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GRAPHS IN THE TEACHING OF THE ANALYSIS AND IN ASSESSMENT

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ABSTRACT

The networks and graphs are being applied in an increasingly wide range in our days. More and more scholars deal with the research of the various contact nets. My own research covers the methods of teaching of analysis; I am looking for the essential point, which are important for the students in the accurate acquisition of the concepts. In addition, I search for methods for development. We can also create contact nets among the methods, which can help to survey the problems. I am showing some examples for this, and I am demonstrating the evaluation of the test results with the help of graphs.
Keywords: education, graph, methods of teaching

INTRODUCTION

I came across the name of Viola Takács during my research work. She was a colleague of the Teachers' Training Institute in Pécs and a devoted user of Galois-graphs in her teaching profession. The application of these graphs is not only very modern, but it also makes evaluation very visual. Visualises is a basic concept of the teaching-learning process; I consider it very important; one of the mental planes defined in the representational theories is also visualises itself.

We can classify the Galois-graphs according to the different fields of teaching work in which they are used:

- objects and their characteristics
- individual graphs: they can be scientific or student graphs
- collective graphs: student-task graphs
- psychometric graphs
- graphs characteristic of research applications

How are Galois-graphs drawn? There are two primary sets (universes of discourse), among the elements of which there are more serial relations. At the same time between the subsets of the first and the second set we can create a one-to-one primary relation. Such a subset is called closed, if the number of its elements cannot be supplemented without reducing the number of the other subset's elements and vice versa. If we can find a relation which is binary between the element pairs of the two given primary sets, we can consider the application of a Galois-graph. Formally: O(o1,o2,…,on) is one of the primary sets and P(p1,p2,…pm) is the other primary set, let us consider the $R \subset O \times P$ relation, where any $o_i \rho p_j$ can be, if $o_i \in O, p_j \in P, if \ (o_i, p_j) \in R$ and R is a binary relation.

When we draw the graph, we designate all closed partial set pairs with a circle, and they will create the angle-points of the graph as follows: let us draw the one-element closed subsets next to each other horizontally according to the first primary set and so on upwards. The first row should be called the first stage to make matters simpler. Below the first stage we should draw the circle designating the subset containing zero elements, and above the top stage the one representing the set which contains all the elements. What will the rule of connection be?

Let us pick any angle-point and connect it with all inferior points which indicate the biggest partial set. We do the procedure including all angle-points.

When analysing the graph it can be useful to define the name of the primary set's elements, so one can make more sense of the resulting structure.

I consider the student-task graph important because this way the group's study structure can be made visual, and with the definition of the optimal way you can plan the teaching-learning method in the particular community.

The comparison of certain scientific and student graphs points out the elements where the students have insufficiencies and we can also see which elements are known by them in connection with the given definition or task.

MATERIALS AND METHODS

In this study I am doing the assessment of the first-year finance-accountancy major students' analysis in-class tests, moreover, the analysis of some examination tasks, with special focus on the existence of any congruence between the assessment with graphs and the procedure on the examinations. To draw the graphs I used a programme which was designed and has been constantly improved by *Szigeti* (2003).

RESULTS AND THEIR EVALUATION

In the following I am presenting the data-charts and Galois-graphs of the analysis tests written in the first semester.

The task is to find the binary relation between the students and the tasks as follows: In the *Table 1* we can se the results of the students to find the relation. If the student got at least half of the total score for the task, then his value is 1, and if he got less than the half, his value will be 0. The students' names are represented only by their initials. That says the *Table 2*.

The relation between the students and the tasks was created according to the following: those who got at least half of the maximum score are represented by a 1, and those below the half of the score are represented by a 0 (*Table 2*). Then the graph was drawn (*Figure 1*).

The *Figure 1* demonstrates well which students solved the particular tasks. We can get information about the structure of the group, about the students who are good at solving the tasks – their number is decreasing: 3 people; and there is one person who in fact solved all the tasks.

We can notice that the group of good task-solving students was formed in a rather different way (*Figure 2*).

The type of the exercises was the same in both tests, they differed only in the figures. In both graphs those who solved 5 exercises, had the same on one branch, and different ones on the other branch. During the assessment of the second in-class test I defined the relation as before. I am not reporting the relation tables, I only drew the charts.

The second test study evaluating the relation of the previously defined as described in the relation tables not stated, the graphs drawn.

Table 1

Results of the students, A test; B test

A							B						
Name	1.	2.	3.	4.	5.	6.	**Name**	1.	2.	3.	4.	5.	6.
HV	6	9	3	3	1	2	KZ	2	5	0	5	6	3
FE	5	8	5	4	0	2	GE	5	8	3	2	5	4
HN	6	7	5	6	6	5	HK	7	10	4	3	7	7
KG	7	10	5	5	3	7	CB	5	10	5	4	0	6
SZÁ	3	7	5	3	3	0	JF	4	10	3	1	1	7
FT	7	12	5	2	6	5	CSG	4	9	5	4	2	7
KR	4	7	2	4	3,5	1	HP	5	7	3	6	1	4
JB	5	6	3	3	0	2	KN	3	7	5	3	8	6
KKL	2	9	4	2	8	7	EA	1	8	5	1	6	4
BM	0	3	2	5	3	1	LK	7	10	1	3	2	6

Table 2

Relation table

A							B						
Name	1.	2.	3.	4.	5.	6.	**Name**	1.	2.	3.	4.	5.	6.
HV	1	1	1	1	0	0	KZ	0	0	0	1	1	0
FE	1	1	1	1	0	0	GE	1	1	1	0	1	1
HN	1	1	1	1	1	1	HK	1	1	1	1	1	1
KG	1	1	1	1	0	1	CB	1	1	1	1	0	1
SZÁ	0	1	1	1	0	0	JF	1	1	1	0	0	1
FT	1	1	1	0	1	1	CSG	1	1	1	1	0	1
KR	1	1	0	1	0	0	HP	1	1	1	1	0	1
JB	1	1	1	1	0	0	KN	0	1	1	1	1	1
KKL	0	1	1	0	1	1	EA	0	1	1	0	1	1
BM	0	0	0	1	0	0	LK	1	1	0	1	0	1

Figure 1

The graph of the students, A test

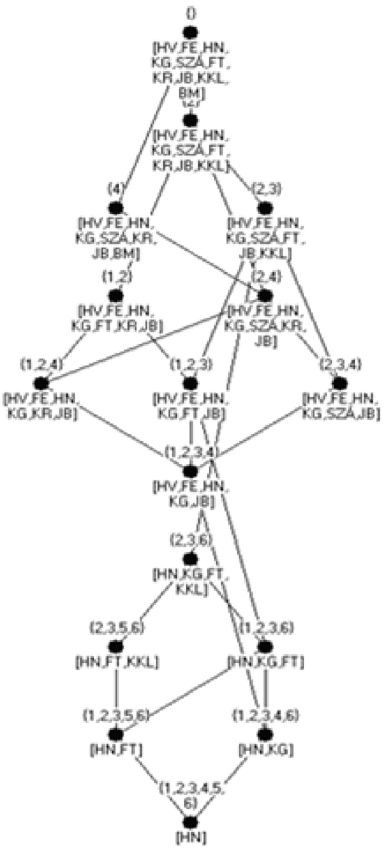
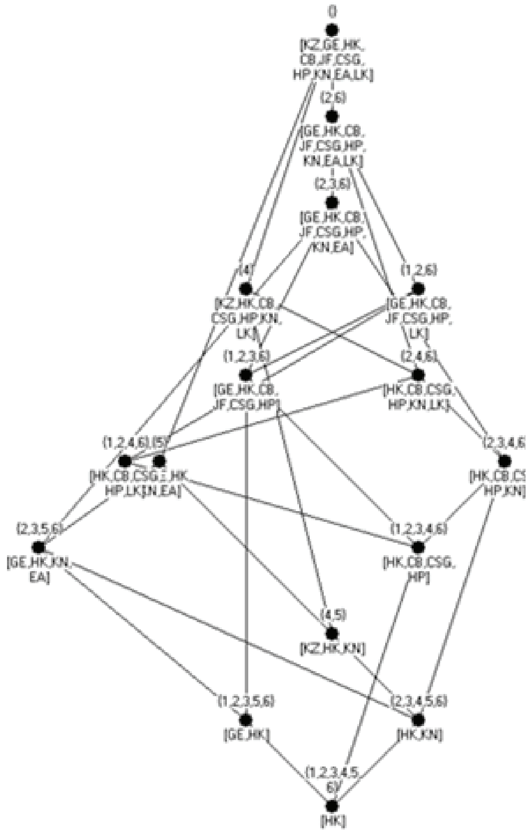


Figure 2

The graph of the students, B test



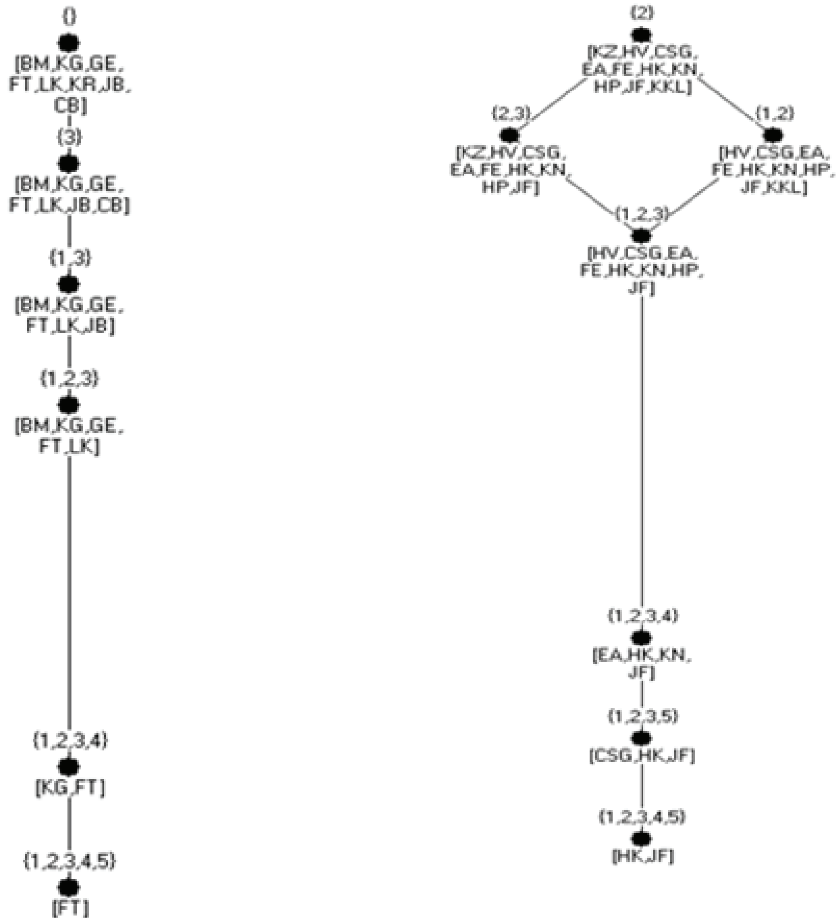
The result of the test was interesting, there was a new student among the good ones, but other new names appeared among the ones who could solve most exercises (*Figure 3*). In Test A the exercise concerning the tangent of the function got the most good solutions, and in Test B the definition of the limit value was the most successful task.

Now I am assessing the examination tasks of 29th December 2008. The binary relation was defined like earlier, but the graph will be examined in the task-student relation.

The lowest point of the graph (*Figure 4*) is the total of all students taking part in the exam. On the next stage the most popular exercises are placed, together with the students who solved them. On the third stage we can find those exercises which were solved by most people. The fifth angle-point of the first stage demonstrates that these four exercises in this formation were not solved by anybody (empty set). The set of those who solved all exercises is also empty.

Figure 3

The graph of the students, A test and B test

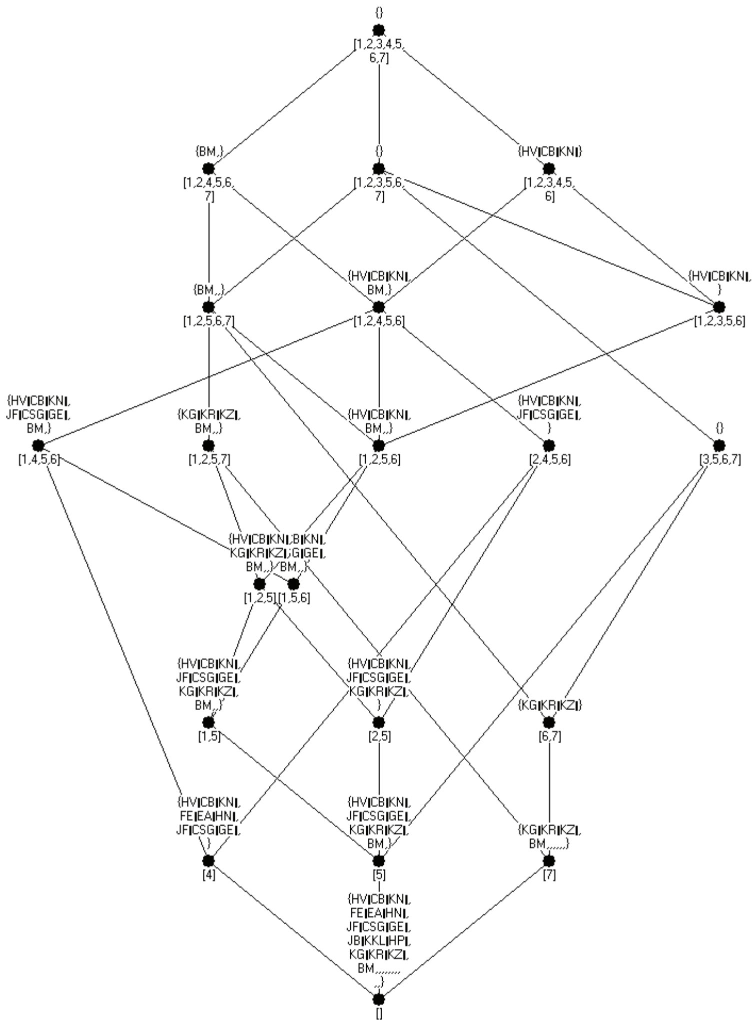


At the exam students could get 1 point for each exercise, we did not use a 'subtle' division, but it was possible to get fractional points, and we subtracted a quarter point for calculation mistakes.

Those students who had at least 3 points, were assessed as 'rather weak'; the ones with 4 points as 'satisfactory'; the students who got 5 points, 'good', and those who solved at least 6 exercises, were assessed as 'excellent'. How could we do this assessment with our graph? The graph has got 7 stages, which equals to the number of the tasks. Let us say that the people, who got at least on the 3rd stage, can get a' rather weak', and so on: being one stage higher means one grade better, and the ones on the top get an 'excellent'. We can find several angle-points on each stage, so you can differentiate the particular grades; the students could get a 'satisfactory', for example, for solving different exercises; however, if we study only the total points, we cannot see these differences.

Figure 4

Results of the analysis exam of 29th Dec 2008



CONCLUSIONS AND SUGGESTONS

The assessment of the exam tasks showed that there is an agreement between the stages of the Galois-graph and traditional evaluation, so graphs are suitable for testing and assessing knowledge. Moreover, graphs can inform us better about each student's knowledge of the subject and show the differences between the particular grades.

The figures of the in-class tests also show the differences between the subject-matter: the exercises of the first test were based on different material, while the second one was built entirely on the basics of differential calculus. Those students, who acquired the method of derivation, were able to get good results in almost every part; that is why the group's knowledge resulted in such a linear graph.

Using Galois-graphs for students' assessment is a very recent phenomenon; it started in the late 90s. In my opinion it is very useful, and using the graph-drawing programme makes the work easier.

I intend to use it in the instruction in the future as well. It helps to plan work, and to decide on the directions of the instruction, but unfortunately this process cannot be detailed here due to the space limits of this article.

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