes into account their interests, abilities, needs and aspirations. It stimulates the emotional development of the student, group work skills, familiarises with responsibility for one's own and group actions. The project method helps to perceive mathematics as a form of creativity, in which the world around us plays an important role. The students can carry out even unconventional ideas, surprising their teacher. My students showed highly creative attitude in specifying the levels of mood, using internet emoticons, verbal description or drawings (*it's bad but I'm still alive; weak, oh, no ...*). Similar final conclusions were reached: *My mood was getting better when it was weekend and I did not have to go to school; On Friday it was worse, because I had to use my energy reserves to get up to go to school; Wednesday was awful - test in English.*

The additional advantage of the project method is that it clearly shows two basic assessment functions: classifying and diagnostic. To realise both the teacher must carefully prepare the criteria of assessing the particular stages of work and types of students' activity. The possibility of students' self-assessment, not present in the traditional system of assessment, is an important element.

3. The effects of using the project method

The method proposed in this work for teaching functions and their basic attributes is based on experimental attitude to this issue. It is a method based on students' closer, every-day experience, who carry out certain ventures, broader than the traditional homework. It turns out that using practical solutions corresponding with student's world, dealing with a real problem, we can make function quite a pleasant notion. This is what happened with my students, which can be proved by the fact that the test in function results were very good: 52 per cent of students received mark good (4,0) or higher. What is more, the method helped to:

- a) Suggest a not only formal look at mathematics,
- b) Decrease the fear before mathematics class,
- c) Mathematics as a tool for describing the phenomena surrounding us,
- d) Forming such features as: responsibility, diligence, punctuality, independence and self-discipline,
- e) An opportunity to form arguments allowing for accepting or rejecting an opinion,
- f) The ability to react to other students' arguments (particularly during the presentation),
- g) The ability to prepare in writing and present materials,
- h) Multi-aspect understanding of mathematical terms on the basis of one's own experience,
- i) Making attempts to define and classify objects,
- j) Facilitating constructive attitude in teaching and learning mathematics, including the ability to form conclusions, interpretation and finding cause and effect relationships,
- k) To notice students' outstanding, other abilities.

To sum up, I'd like to collect my students' most common problems and dilemmas, appearing during the realisation of the project.

- a) Specifying the set of arguments and the set of values (in some cases - the day of the week became dependent variable,
- b) The problem understanding assignment idea (2 people),
- c) Incorrect intuition connected with the understanding of the zero of the function - if there is no line, which intersects axis OX,
- d) Problem coding the subset of the set of arguments (transferring the record on arguments from the finished set) - 40 per cent of students,
- e) Joining points on graph (because that's how they showed it on TVN - student's defending argument, after making an incorrect graph).

The projects were finished with evaluation in the form of a short questionnaire, containing the following questions:

- a) What have we managed to achieve?
- b) What new things have we learned?
- c) What value does it have for them?
- d) What could have been done better?
- e) Is it worth working using this method in the future?

The students have all said that working using this method has been very pleasant and they are willing to take new tasks of this kind. The students took this job voluntarily. It has not been obligatory, according to Kilpatrick, who said that students should not be forced to take unwanted tasks, because as unwanted they will not give long-lasting and satisfactory results.

The research helped to see that the effective impulse motivating the students to work are all types of activity. This attitude contributes to complex acquisition and development of communicative skills, which is compatible with the project method. This method was initially used at the beginning of the 20th century, and the aim was to make it possible for students to independently obtain knowledge and check their skills in every-day situations, instead of purely theoretical knowledge.

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