TRANSFORMATION PROCESS IN SCIENCE AND MATHS TEACHER EDUCATION (EXAMPLES FROM SLOVAKIA)

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Abstract

Slovak universities have had the chance to gain money from the pre-admission funds as well as from the European social fund (ESF) since 2004. In the framework of the several challenges of the Ministry of Education of the Slovak Republic all universities out of capital Bratislava region could submit the projects dealing with the educational activities. The article describes the experience connected with the implementation of the ESF"s projects of the Faculty of Natural Sciences of Constantine the Philosopher University in Nitra. It introduces one of the activities of the project A – CENTRUM: Academics training and monitoring centre of human sources which was realized by the faculty during 2004-2005 and following project: A-CENTRUM for 21 century: From present to distance education, which is realized now. Faculty of Natural Sciences in these projects has prepared the educational modules for teachers in practice named: Natural sciences dealing with the further education of teachers of mathematics, computer science and natural sciences" subjects at the elementary and high schools. The introduced projects and their activities are the example of the real ability of the faculty to communicate with teachers effectively and offered them interesting programme for using at schools. Engagement in these projects reflects also the possibility of an academic space to realize the activities with the positive response in practice.

Two examples of activities for teachers in practice are given in the article:

- *modern didactic computer teaching programmes in biology,*
- *graphics calculators in mathematics education.*

Both examples follow the effect of increasing efficiency of teacher's work and pupil's motivation.

Key words: *courses for teachers, educational programs, graphic calculator, information and communication technologies, multimedia.*

Introduction

For the past half-century, education has witnessed an intense debate. The changing needs of the world's economy, advancements in technology, changes in socio-political climate, and even simple everyday routines have stirred waves of change in the field of mathematics education. Information and communication technology means are now part of our daily life. Most often, advancement in technology is given as the main catalyst for the change, however, whatever the cause; the effects of these changes are of true significance.

Accordingly, the education system has witnessed many trends in reforms, but the majority of these reforms can be lumped into one large category that one can call the shift towards the

introduction of technology in classrooms. It is clear, that most of teachers in practice are not able to use computers or other technologies during their teaching in adequate way. The reason is simple: they were not educated nor as users themselves and as teachers who are able to use technologies for better introducing and teaching their subject. This situation could be solved by several ways. One of it is located at universities which are involved in teachers study programs.

Slovakian educational bodies; such are faculties or universities; have had several chances to ask for European Social Found (ESF) grants by preparing and implementing project under the national scheme: Increasing of qualification of employers. It seemed to be very successful and useful to focus on to the practicing teachers in these projects aiming to introduce them modern technologies and its using in daily school practice.

Faculty of Natural Sciences is one of the five faculties of Constantine the Philosopher University in Nitra, Slovakia. Faculty has almost fifty years tradition in teacher's education in: mathematics, biology, physics, chemistry, geography, informatics and environmentalist. Every department is in close contact with school in the region and with teachers of its subject, as well. The idea of courses for teachers in practice has been successfully involved and implemented through ESF approved projects: pilot project named: A-CENTRUM (2004-2005) and following project: A-CENTRUM for 21-th century (2006-2008). Mostly young and progressive university teachers are involved as mentors of courses for teachers in practice to introduce them modern methods in natural science education and help them to be more familiar in using information and communication technologies in their teaching at primary (in Slovakia: children 6 – 15 years old) and secondary schools (in Slovakia: children 15-19 years old).

One course is not shorter than 6 hours; some of them are divided into several sessions taking regularly in the period of two-three months. Every course is taken in the special computer laboratory and participants are able to use every possible device they need to be coping with particular activity. Participants are obliged to reflect the efficiency of their new knowledge to their practice by performing their own project showing their particular experience in changing the methods of teaching. Participants are given by certificate on the end of course. This certificate is the evidence of reaching important step in their self-developing.

The responses from teachers are only positive. Participating teachers are very positive after the course; they are enthusiastic and willing to continue in these activities in the future. This feedback is absolutely valuable and need for university teachers. It helps them staying in contact with practice and better understand needs of teachers in practice. Courses are also an inspiration for research in theory of education of natural sciences, mathematics and informatics.

Modern didactics computer teaching programmes in biology

Use of modern didactic computer teaching programmes could increase efficiency of teacher"s work and pupil's motivation. These programs are closely related to the sufficient school hardware facilities and to expertise ability of teachers.

Implementation of modern communication technologies into the educational process needs innovation of methods and forms of teaching. To increase the effect of the teacher's work, to unload students of uninteresting memorization and motivation increasing help the usage of modern didactics teaching PC programs (Dytrtova, 2003).

According to the fact that there is a poor choice of teaching programs of Biology on the trade in Slovakia in Slovak language; we would like to deal with creation of simple educational programs for didactics of Biology during several seminars with master students and during the courses for teachers in practice as well. Both students and teachers are interested in the creation of such teaching programs very much. Each author of a program may check his own one during the course and than during his/her own pedagogical practise at school.

The importance of the teaching program

Teaching and learning by using ICT develops visual fantasy and provoke picture memory of students and pupils better than using the textbook only. It is important for teachers to have a not very complicated program at his/her disposal. The program should not overtake the

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present curriculum. Preparation of teaching programs is based on the knowledge stated in the textbook of Natural History - in Slovakian curriculum it is involved in the 6th class (12-years old pupils) of the elementary school (Hantabalova, 2002). Simultaneous usage of both the published textbook and the teaching program with virtual textbook, displayed by ICT, ensures faster and more complex adoption of knowledge, takes a good feedback and checks the fixed elements of knowledge, too.

The advantage of using ICT lies in the fact that all applications (photographs, video sequences ect.) can be displayed by one computer during the particular lesson or during the performing and evaluating the particular biological topic, as well. If teacher applies well prepared methodical techniques and the teaching program will not be used as a device for independent work of students, it could be a subject for consultation. The consequent solution of problematic test questions develops creativity and inspires students to self-study (Lengyelfalusy, 2003).

The presented educational program works on the basis of program teaching. It is not possible to attract students" attention until they get sufficient motivation. Exact information performing by program can be seen in the informational scheme and in classical textbook, too. The scheme is filled by colour pictures, photographs, tables and graphs. Achieved knowledge can be controlled or repeated by students using test questions placed on the end of each chapter. Teacher, as the creator of the program, gets feedback and finds out success of the program usage as a motivational, additional and non-traditional teaching method at the same time.

The structure of the teaching program

Thanks to the undemanding character of the program PowerPoint, the teaching program can be applied at each school. The structure of the whole teaching program has its basis in Hantabiļovį"s textbook „Natural History for the 6th class of elementary schools"(2002). In regular intervals of time six tests are incorporated. Their successful passing enables going ahead to the next pictures.

Assumption of this work without any problems needs the followings: basics skills in using PC, interesting processing of the program and students" interest to the given topic (Tulenkova, 2004).

Movement operation in the program textbook is secured by the following buttons:

 This button helps to go ahead to the next picture.

 This button helps to go back for the previous picture.

(End) Button is for finishing the program.

(Unicellular) There are hyperlinks that help in the movement through pictures. Normally hyperlink is an underlined and differentiated text.

 Information button gives the information about the program and its usage.

 This button enables access to video sequences.

(Gallery) The virtual textbook includes a lot of photographs which widened curriculum. Students may better understand differences of biological objects (Szekeres, Balla, 2003) using the method of comparison. Students can display photographs using the button.

The world of animal kingdom and kingdom of plants is very interesting topics for students. They learn about animals and plants that can be found in their surroundings, they learn to know how their body functions, what kind of life style animals have and what their place in the ecosystem is. The program is focused on the protection of the environment, as well as on endangered, and protected animals and plants.

The program presented during the practicing teachers' courses was attested in the academic years 2005/2006 and 2006/2007 in teaching the topics: Natural History, for pupils of the age of 12 (6th class) by university researchers and university students during their practice at schools. Handouts, which accompanied the program, were used as the tests for verification pupils' knowledge. The results testified its popularity and validity in increasing pupils' knowledge their better motivation and stimulation in learning biology. The program is stimulating for teachers as well. It helps to prepare more interesting lessons in biology. The effect of the program is multiple by handouts using for individual students work or as testing tools.

Graphics calculators in mathematics education

The clear challenge to today's educators is to develop new strategies and methodologies to help integrate calculators in classrooms. To meet the challenge, educators have to change the methods of implementing the curriculum, and create training for teachers to enable to help smoothen the transition from the traditional paper-pencil computation to calculator based instructed lessons.

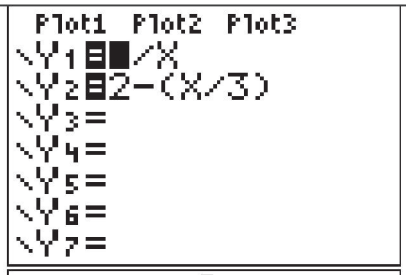
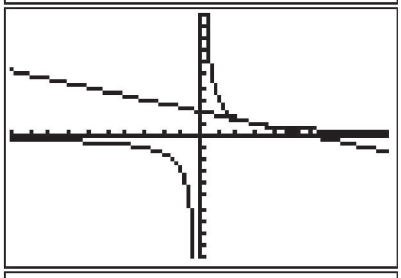
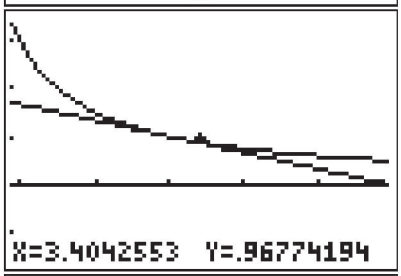
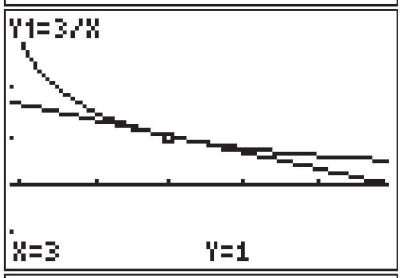
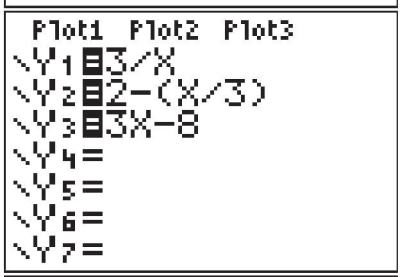
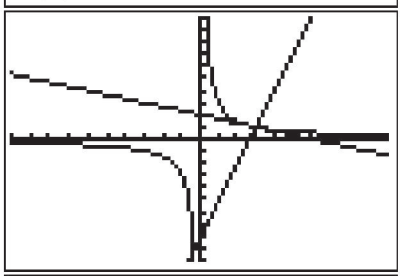
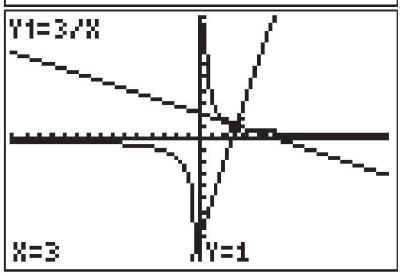
Graphics calculators offer students a method of performing computations and algebraic manipulations that is more efficient than paper-and-pencil methods alone. They are inexpensive enough so that classrooms may have a set for students, and many students are able to afford their own. Each generation of calculators is becoming more powerful, useful and accessible to all. There is the possibility for schools to borrow the calculators' classroom set for one school year period from special educational point, although. This possibility opens maths teachers the field of experimentation in maths lessons.

The examples of two mathematics topics in the form of the learning text for practicing teachers' courses follow.

Tangent lines and Normal lines

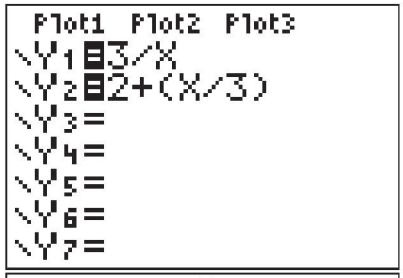
Problem: Find the equation of the tangents line and the normal line to the hyperbola $y = \frac{3}{x}$ at the point (3, 1).

Students will algebraically execute the solution and the calculator will be a helpful checking tool to check if their solution is right. They will have a visual proof if the line they have found is a line of a tangent and the normal line to the function at point (3, 1).

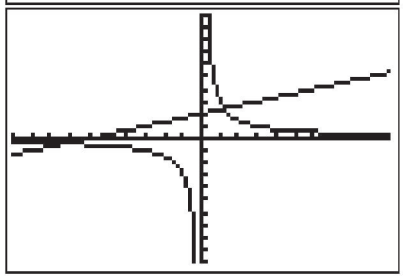
Steps	Calculator screens
Enter the function and the equation of the tangent line into!	
Graph the function in the standard window and the ZOOM IN at the point (3, 1) stand close to by pressing the arrow keys.	
	
Then trace the graph to see exactly the point (3, 1).	
Now we will graph the normal line together with the tangent line and the function in the same viewing window.	
	
We have to change the viewing window that we can see the right angle between the tangent and the normal line and then trace the graphs at point (3, 1).	

This is a fast way to check the work if the tangent line was wrong we can see it immediately from the graph.

We will change the equation of the tangent line to a wrong one.



Now we look at the graph.



We can immediately see that the line which popped up is not a tangent but a secant line.

Seeing Motion on the Calculator

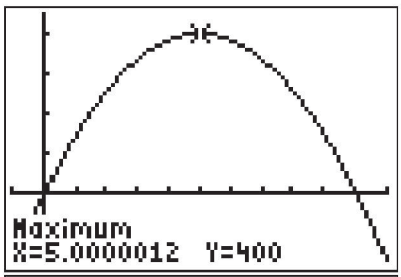
Problem: A dynamite blast propels a heavy rock straight up with a launch velocity of 160 ft/sec (about 109 mph). It reaches a height of $s = 160t - 16t^2$ ft after t seconds.

a) How high does the rock go?

b) When does the rock hit the ground?

Graphs give us plenty of information about flight of the rock but neither of them simulates the path of the rock in the flight. We can simulate the moving rock by graphing given equation in parametric mode.
We can graph the position function and get information from the graph. We can enter it into but we can't see the simulated motion.

Calculator screens



We will change the Mode of the calculator to Parametric one.

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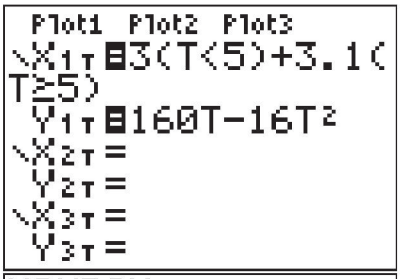
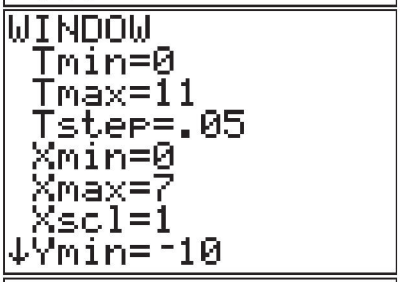
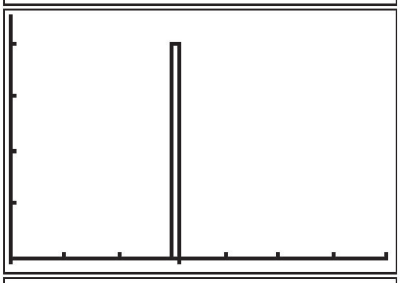
Now we will enter the equations.



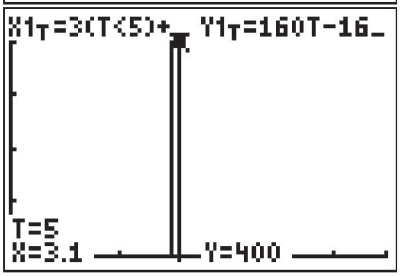
Now we will set the window that we can see the whole path of the particle
Tstep is a variable which takes care of the speed. (Higher number will make the simulation move faster).



Let's look at the graph.



Use the TRACE key to support that the rock is going up it reaches the highest point at t=5 and then changes direction it is moving down and reaches ground at t=10. We can see that when the rock reached the maximum point at t=5 it turned back on the second picture and it is moving down.



Conclusions and Discussion

The teachers who took part at the courses expressed that they have learnt more about how to use ICT, mostly in biology, or graphics calculators. The next step in these activities is implementation new teachers' knowledge and skills into their everyday teaching practice at primary or secondary schools, to promote knowledge to their students. The project continues and the teachers in particular subject (biology, mathematics, etc....) have formed potential group of co-researchers and collaborators together with university teachers and PhD students in theory of education. The effect of the ESF grant is evident. Its profit is going to be deeper after publishing texts for teachers not only using the project web page (http://www.acentrum.fpv.ukf.sk) but in CD ROM or in book version as well.

There are many interesting discussions during the project activities with participants – practicing teachers. Those, who are able to understand the idea of using ICT and/or calculators, and are little bit experienced in using it, they are not more afraid of the idea of replacing teacher by a computer or some techniques or some learning program. No program, no computer, no techniques can answer inquiry students questions raised during the lessons. The role of teacher and his/her work in the classroom is irreplaceable.

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