New Challenges in Education

Retrospection of history of education to the future in the interdisciplinary dialogue among didactics of various school subjects

Mária Gallová, Ján Gunčaga, Zuzana Chanasová,
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VERBUM

Ružomberok 2013

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Scientific monograph supported by **grants Nr.**13203-1069/RUZOMBE01
Erasmus Intesive programme

Lifelong
Learning
Programme

Tento projekt bol financovaný s podporou Európskej Komisie. Táto vedecká monografia reprezentuje výlučne názor autorov a Komisia nezodpovedá za akékoľvek použitie informácií obsiahnutých v tejto vedeckej monografii.

Publisher:
VERBUM – vydavateľstvo Katolíckej univerzity v Ružomberku
Námestie Andreja Hlinku 60, 034 01 Ružomberok
http://ku.sk, verbum@ku.sk, tel. +421444304693 kl. 308

ISBN 978-80-561-0065-3

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PREFACE

The intensive program “NCE - Retrospection of history of education to the future in the interdisciplinary dialogue among didactics of various school subjects” was the project in the frame of the Erasmus Intensive Programs. This project had following aims:

1. give the students a glance into the interdisciplinary approach in didactics of various school subjects.
2. discussion and training course on how computers can help in the educational process; creation and use of e-learning and modern educational materials. The final results of our work will be produced during practical exercises in the branch of educational techniques (cooperative learning, drama pedagogy, etc.),
3. practical course in the branch of practical pedagogy, school conception politics in the range of EU countries (mainly partners of this group), picture of the teachers in society in the view of media, curriculum and values in pedagogical process, curriculum and society.

This scientific monograph is a contribution to the results of mentioned project. The interdisciplinary approach to the primary and secondary education in didactics of various school subjects supports relationships between these school subjects. It is very important because knowledge presented in educational process is often isolated. The contribution of information and communication technologies, different manipulative activities and components of drama pedagogy in education can motivate pupils in the process of gaining the knowledge.

Every country has its own tradition. The chapters of this monograph bring possibility to compare different school traditions and educational techniques. Scientific monograph is devoted to the teachers of primary and secondary schools in the process of the lifelong learning, pre-service and in-service teachers and doctoral students in the study programs of the didactics of various school subjects.

Ján Gunčaga

1 SOME INTERACTIVE ELEMENTARY MATHEMATICS LESSONS

Edith Debrenti

Abstract

According to George Pólya once someone has discovered the joy of mathematics, they will never forget it. In this research paper I present a set of activities that were carried out during the previous academic year among second grade student (aged 7 - 8) living in Oradea. The purpose of these activities is to make the student enjoy and like studying mathematics and to make them motivated in gaining mathematical knowledge. Moreover, I was applying methods that can make math classes interesting and efficient. Different interactive methods were applied using elements of Drama Pedagogy, didactical games and some components of the cooperative method. Our main standpoint was to let student be a part of solving process of the mathematical problem and to encourage them to cooperate as often as possible. Our intention was to show students that they should not be afraid of trying to solve the problems and that they should not be afraid of failure. Thus they can enjoy solving problems even on their own.

Key words: experience, skill development, action-oriented and child-centered learning, sense of achievement, intrinsic motivation.

1.1 Introduction. Alternative pedagogies

In the 60s in Hungary, Varga Tamas and his work team have brought about a new revolutionary method of teaching mathematics, which is a complex system of *curriculum*, teaching strategies, methods and teaching aids. This teaching method is known abroad as the Varga- C. Nemenyi method of teaching mathematics and it has been under implementation in Finland since 2000.

"The playfulness is served by clever, constructive games. The main occupation of a child is the play because it brings along excitement, enthusiasm and enjoyment. At the beginning of the class it can raise the interest or it could close a learning stage. The play may help dissolve the phenomena that inhibit the thinking procedure. (KIKOVICSNÉ *et al* 2006, 26-27)

We owe to Tamás Varga the discovery that the young pupils need to be taught not only counting and measuring, but need to be initiated into other fields of mathematics. He thinks that a prolonged experience in acquiring knowledge is necessary.

“If the children are in an accepting atmosphere in group where they meet problems specific to their age and interests, they will experience the freedom and joy of independent thinking. We cannot exclude some teaching procedures from our schools, such as: amazement, recognition, the pleasure of solving a problem, the experience of surpassing oneself, the group work, being together with peers, thinking together, the joy of creating. Excluding all those, we would exclude the joys of life from schools.” (KIKOVICSNÉ *et al* 2006, 33)

“The more teaching methods we use, the more learners we reach. And the more ways we apply to reach them, the deeper the knowledge embeds”. (Spencer Kagan)

Few of the main objectives of the alternative pedagogies (such as Waldorf, Montessori, cooperative teaching, teaching through drama) are: the education for an individual thinking, the use of such methods, techniques and plays which develop the child's imagination and sentimental education.

Instead of filling the child's mind with a pack of information that he will soon forget anyway, I chose to make use of the possibilities which lie in the circle plays. Thus the time spent playing made learning more effective and our work more successful. The children memorized more things because they were an active part of the learning process. (Finser 2005, 28.)

Finser M. Torin, a Waldorf teacher, who tries to teach mathematics similar to the Varga method to children aged between 7-14 asserts that his aim is not only to make them practise some skills but to develop their talent, too. To develop those talents that can be used in different situations in life. It includes that the children should learn not only how to follow the sequence of tasks and of numbers, but they should develop the ability of flexible thinking, preserve their imagination, learn how to solve problems together and experience things together. (Finser 2005, 84.)

The drama in education (the drama pedagogy, further “DP”) arrived to Oradea 15 years ago due to some enthusiastic teachers and since then it has been offering teachers an alternative and a possibility to meet their peers and to teach in a colorful way. The essence of the DP is to touch the feelings and to make children learn through actions and activities. The DP workshop of Oradea (NDPM) is a professional learning community where the members take part actively in the learning process while they share their teaching experience and thus reinforce their identity as members of a community. After some time the members learn to learn from each other, to work together, to take responsibility for each other and to cooperate for the common aims. The professional learning community - besides the fact it assures the professional development of the individual and of the whole – functions as a supporting community, working as a protecting factor against the loss of enthusiasm of a teacher.

1.2 Activities

In my lecture I'm going to talk about a series of activities designed by us, which are taking place during the current academic year among 24 second grade pupils (aged 7-8) from Lórántffy Zsuzsanna Reformed Church School, an average class in Oradea. Their Teacher is Ildikó Kovács. The activities are held once a week during a lesson.

Age Characteristics: The children aged between 4 and 8 are the most receptive to forming. According to specialists this age is perfect for basing the natural sciences. This is the time to help them build up relations with the world around them, the rules and phenomena of nature.

The age between 7 and 14 is the period of time when the child's sentimental life is preeminent. All that we teach him during this age, using his imagination, will remain well embedded in his mind. If we consider the stages of intellectual development, Piaget says that the child of this age is in the stage of *concrete operations* (Piaget 1970). This is the time when, in the way of thinking, there appear a series of logical groupings: logical relations, connections, the concept of number, time, length, area, volume, mass, weight. All these are called operative concepts because they are formed based on certain operations. They were named concrete operations because they depend on the recent concrete experience and the logical conclusions are restricted to these operations.

The child can understand and do only such operations that do not surpass the models. The children are not able to draw conclusions on a theoretical level. They need a tangible, real object. The operations are always concrete, they are always connected to an activity. They are never abstract. (Ambrus 2004, 45-46)

Aims: The aim of these activities is to make learning mathematics more interesting, more exciting, more attractive for pupils and to raise their interest in acquiring mathematical knowledge, as well as to try out such methods that may turn the Mathematics classes into interesting and effective classes.

The aim is also to stimulate pupils to calculate in mind, being able to add and subtract in mind any time without using paper and pencil.

We look for various exercises, more or less difficult, which cannot be found in a school book and which are closer to true to life situations. Sometimes we transform the more abstract tasks into more tangible ones to bring them closer to the pupils and to make them more pleasant. We search for or try to invent such activities and exercises, which can captivate their volition so that the children will work to solve it involving all their energy, all their senses of perception, and finally their whole body. Thus we can stimulate not only their minds but their whole body. Using this procedure the teaching material will be learned better.

Our aim is to develop their creative thinking and their problem solving ability, to guide the them in using the acquired knowledge, to encourage them discover connections, to stir the logical thinking, the critical or divergent thinking and the argumentation. We analyze open problems, too, where they meet different approaches to the problem and there are more questions related to the same problem.

We would like to offer a learning environment which facilitates discovery, stirs the inner motivation, motivates learning and the group work, the exchange of experience and supports the talent.

We use different active and interactive methods, we try to vary the activities, mainly those which bring mathematics closer to the learners. We prefer the well working Hungarian methods (those of Tamas Varga and Zoltán Dienes). We do not intend to replace them with foreign methods but we prefer to use drama, didactic games and elements of cooperative methods.

The main objective is the learner: to make him part of the problem, involve him in the solving procedure, offer him the possibility of self expression or manifestation, help him to experience success and form him not to be afraid of failure, make him understand that mistake is allowed and lead him towards the pleasures of solving a problem.

"If we fill them with dry, abstract concepts, then no wonder that they will finally exclaim: And what if …….? The abstract thoughts, conceptions will shortly become useless and insignificant." (Finser 2005, 40)

Activities: We start the lesson by pushing aside the desks in the classroom, making some space. Then we continue with some games as warming up. These are usually skill games mingled with some mathematical elements, designed by us so that they preserve their ability feature but in the same time introduce some mathematics. After two or three games there are several groups of four formed. Examples of such games:

1. Circle game, ball game: the children are in a circle; everybody says a number in an increasing sequence and memorizes his or her number trying to remember the other ones', too. The pupil holding the ball starts the game by saying: "I went to the market and I bought 6 kg of apples" then throws the ball to the pupil who's number is six. The latter continues: "why 6? why not 12 ?" and throws the ball to number 12. Those who do not pay attention or fail the others' numbers or do not notice those who fell out of the game and whose numbers cannot be further used, will fall out of the game, too.
2. Circle game: we make up sequences. Somebody says a number and the teacher asks pupils to add to previous number another number 1 or 2 or 3 … by the time everybody had his or her turn, they would realize that this procedure may be continued with one or two rounds or it can be endless.

3. Animal and number game: everybody picks a piece of paper containing a name, an animal name and a number (eg. Goose Gill 367). They are asked to walk about and find the members of their family by making sounds imitating the animals (those who gaggle find each other). As soon as they find each other they have to sit in each other's lap starting with the eldest to the youngest (eg. Goose George 895 sits in Goose Gina's lap 657, who then sits in goose Geer's lap 489 who finally sits in Goose Gill's lap 367). The newly formed family will function during the rest of the lesson as a work group.
4. Domino game: everybody gets a colored domino card which has a number on one side and a mathematical operation on the other side. The teacher starts the activity with her own card. Everybody solves in mind the operation lying on the floor, so that he or she should know when to continue the domino line with his or her own card.
5. The club of hundreds: everybody picks a colored piece of paper containing a mathematical operation to be solved. As soon as he finishes the calculation he can pick from the blackboard another colored piece of paper with a number on it so that finally the sum of the numbers on his cards should be exactly 100. When the teacher calls out “Stop” they should finish the calculations. With the teacher's help they check each other to see who can sign in the club of hundreds (those whose final sum in their hand is 100).
6. Honey cake: everybody gets a card with a number. The pupils are lined in 2 rows, with back to back to each other. The teacher reads aloud a receipt containing some mathematical operations. The children should solve these operations in mind. The first to recognize that the result of the operation is the same with the number on his card should start running to the end of the row. There are always two children having the same number and thus the same result to an operation. But who gets there first? By the end of the receipt a pupil will have to run several times.

The receipt: Ingredients for the dough: 25-15 dkg butter or 17-9 dkg grease, 15-8 dkg sugar, 41-21 dkg honey, 35-34 entire eggs, 29-26 dl milk, 13-12 coffee spoons of baking soda, 19-17 coffee spoons of cinnamon or powder clove. We mix all these and then we add 63-13 dkg flour. We bake 18-12 tablets on the back of the baking dish. We leave it in the oven for 56-26 minutes. Then we leave them to cool down for 43-33 minutes.

The cream: we heat up 48-18 dkg sugar until it gets brown and then we pour on it 26-23 dl of water and 16-12 dl milk.

We mix 23-13 dkg flour with 8-4 dl milk, and we add it to the hot caramel then we boil the mixture and leave it to cool down. We add a pack of Rama margarine to the cold cream and 30-28 vanilla. We mix all that together.

We cover the filled plates with chocolate coating: we melt 56-36 dkg chocolate above steam or we can prepare our own chocolate like this: we boil together 34-24 sugar, 15-9 dl water and 57-55 spoons of cocoa. We take off the stove and we add 24-16 dkg butter.

Time of preparation: 78-28 minutes. Once made, it will not last more than 23-16 days.

After the warming games, when the teams are already formed, they sit at the tables in groups of four and get the tasks. First task is a handcraft where they have to assemble certain number of cards according to a given sum. Then they pass to the next task. Together with the teacher I check each team, we listen to their arguments, we accept the good results or if it is needed we help them with prompts/ questions that may lead them to the solution. We sometimes act out the problem or we encourage them to draw representation of it.

1.3 Tasks

1. Uncle Tom has an orchard with 24 apple trees. He waters them every day this way: he goes to each tree once a day and he never steps twice the same path. How can he get from tree 1 to tree 24?
2. There are some snakes, frogs and two storks in the reeds. They count altogether 9 heads and 12 feet. How many snakes, frogs and storks live there?
3. A king has 4 sons. Each brother has a sister. How many parts should he divide his kingdom into, giving each child an equal share?
4. We have got a pot of 25 liters. There is 18 liters of water in it. If we add 10 more liters, how much water will be in the pot?
5. Tom and his sister have altogether 30 cards of calendar. If Tom gave his sister 5 cards, each of them would have the same amount of cards. How many cards has now each of them?
6. Two little elves, Moss and Fern are planting in the garden. While Moss plants 3 plants, Fern manages to plant only 2. How many plants does each elf plant if they finally plant 30 altogether?
7. A snail fell into a 6 meter deep well. During the day it climbs 3 meters but it slips back 2 meters each night. When does it finally gets out of the well?
8. If a tortoise can cross the road in 60 minutes, how long does it take for 10 tortoises to cross the road together?
9. Ludas Matyi is going to Dobrog. On his way he meets 3 men on horseback, 3 men in a carriage and 3 men walking, all coming from the opposite direction. How many people are going to Dobrog?

10. Mr Kovacs has 6 children. There is 2-year difference in age between them. What is the age difference between the youngest and the eldest?
11. Hencida is 12 km far from Boncida. Two men meet on the way between the two towns: one on foot, the other riding a bike. Which one is farther from Boncida if they left at the same time from the 2 towns (one from Boncida, the other from Hencida)?
12. A candle burns out in an hour. If we light 5 such candles in the same time, how long will they be burning?
13. How many 3-digit numbers are there, which you can read from left to right and vice-versa and it still remains the same?
14. The miller goes to the mill. There are 4 women coming towards him. Each woman is carrying 3 sacs. In each sac there are 3 cats, and each cat has 3 kittens. How many of them altogether are going to the mill?
15. There are 100 hundred houses in a street. A craftsman is asked to write the numbers of each house. How many times does he have to write the number 9?
16. You have got a bag of candies. You give half of them to your friend. You drop half of the rest so there are only 6 left. How many candies did you have in the beginning?
17. I picked a number. I took away 3 and then I added 5 to the rest. Afterward I took away 10 so the rest was 10. Which was the number I thought of?

1.4 Teaching experience / conclusions

During the activities we observed the following:

In the beginning it was very difficult for the pupils to make calculations in mind but they got used to it and got faster (even at catching the ball).

They pay better attention to each other. When one of the team member tries to explain the others the situation, we are amazed how well can he do that. It's true that the children can explain things best to each other. In the same time they have to explain to the teacher their choice and thus they will better understand the task and they can see it through.

They notice many features they have not learned yet, lik the features of the addition (associativity and commutativity which make the calculation easier). They haven't learnt the multiplication yet, but certain exercises can well prepare them for it.

They have learned to pay more attention to the text. We do not solve two similar exercises which have an analogue solution. The children must pay great attention because there are various logical problems hidden among the others.

We have even solved equations, but step by step, analyzing.

We always ask them to draw, encouraging them to use the presentation.

We stimulate a positive attitude towards mistakes, that is, we let them do the calculation they have started, asking them whether they are convinced about the result. They may realize that they have made a mistake somewhere.

They children enjoy very much these classes. There were pupils who told us before the second meeting that they had been looking forward to this class.

According to György Pólya "solving a mathematical exercise can be so much fun as solving a crossword, because the powerful intellectual work can be as good as a powerful tennis match. If somebody tastes joys of mathematics, he will never forget it. In this case all the chances are given to make the pupils give some importance to mathematics in the future.

I am grateful to the drama workshop in Oradea (NDPM) who supported my work. I would also like to thank Mrs. Ildikó Kovács, the teacher of the 2nd grade, for her support. It was her pupils I worked with, and I owe her acknowledgments for her cooperation which made possible the whole series of activities.

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2 ORIGAMI AND MATHEMATICS

Asuman Duatepe Paksu

Abstract

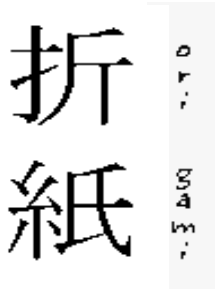
The aim of this chapter is to present knowledge and perspective about use of origami in mathematics education and in other school subjects. The readers will be introduced with origami as such and the benefits of its use in mathematics.

Key words: Origami, mathematics, geometry.

Introduction

Origami is an ancient Chinese and Japanese art of paper folding. Generally, it involves the creation of paper forms entirely by folding, without cutting or gluing.

The word origami is a compound of two smaller Japanese words: "ori", meaning fold, and "gami", meaning paper.



People began to fold paper after the invention of paper and as a result of its use in society. Japanese origami started short after Buddhist monks carried paper to Japan during the 6th century [Robinson, 2004]. The first Japanese origami is dated since this period and was used for religious ceremonial purposes only, due to the high price of paper [Lang, 1988].

Usage of Origami in Teaching Mathematics

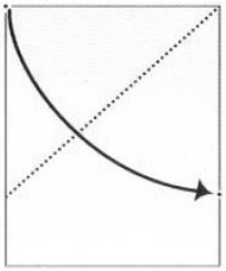
Although origami may not seem to involve much of mathematics, it has received a considerable amount of attention by mathematicians. Many concepts of geometry, calculus, abstract algebra and others can be explained using origami.

Both mathematics and origami can be regarded as beautiful forms of art in their own distinctive way, having unique relationship [Wood, 2009]. Origami can help teacher develop the mathematical understanding. It can be easily incorporated in mathematics curricula on all levels of education [Brückler, 2007]. Here are some examples of getting geometric shapes by paper folding:

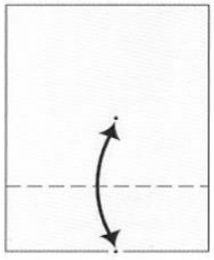
A square from a rectangle

We can discuss with our students how we can get a square from a rectangle. The following steps can guide us to get a square from a rectangle [Wood, 2009].

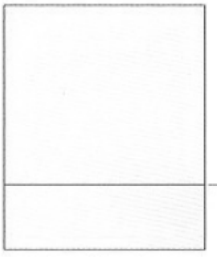
1. Fold diagonally and mark the edge of the fold with a small crease. Then unfold.



2. Fold over the edge of the paper at the crease mark. Crease the whole fold firmly. Then unfold the paper.



3. Tear off the end of the paper to get a square.



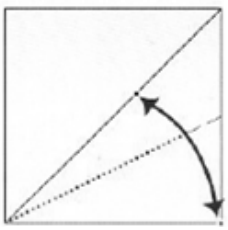
With these 3 steps we can get a square. After getting it we can discuss with our students, “How can we be sure that it is a square rather than a general quadrilateral?”

This can be our starting exercise to begin with origami. Usually, most of the origami begins with a square paper. At this point we can discuss the reasons why many origami figures start with a square paper. With this discussion students can explore the properties of square like symmetry.

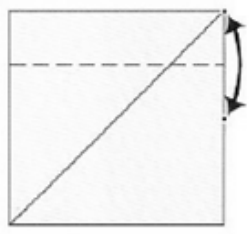
A rectangle from a square

As well as a square from a rectangle, we can get a rectangle from a square. To do that, we can guide our students as follows [Wood, 2009]:

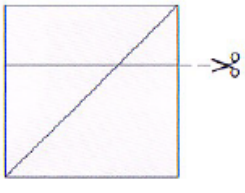
1. Fold a square in half diagonally. Then fold done side along the crease. Pinch where the edge folds. Unfold.



2. Fold in the edge of the opposite side so that it meets the pinch mark. Crease well. Then unfold.



3. Cut off the end of the paper. Finally we get a rectangle of roughly A4 (letter size) proportions.



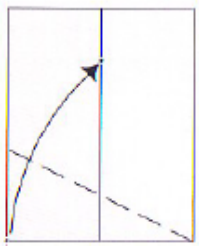
Similar with the previous paper folding, we ask our students about how we can be sure that it is a rectangle. This discussion leads students to explore the properties of rectangle.

Besides, in each step we can ask about the measure of angles we get. Particularly we may ask our students to show angles of 45^o; $22,5^o$; 135^o and 90^o.

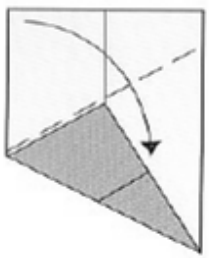
Triangle from a Rectangle

By paper folding we can get a triangle from a rectangle using the following steps [Wood, 2009]:

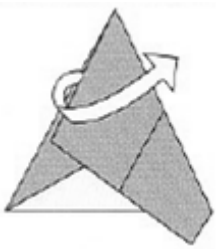
1. Fold paper horizontally in half. Crease the midline. Then fold lower corner to the midline.



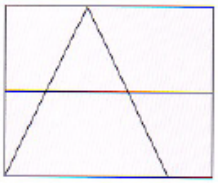
2. Fold along the edge as in the figure.



3. Unfold the previous two foldings.



4. Tear off the excess paper to leave a triangle.

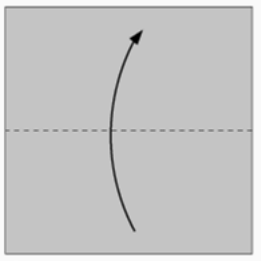


Once getting a triangle we can ask our students what type of triangle this is. After that we can create a discussion on how can we be sure about that concrete type. The discussion helps us to emphasize the properties of the triangle.

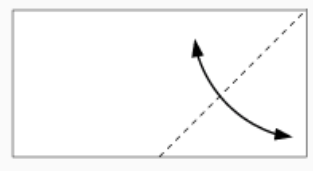
Pentagon from a Rectangle

To get a pentagon from a rectangle, follow the next steps [online source1].

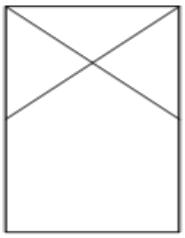
1. Fold the paper in half horizontally.



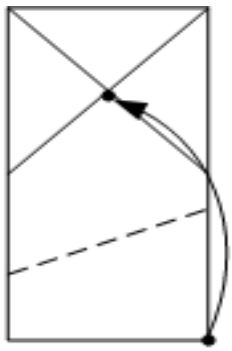
2. Fold to make this crease. Then unfold.



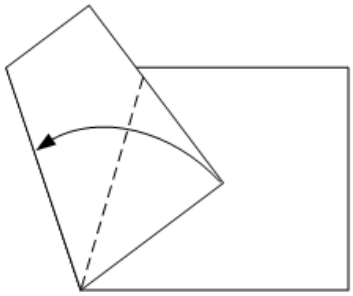
3. Fold the opposite corner to get another diagonal and crease firmly. Then unfold. Mark the intersection of the creases.



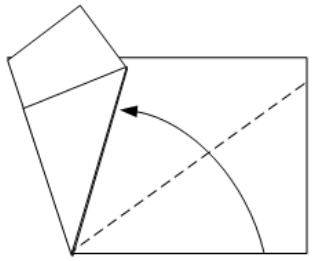
4. Fold the left bottom corner so that it meets the intersection of the segments.



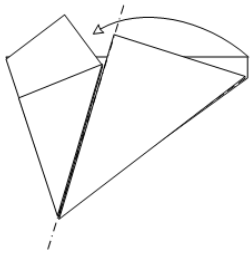
5. Take the corner so that its edge meets line on the crease.



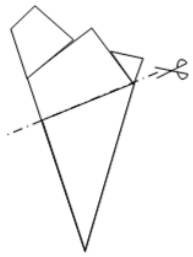
6. Make a new fold so that the bottom edge meets with the last crease.



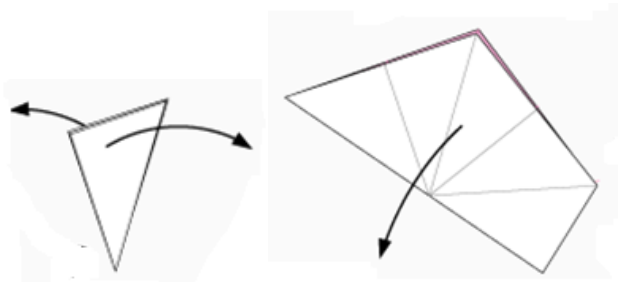
7. Fold the paper across the dotted line as in the figure.



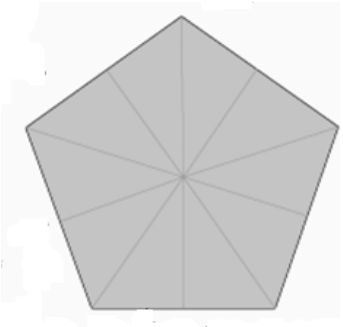
8. Cut of the paper across the dotted line. Then unfold all foldings.



9. Open the paper.



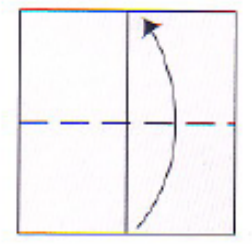
10. We finally get a pentagon.



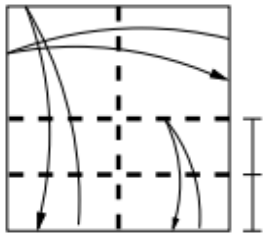
Hexagon from Square

We can get a hexagon from a square paper as follows:

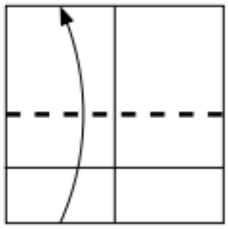
1. Fold paper horizontally in half. Crease the midline. Then fold vertically in half.



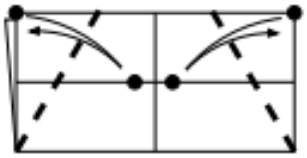
2. Fold lower half of the paper in half horizontally. Then unfold.



3. Fold the paper horizontally.

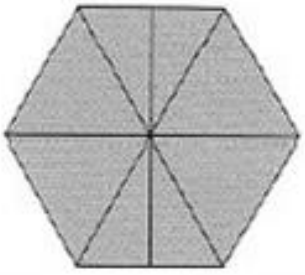


4. Fold the paper to get the corner on the midline as in the figure. Then unfold.



5. Cut the paper along the dotted line.

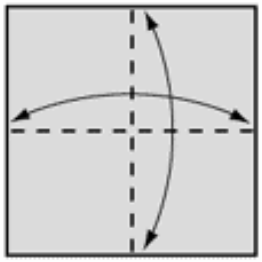
6. We finally get a hexagon.



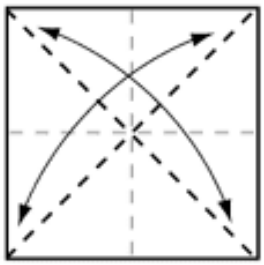
Square pyramid (tulip)

Origami can be used to create also 3D figures. One of the basic figures is a pyramid with a square base [online source 2].

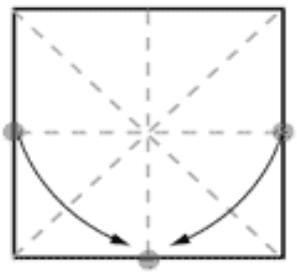
1. Fold horizontally in half, crease firmly, then unfold. Fold vertically in half crease well, then unfold.



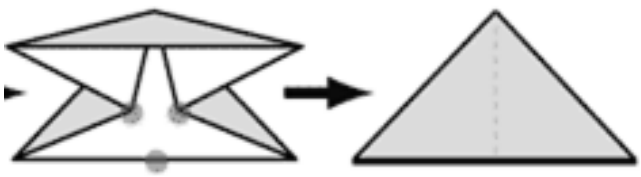
2. Fold diagonally in half, and then unfold. Fold diagonally in half along crease.



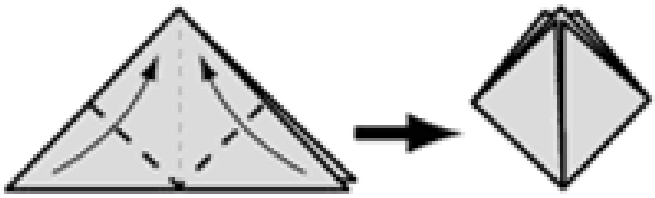
3. Push the sides in, allowing the centre to rise up, and the sides to come together.



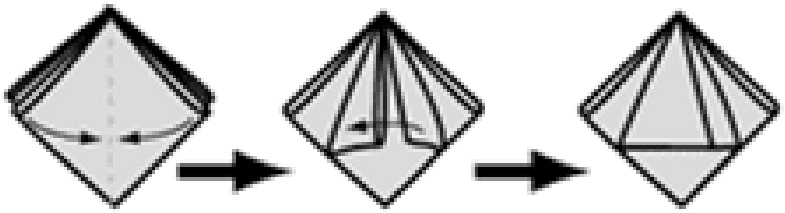
4. Flatten the base bringing the corners to each side together, ensuring all the points meet neatly at the bottom of the base. Note that the color outside is facing upward in step 1.



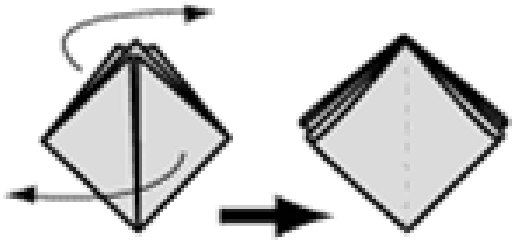
5. Fold the lower right side to meet the symmetry axis and crease well. Repeat this step for the left side.



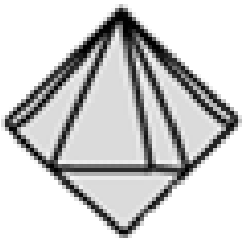
6. Then flip the paper over. Repeat the same steps on this side. Fold both right and left sides to meet in the center in a similar way.



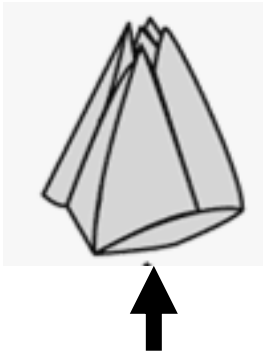
7. Move the top flap from left side to the right side. Do the same folding on this side.



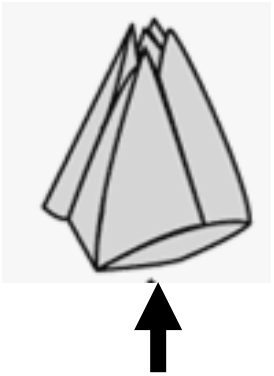
8. Fold both sides to meet in the center. Now we are going to fit one side into another. If you open this part, you see that there is a pocket. Put this tip into the opposite pocket.



9. Blow the paper hole seen in the picture.



If you want to get a tulip, gently peel back the first petal. Repeat this for the other petals.

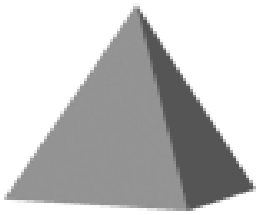


We get this tulip from a square pyramid.

After this folding we can discuss the mathematics behind origami.

Furthermore, we can create a discussion on, “can you think of any other useful thing than pretty flower?” Considering our students’ level, we can ask them

to count surface area and volume of the pyramid in terms of one side of the starting paper. Using this students can investigate this solid figure.



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3 NEW INEQUALITIES IN HIGHER EDUCATION: PRE-SERVICE TEACHERS IN PARTIUM REGION

Ágnes Réka Dusa, Edina Kovács

Abstract

The expansion of higher education created new type of inequality. The students who have worse social and cultural background than others have no acces to student mobility programs and do not plan to take part in PhD courses. Pre-service teachers – who sholud be chosen from the most talented students – one group of these new type students group with fewer opportunities. Our analysis is based on the HERD research study database: 2 728 students were interviewed. Results show that – despite of some advantages – pre-service teachers' academic achievement is worse and they are less involved in student mobility. To avoid the increase of their inequality during the higher education, colleges and universities should pay special attention to encourage their participation in academic competitions, PhD courses and student mobility programs.

Key words: higher education, teacher training, student mobility, academic achievement, inequality.

Introduction

A number of international studies pointed out that the quality of education system, in parallel students' performance will improve if the most talented students enter the teacher training. Those countries which have successful and effective education system, select the most talented students when they are applying to tertiary education (Sági and Ercsei 2012). However, according to researches, there is negative self-selection in Hungary: the students with worse secondary school academic achievement apply for teacher training, and among graduates the ones who choose teaching profession are the ones who had weaker performance during their training (Varga 2007, Ercsei 2011). Most of the pre-service teachers are first generation in higher education: they are a part of a new student group which has appeared at universities because of the expansion of higher education. The presence of these new types of student groups created new situations and sometimes new problems at universities (Pusztai 2011). One of these social problems is that these student (also) have entered into higher education to increase social mobility chances (primarily through increase of their

cultural capital), but the expansion of higher education – besides equal opportunities – created a new kind of inequality in education. Access to international student mobility is one of these new type of educational inequality (Hrubos 2012). It would be desirable to reduce inequalities during the teacher training, in academic achievement and in student mobility, and thus increase the cultural capital of future for future teachers. First part of this paper reviews who typically chooses to become teacher, and what factors affect their mobility and their achievement. In the second part we examine – based on HERD research database – how are the pre-service teachers in the Partium region compared with other students and how they are involved in student mobility.

Scientific literacy versus negative self-selection

Recent research on the effectiveness of educational systems underscores the importance of good teachers in ensuring the quality of an educational system (Mourshed and Barber 2007, Mourshed, Chijioke and Barber 2010). At the same time we can see that pre-service teachers have poorer academic performance and less interests in PhD studies than other students in the most European countires. Discussions often linked these facts to the feminization of teaching profession. But maybe it is not that obvious, because the long-term engagement and caring attitudes of pre-service and beginner teachers are only slightly affected by gender.

Taking part in PhD programs is made important because of the so called scientific literacy. Knowledge creation is not a linear process anymore; it is constructed through researches or increase via social interactions. Without scientific literacy teachers have very few opportunites to learn new, and question earlier knowledge and practices. In addition, teaching profession should be seen as an academic career: now it has a low status in most european countries and teacher education is not a real choice for talented students (Niemi 2008). Unfortunately the 'Graduate Follow-up Research 2010' shows that PhD studies would only be chosen by 2.2 percent of pályakezdő teachers as opposed to the 4.3 percent of the whole sample. At the same time there are no differences concerning master's degree courses: one tenth of those asked think that they would like to undertake further study (Kovács 2012).

Another problem is that one third – in some countires half – of beginning teachers are leaving the profession, usually those who have university degree. Some of them, although still teaching, consider different profession. As Hargreaves and Fullan write: students encounter less and less satisfied teachers and a high proportion of them would rather be somewhere else. This hinders creation of

professional capital which has three components: human, social and decisional. Latter is defined as the knowledge of complex situations and the capacity of analyzing and solving problems (Fullan and Hargreaves 2012).

Factors influencing engagement to a teaching career were examined in a number of countries. Women in Netherlands are more apt to stay in teaching profession, the study shows. Those who are satisfied with their training and have positive experiences during the teaching practice, would like to teach. Students with extrinsic motives indicated having negative teaching experiences and they intended to remain in the profession for shorter periods. (Bruinsmaa and Jansena 2010). A swiss study found that among first generation students in higher education it were mostly women who chose teacher training institutions. This self-selection is motivated by short duration of training, the practical orientation, and the lack of scientific interest (Denzler and Wolter 2008). A study which reviewed three Australian universities found that, teaching as a profession was typically chosen by young women from less affluent. Researchers examine whether there are empirically identifiable types among beginner teachers at the outset of their career and developed profiles based on professional engagement and career aspirations. They established three clusters based on these dimensions. There were no difeerences between clusters by gender; age and social background show only a slight difference (Watt and Richardson 2008).

Hungarian researches suggest there are no significant differences between pre-service teachers and other students by social background or the level of parents' education (Varga 2005). However, researches of Fényes show that within the feminine scientific and educational fields – including teacher training – boys have better social backgroud and they show less mobility (Fényes 2011). Male beginner teachers more often start their career in another profession or leave teaching profession. There are no academic achievement gaps between the pre-service teachers and other students in university-level teacher training, but Varga found that among college students one has worse academic performance if he comes from college-level teacher training (Varga 2007).

International Student Mobility and pre-service teachers

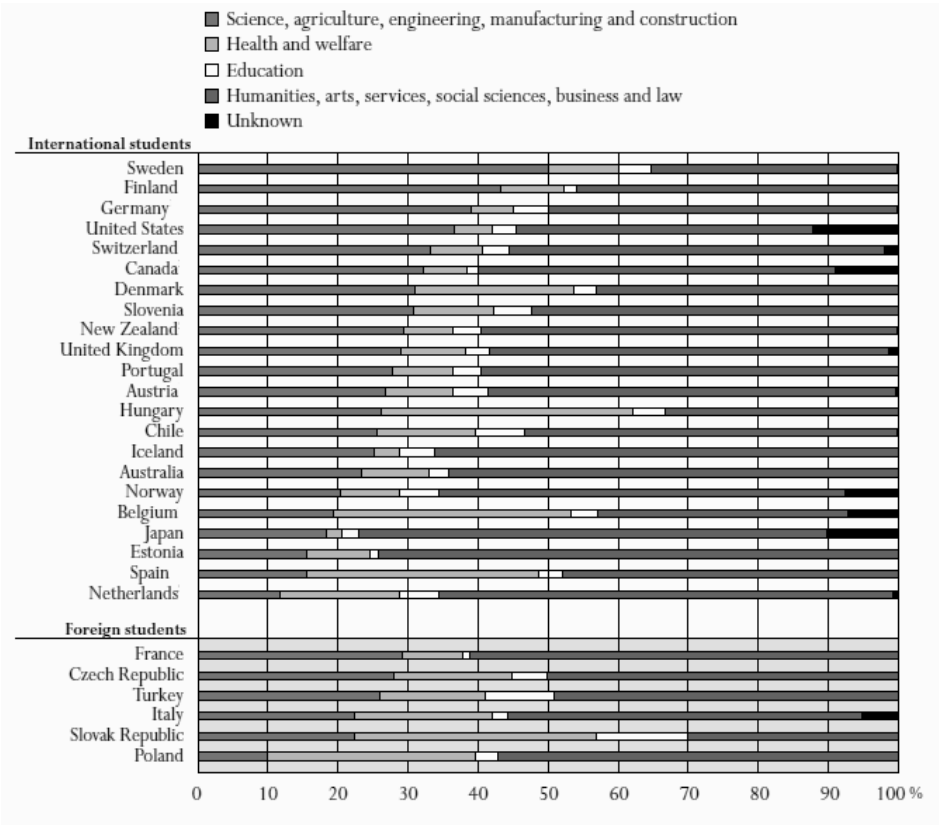
The literature on higher education research defines negative tendencies of student mobility on one hand, with the phenomenon of 'brain-drain', and on the other hand, with the widening of the gap between students (mass education vs. elite education). Notwithstanding that studying abroad has become accessible for

a much broader strata, there is a lot of students who does not have opportunity to travel to a foreign university. Former studies about inequality in international student mobility emphasize the influences of the parents' level of education (González et al 2011; Danka 2010; Eurostat 2009; Bauwens et al. 2008), the socio-economical background (Kasza 2010; Teichler 2011; Finger 2011), earlier tourist experiences (Illés – Michalkó 2008; Berács – Malota 2007; Carlson 2012) and lack of foreign languages skills (Pusztai – Nagy 2005; Eurostat 2009; Kasza 2010).

At the case of subject areas, we can see that there are "mobile subjects" and "immobile subjects" in higher education. The research of OECD shows that students who study in the field of Education, are minority compared to other areas.

Figure 1. Distribution of international and foreign students, by field of education (2008)

sources: Education At A Glance 2010: 322.



If we examine the case of Erasmus, we find that during the period 2000/01 to 2007/08 there was an increase in number of Erasmus students studying 'social sciences, business' but a decrease in those studying 'education'.

Table 1. Subject areas of Erasmus student mobility from 2000/01 to 2007/08

sources: Lifelong Learning Programme. The Erasmus Programme 2008/2009. A Statistical Overview.

Subject areas (%)	**2000/2001**	**2004/2005**	**2007/2008**
Business and social sciences	31	32.2	34.3
Arts, humanities and languages	25.6	23.5	23.6
Engineering and architecture	13.7	14.4	14.8
Other subjects	6.8	7.7	3.3
Law	7.9	6.7	6.7
Medical sciences	4.8	5.2	5.8
Natural sciences	4.1	3.7	5.2
Education	**3.7**	**3.2**	**3**
Maths and computing	2	3.2	3.3
All subject areas	100	100	100

Within Erasmus the most popular subject areas were the 'social sciences, business and law' (a 41.6 percent share), and 'humanities and arts' (23.3 percent) in the academic year 2008/09. The 'services', 'agricultural and veterinary sciences' and 'education' were the least participated areas.

This is similar to Hungarian data. When we examine the mobile Hungarian students' subject areas, we can see that the most popular is the business and less popular are the natural sciences and education.

Table 2. Studens who attended foreign training or work experience during the higher education, by field of studies (%)

source: Graduate Follow-up Research 2010, Educatio Non-profit Kft.

	Take part in study abroad
business	39
arts (included languages)	21.6
law	8.3
engineering	8.3
medical sciences	6.1
social sciences	6.1
informatics	3.8
agrarian sciences	3.4
education	2.3
natural sciences	1,1
All subject areas	100

Therefore it is rather worrying if students with a lower economic status, with lower tourist experiences, etc. are left out from the academic mobility, i.e. from acquiring the special skills and knowledge that are specific to studying abroad, because a further new type of inequality may be caused in a knowledge-based society. According to a 2008 international research, the special skills and knowledge besides the command of a foreign language are: independence, the development of general communication skills, team work, tolerance and empathy, the ability of dialogue between cultures through overcoming prejudice and stereotyping, as well as the easier adaptability to new, coping with unexpected situations or unfamiliar teaching methods (Bauwens et al. 2008). These skills will play an important part later in their higher education careers and work: researchers analyzed the most important competencies needed in employment and found that independent work, cooperation within a team (Fónai et al. 2012), initiative, speaking skills in a foreign language (Kiss 2010), realistic self-esteem and motivation (Csoba – Cibere 2012) are frequently demanded skills. Since these are competences that can be developed during a shorter or a longer period of study abroad, its participants may gain advantages that the students remaining at home may not benefit from (Tót 2005). The characteristics assume those skills are important for people regarding the job in question – compared to the whole of the sample – the ability to interact with others is significantly more important for teachers, which may be connected with the caring attitude expected from them (Kovács 2012).

The concept of mobility capital is a new supplement of the new type of inequality in higher education (access to international student mobility). Murphy-Lejeune (2002) used the concept of 'mobility capital' in connection with her anthropological examination of European student mobility. According to her, the mobility capital is an elemental component of decision-making in international student mobility: who has high mobility capital, goes abroad, who has low mobility capital, stays at home. Murphy-Lejeune's definition of mobility capital consists of four components.

First, the student's mobility capital is increased by the student's personal history, the international ties of family and friends and his/her family's geographical mobility history. Another examples are mixed marriages, moving to a foreign country (for example, due to the parents' job), or graduating in an international high-school. The second component of mobility capital is the student's former mobility experiences, including language competency. Even the very short study tours or family holidays lead to high mobility capital. The third

component consists of student's personality traits like sociability, openness toward other ethnic, new cultures or new situations. According to Murphy-Lejeune you can get these competencies without geographical mobility. For example, if somebody is member of national, ethnic, religious minority, or living in a multicultural society. At last, the fourth element is the ability to cope with culture shock, and successful adaptation of new cultures, unknown habits and norms (Murphy-Lejeune 2002).

Differences between pre-service teachers and other students in achievement and mobility

Our analysis is based on the HERD research study database. The sample includes full-time students – both state funded and tuition paying – who are participating in the 1st and 3rd year BA/BSc, the 1st year MA/MSc, and the 1st and 4th year integrated programs. The sampling technique was a combination of stratified group sampling and clustering – after the stratification of the population per faculty, stratification was applied for educational levels and year per each faculty. From the group interviewed within the HERD survey (N=2 728) 204 students have completed pre-service teacher's inset at faculties that educate teachers. They come from the following higher education institutions in the Partium: University of Debrecen (64 persons), Ferenc Kölcsey Reformed Teachers' Training College (17 persons), Debrecen Reformed Theological University (2 persons), College of Nyíregyháza (17 persons), Babeş-Bolyai University - Extension in Szatmárnémeti (50 persons), Ferenc Rákóczi II Transcarpathian Hungarian Institute (53 persons); one respondent did not specify any institute. Because of the incidental completion of the inset, the teachers' sub-sample does not follow the distribution of the whole sample, thus the sub-sample's sampling is not representative for anything by itself. For this reason, our findings do not generally apply for all students in teacher education within the region, yet our data may significantly contribute to knowing them better.

The inset mentioned above includes questions about satisfaction with training, commitment, future career plans and also 36 questions about how important it is for the student to achieve the goals set during teaching. In addition to the previous variables, we studied: gender, field of study/subject and social background of the respondents.

Hypothesis 1: the students of pre-service teachers have worse financial conditions and less cultural capital than non-teacher training students, and their learning achievements are worse.

Hypothesis 2: the students of pre-service teachers are less mobile and have lower mobility capital.

30.8 percent of the respondents of the whole sample are men and 69.2 percent are women. As one would expect, the proportion of women among the students in teacher training is higher than throughout the whole sample, namely: 79.7 percent versus 20.3 percent men. The students' cultural capital does not distinguish between pre-service teacher and others: the highest level of education of both parents is similar in the whole sample.

The questions sought to uncover objective and subjective material conditions of students' families. There was no difference between the pre-service teachers and the rest of the sample concerning their family in comparison to national average, friends and to classmates.

The objective index has been complied on the basis of eleven durable consumer goods listed in the questionnaire. Thus, if the person's family has all of them, the aggregate index is 11, if it has none of them, the index is 22. Financial situation of students who are not in teacher training is better: their index is 16.58, while the pre-service teachers' is 17.74 (significance = 0.000).

The questionnaire measured student's learning achievements by several indexes. For example if student got scholarship or any award for academic achievement in secondary school, and if he got additional points for state language exams and extra learning achievement. He was also asked about grants and academic activities during his higher education.

Pre-service teachers seem less successful than the rest of the sample: several variables show a significant difference.

More non-teacher training students got scholarships from academic achievement in secondary school.

More non-teacher training students have intermediate and advanced state language exams. Advanced languge exams gap is reduced during the higher education, but there remains a significant difference in the number of intermediate exams.

Table 3. High school academic awards by fields of studies (%)

	Have award	Do not have award	Total
Pre-service teachers	31.9	68.1	100
Other students	39.0	61.0	100

significance = 0.022

Table 4. Intermediate state languge exam by fields of studies (%)

	Have exam	Do not have exam	Total
Pre-service teachers	26.9	73.1	100
Other students	50.7	49.3	100

significance = 0.000

Table 5. Advanced state languge exam by fields of studies (%)

	Have exam	Do not have exam	Total
Pre-service teachers	5.8	94.2	100
Other students	11.7	88.3	100

significance = 0.002

In contrast, significantly more pre-service teachers took part in the National Secondary Schools Competition (so called OKTV). But this special interest disappears in higher education: there are no differences between pre-service teachers and other students who took part in the competition of National Student Conference.

More pre-service teachers have their own research topic or field and it is not just a mere interest because many of them have publication as well.

Table 6. 'OKTV' attendance by field of studies (%)

	Have OKTV	Do not have OKTV	Total
Pre-service teachers	11.9	88.1	100
Other students	4.9	95.1	100

significance = 0.000

Table 7. Have their own research topic by field of studies (%)

	Have	Do not have	Total
Pre-service teachers	39.7	60.3	100
Other students	24.9	75.1	100

significance = 0.000

Table 8. Have publication by field of studies (%)

	Have	Do not have	Total
Pre-service teachers	7.8	92.2	100
Other students	4.5	95.5	100

significance = 0.015

To examine the mobility capital of pre-service teacher, we make a new variable with help of questions of HERD database. First element is the mobility history of students and their families. Sadly, we have very poor information about the students' previous geographical moves or international ties. But we asked them about type of their secondary-school specialization, especially the bilingual courses, so that we can interpret "international experiences", because these students learn one foreign language. We also count the language exams to former mobility history, if the student took that before attending higher education.

The second component of mobility capital is the students' individual international experiences and languages skills. The previous mobility experience can be measured with working abroad and family holidays[1]. To measure the language skills we used not only subjective self-assessment but questions that measured objective language skills. First, whether respondents have passed a language exam. Second, whether they have curriculum vitae in any foreign language, because the foreign language curriculum vitae is a good indicator that someone is planning to work/study abroad or worked/studied in another country.

The third factor is the openness towards other cultures, which is prepared on the basis of questionnaires HERD. We used a shorter and adapted version of Bogardus social distance scale. The original question was: How would you react if you had to share a room with a Roma/foreign/exchange/ethnic minority students? Into the third factor we included the students' satisfaction with international events and other programs that waere organized by university. We assume that when somebody expressed the level of satisfaction, he/she has at least once participated in international events. The fourth component of capital mobility is coping with the culture shock and ability of adaptation to new culture and norms. Sadly, we had to skip that component because of lack of questions.

[1] How often do your family vacation / holiday abroad (not for work, not near the settlement boundary)?

The final questions are included (e.g. subjective knowledge, tolerance) and then converted into dichotomous variables:

Question	**1 – increases mobility capital**	**0 – does not increase the mobility capital**
1. Did you graduate from bilingual secondary school?	yes	no
2. Did you receive any extra points at higher education admissions because of complex intermediate (B2) and/or advanced (C1) language exam?	yes	no
3. Do you have curriculum vitae in a foreign language?	yes	no
4. How would you rate your English and/or German and/or French language skills?	the student rated his/her language skills at least in one language and at least with "good" grade (speaking skills, writing skills and reading)	the student rated "bad" at least one of his/her sub-skill (speaking skills, writing skills or reading)
5. How satisfied are you with international programs organized by the university?	rather satisfied or very satisfied	rather dissatisfied very dissatisfied
6. How often does your family go for a holiday abroad (not for work, not near the settlement boundary)?	several times a year, once a year	less often than once a year
7. How would you react if you had to share a room with a Roma/ foreign/ exchange/ethnic minority students?	fully agree, rather agree	rather disagree fully disagree
8. Have you ever worked abroad?	yes	no

We labeled cases “low mobility capital” when somebody answered positively maximally to two questions, “moderate mobility capital” if somebody answered positively three or four questions and “high mobility capital” if somebody answered positively minimum five questions out of eight. As expected, the pre-service teachers have lower mobility capital compared the other university students.

Table 9: Differences between pre-service teachers and other students by level of their mobility capital

	Pre-service teachers	Others	Total
Low mobility capital	52,4	43,4	44
Moderate mobility capital	40,3	48,3	47,7
High mobility capital	7,3	8,4	8,3
Total	100	100	100

significance: 0,05

Conclusion

The first hypothesis seems partly verified: students in teacher training have worse financial background than other students and their academic achievements are worse, too. But there is no difference in student’s cultural capital: more than half of them are first generation students in higher education. The reason can be the characteristics of Partium region. It should be noted that the only indicator in which the pre-service teachers are better than the secondary school is competition attendance. More than one out of ten come to the universities extremely interested in a subject or a special topic. But this interest disappears during the higher education and at last they do not take part in academic competitions.

The second hypothesis was verified, the pre-service teachers’ mobility capital is lower than the case of other students. Similarly to the international results, the pre-service teachers do not have enough mobility capital to choose studying or working abroad. We hoped higher tolerance (that is an important characteristics of pre-services teachers) will enhance the pre-service teachers’ mobility capital, but we found that it was the only component which showed higher scores compared to other students. Overall, the higher level of tolerance is not enough to stand by other components like language skills or earlier work experience.

It seems that pre-service teachers have some advantages over others: many have some special interest when they enter higher education and one of their most important competence is their ability to interact with others and tolerance. The last one is not a surplus of student mobility beacause their foreign language skills are poorer than other students'. Although they have their own research topics, they do not feel urge to move forward in academic ranks. Their social background is worse than that of students who are not in teacher training and most of them are first generation in higher education. To avoid the increase of their inequality during the higher education, colleges and universities should pay special attention to encourage their participation in academic competitions, PhD courses and student mobility programs.

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4 INSTRUCTIONAL SOFTWARE WITH FOCUS ON INSTRUCTIONAL GAMES IN MATHEMATICS AND CHEMISTRY EDUCATION

Pavla Hanzalová, Kateřina Chroustová

Abstract

This chapter provides basic information about instructional software, mostly about instructional games, which are often neglected. First part introduces definitions of basic terms as instructional software, educational game and instructional game and also their classifications. Second part presents some examples of instructional software, mostly instructional games usable for mathematics and chemistry education. It focuses on Czech and English web portals. It also includes particular examples of interesting games with theirs screenshots. The significance of instructional games progressively increases because the computer and the Internet is becoming part of everyday life for every pupil. Therefore, the conclusion summarizes the occurrence and availability of instructional games on the Internet.

Key words: Instructional software, instructional games, mathematics, chemistry, education.

Introduction

Changes in society and everyday use of information and communication technologies (ICT) bring about the changes of requirements in the educational system. Nowadays everybody is expected to handle these technologies at least on the user level. That is why the ICT literacy became one of the key competences of the curriculum in the Czech Republic. This is not the only reason why ICT is involved in the education more often. Teachers are no longer using ICT as a mere complementary and helpful tool for interpretation, the ICT starts to penetrate the education itself. One of the options of partly replacing in some of the roles of the teacher is to use the instructional software. The instructional games are counted among the instructional software and with their help we can make the unpopular and difficult subjects, such as mathematics and chemistry, more attractive.

Instructional software and its definition

By instructional software we can name any educational program which partly or completely replaces the teacher while teaching. So we can equate term instructional software to the term educational software. Educational software has a lot of definitions. One of them is stated by Dostál (2011; author´s translation): *"Educational software is any computer software which is designated for educational purpose and can fulfill at least some of the didactic functions."*

In similar wording, instructional software is delimited by Doering & Veletsianos (2009):

"*Instructional software is applications software designed specifically to deliver or assist with student instruction on a topic. Although applications software such as word processing and spreadsheets can also enhance instructional activities, this textbook differentiates between applications software and instructional software. Software tools serve many purposes other than teaching; instructional software packages are developed for the sole purpose of supporting instruction and/or learning*."

We can find another definition for example in the pedagogical dictionary (Průcha, Walterová and Mareš, 2009; author´s translation): "*Computer software which allows a person-computer system to fulfill didactic functions. Educational software controls the work of a computer and according to its quality adapts to the way of pupil´s learning, or according to his personality, and it controls his learning. It can fulfil the role of a lector, repetitor or examiner. It can simulate unique situations, set a different difficulty of the tasks, and provide continuous and final feedback. Educational software can be single-purposed or universal (user sets it according to his own needs). It is named as 'teachware' abroad*."

Classification of instructional software

We can classify instructional software by several criteria. First of all, let's focus on the classification dealing with the use or more precisely role of the computers and subsequently instructional software in education.

Bílek (2005) provides the Moore classification from 1964. He separates the use of computer (software) in education to four categories:

- **CAIDI** (Computer AIDed Instruction) – computer is only used as a helper while presenting the subject matter
- **CAI** (Computer Assisted Instruction) – teaching led by a computer, which takes over all the functions of a teacher

- **CATC** (Computer Assisted Test Construction) – tests generation supported by a computer
- **NTCA** (Non Tutorial Computer Application)

Another classification (Černochová, Komrska and Novák, 1998) is provided by Taylor in his work "*The Computer in the School: Tutor, Tool, Tutee*". He separated working with computer and instructional software according to their position (role):

- **Tool** – programs which serve only as a tool for our activity and that is why we do not classify them as an instructional software
- **Tutor** – programs which replace the teacher, they teach the pupil, exercise with him, test him and meet the requirements of instructional software
- **Tutee** – program which leaves the control on the pupil, receiving and following his commands; pupil becomes a teacher
- **Toy** – includes computer instructional games; this category was added later

The division of instructional software according to the function can be found for example at Doering & Veletsianos (2009):

- **Drill and Practice** – software provides exercises in which pupils work out problems or answer questions and provides them feedback on their correctness
- **Tutorial** – software which teaches pupils; its instruction is similar to a teacher's classroom instruction; according to this instruction pupils should be able to learn the topic without any other help or materials
- **Simulation** – software demonstrates the real or imagined process or system over time; this computerized model teaches pupils how this system works
- **Instructional Game** – including games designed with educational purposes, which increases motivation by adding game rules into educational process
- **Problem Solving** – this software is focused on developing skills towards general problem-solving ability, it gives pupils opportunities to practice solving various kinds of problems

We can find a similar division of instructional software according to function in the Czech Republic (Chroustová, 2013; Szotkowski, 2007):

- **Programs for exposition of the teaching material** – the goal of these programs is to mediate new knowledge to pupil; they can completely replace the interpretation of the teacher or of the textbook.
- **Programs for fixation of the teaching material (exercising)** – used for exercise the topic after its previous interpretation; they are probably the

most used programs; they are mostly designated for independent work of a pupil but they can also be used for exercising during the class

- **Programs for testing of the level of adoption of the teaching material** – used for testing of knowledge of pupils; can be also used for verifying their results whether by a teacher or by a pupil himself
- **Simulations** – simulation is a computerized model of a real-world process or system, which allows changing the parameters interactively and showing influence of this change immediately
- **Instruction games** – games developed with educational purposes which provide education by fun
- **Programs for controlling the lab work** – contain not only programs for controlling the experiments in so called remote laboratory, but also software to support the real experiment used mostly in combination with various sensors
- **Programs for the teaching of programming** – these programs can be used mostly for teaching informatics or as a tool for developing the logical thinking

In the Czech Republic the most extensive categorization of educational software was performed by Dostál (2011):

- **According to the rate of interactivity**
  - interactive
  - non-interactive
- **According to the level of education**
  - programs for nursery school
  - for basic school
  - for middle school
  - for university
- **According to the rate of providing the feedback**
  - providing feedback
  - none feedback
- **According to the number of didactic functions**
  - programs with didactic function
  - programs didactic
    poly-functional
- **According to specialty for particular subjects**
  - specialized programs
    (for example for chemistry, mathematics, history, geography,…),
  - non specialized programs

- **According to the organized character of education**
  - programs for schools
  - for self-study
- **According to on-line x off-line functionality**
  - off-line programs
  - off-line programs with on-line support
  - on-line programs
- **According to number of users**
  - mono-user
  - more users
- **According to thematic extend**
  - monothematic
  - poly-thematic
- **According to possibility of perception**
  - visual
  - audio-visual
- **According to language mutation**
  - mono-language
  - poly-language
- **According to the version**
  - full version
  - demo version

Instructional game – definition and classification

The game (Hanzalová, 2013) can be defined as a specific type of human activity (but we can found it even among some animals). It is manifested mostly in the early developmental stages of the human, but in other variants accompanies him all his life. It can take different manifestations. Games reflect social and environmental influences and abilities of the human.

Educational game (Maňák, Švec, 2003) preserves most of the characteristics of a classic game. It can be defined as "a self-realization activity of individuals or groups whose freedom of choice, the application of interest, spontaneity and release adapt for educational goals." Educational game should fulfill the following criteria (Krejčová, Volfová, 1994; Hanzalová, 2013). It should be attractive and match the age peculiarities and talents of pupils. The game should employ as many senses as possible. The rules have to be clear and not changed so often. It is

necessary to organize and prepare all materially sources before playing the game. It is not necessary to invent another game for each lesson - a pupil learns the rules and focuses on the present content of the game. Games should not be included in lessons randomly, they should have a goal. The implementation should involve the whole team, each pupil should be able to reach success (or his/her group) - for this purpose game may have elements of chance, chance for weaker pupil to win.

Due to the variety of activities it is difficult to clearly classify educational games. As reported by M. Jankovcová (Jankovcová, Koudela and Průcha, 1989), educational games can be sorted according to many aspects.

E. g.

- According to the **duration** (short and long)
- According to **place where they are set** (in the classroom or outside)
- According to **type of dominant activities** (acquisition of knowledge, intellectual or physical skills)
- According to **what is evaluated** (quality, quantity or time of performance), etc.

Vosáhlo (2011) states the main characters of computer games according to V. Pokorný:

- Have a goal, which informs about their finiteness.
- Requires an understanding of the nature and purpose of the game, which allows to finish game successfully. The loss does not mean much for player.
- Most of them have an individual character.
- Most of the games can be repeated.
- A specific type of games (MUD = Multi User Dungeon) allows the construction of reality. It is a system that allows several players to use simultaneously a comprehensive data bank through the network.

Now we can define a term **instructional game**. Dostál (2009) in his article about teaching programs and computer games states this definition: "*Instructional game is a software which enables to evoke activities aimed at developing an individual's personality by entertaining way.*" (author's translation) The following definition focuses on the activities during instructional game: "*Educational game through the computer is an activity of the individual (or individuals), which is based on a virtual simulated environment on computer - and primarily consists of the development of personality, and according to its specialization can provide fun, entertainment or relaxation."* (Dostál, 2009; author's translation)

Dostál (2009) divides instructional games in the same way as instructional software.

Another classification is provided by Jurinová (2011):

"*We classified didactic computer games into these groups:*

- *games which enrich knowledge, fix, broaden and improve knowledge gained during lessons (crosswords, quizzes, and so on),*
- *games which develop perception, memory, ingeniousness, senses (rebuses, teasers, riddles, mazes),*
- *cognitional games (games dealing with concrete facts from particular area, for example games of technical character, historic, literary, geographical games),*
- *creative games (e. g. for communication development, topic, theme, constructive, graphic-algorithm realized e. g. in Comenius Logo environment)."*

We can classify games also according to inclusion into the educational process followingly: motivation, to gain new knowledge and experience and to fix the knowledge. (Jurinová, 2011)

Instructional games in mathematics education

According to article which deals with web applications in the teaching of mathematics (Robová, 2008), we can divide material available on the internet into:

- comprehensive website (for interpretation, practice and repetition),
- mathematical applets and scripts,
- mathematical programs (demos, shareware and freeware),
- mathematical encyclopedia, summaries,
- mathematical museums (source of historical notes and interest),
- mathematical games and competitions.

Author deals with these categories more and links to individual web pages and portals (it is interesting that in the first category the author points to their lack, mainly in Czech language). In the last category (games and competitions) author devotes only one page to recreational mathematics and few pages to mathematical correspondent competitions.

In the following part we present individual examples of instructional software, mostly instructional games, which are focused on mathematics and chemistry. All mentioned software is available on the internet. It can serve as variegation in schools lessons, but it is especially determined for entertaining practice at home.

Mathematical portals

IXL

Many mathematical games on the internet have a form of tests (a set of questions to which the pupil has to respond or choose the correct answer from the options). One website, which includes a very large number of mathematical topics, is ***IXL Learning*** (2013) designed for children in kindergarten and primary (divided by grades) and secondary school (divided by topics). This is a U.S. website that allows fun practicing mathematics. Unfortunately, this site is commercial and only in English (not available in different language). The access to full version (which includes also the statistics on pupil progress and various awards as ribbons, medals and other virtual prizes that keep them motivated) is granted after paying the membership fee. Without the fee, daily practice limit is 20 free exercises. It is a form of test with questions, which immediately after response indicates if it is correct and if not, it will provide a justification and correct solution.

"*IXL motivates students through interactive games and exercises while keeping teachers and parents informed and involved. With more than 2,500 skills spanning pre-school through high school, IXL offers a dynamic and enjoyable environment suitable for any learning style.*"

"*Used in all 50 U.S. states and more than 170 countries.*

More than 2 million active subscribers.

Over 20 million math problems served per day. Over 6 billion problems served total.

Over 7 million activities and quizzes created by teachers."

Khanova škola (translate: Khan's school)

In the Czech Republic there is very famous foreign (even mathematical) project ***Khanova škola*** (Dítě, 2013). It is a Czech branch of Khan Academy using flipped teaching. It is a complex of videos and exercises. After free registration student can see how many lessons he passed or not (in percentages). It can be also used as account for teachers where you can add your students and use it as a supplement to teaching.

"*With our technology you can:*

- *determine pupils themes (videos) to see*
- *give exercises to fill*
- *monitor how successful individual students perform their tasks.*"

(Dítě, 2013; author's translation)

The website contains videos from the English original, which are gradually translated. According to information on the website, 2.5% videos are dubbed, but more than 75% videos are without translation. Exercises are done in the form of questions and exercises, that student have to answer. After the wrong answer student can choose whether he wants to answer again or wants to be shown the solution - it is shown step by step so it can serve as a help too.

Khanova škola, o. s. is a non-profit organization, which supports all innovative and free education. It has the official support of Khan Academy.

Web portals with instructional mathematical games

Math-play.com (Popovici, 2012) is English portal with mathematical games - like television contests (Millionaire, Math Jeopardy), some test questions, puzzles and other. These games have separate results but they are not saved. You can start the game again from the beginning, but encounter the same questions. There is a lot of websites like these, mainly for younger pupils. For example, there is the Czech website ***Matematika hrou*** (Dobrý, 2013).

MATH NOOK [Math Games and More] (n. d.) is a portal with games and didactic materials for primary school. Games are sorted by branch of mathematics (algebra, geometry...), by the educational theme or by the grade (grade 1-6). This page also provides links to videos from Khan Academy.

Arcademics™ (2013)[Academics + arcade = fun learning] is a web portal focused on instructional games for primary school (grade 1-6). It is one of the few sites that provide multiplayer games. This is a portal in English with possibility to purchase a special account.

Web Game Portals

We can also find mathematical games in the general web games portals as an individual category. For example we can mention ***PrimaryGames*** (2013), ***GAME LICKER.com*** (2013), ***LogickeHry.cz*** (2011) or ***Raketka.cz*** (2011). These web portals often provide similar games.

Particular examples of instructional mathematical games

Mathematical Zuma

This game (Raketka.cz, 2011) has the same principle as the game Luxor. Your goal is to get rid of balls that are slowly moving to areas that you have to patrol (Fig. 1). But it's not just about colour matching. The sum of the numbers on the ball you shoot, must be exactly 10. If you hit a group of balls of the same number, all disappear. You can change two bullets in the centre by press “Space”.

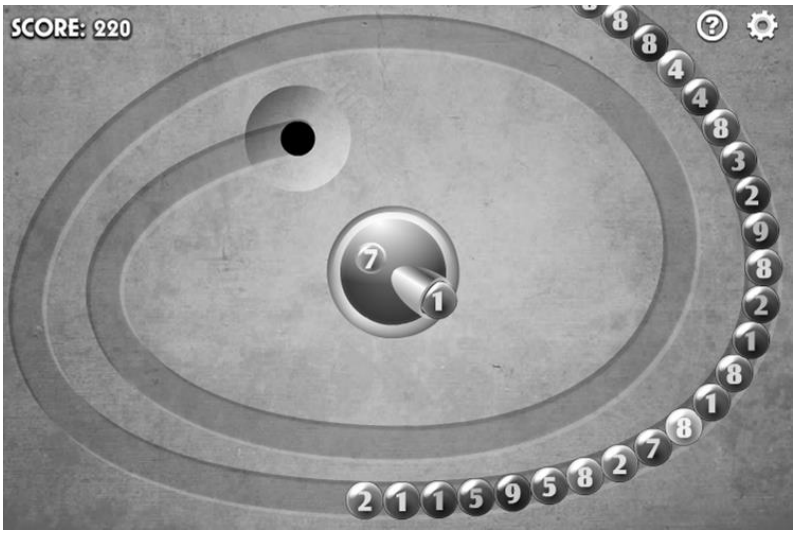

Figure 1: Mathematical Zuma

Slicegeom

This game (PrimaryGames, 2013) is very good for practicing approximation. At the beginning, we see a shape and we have to divide it into certain number of equal parts, but we have exact number of lines (1st Level: circle into two equal parts with one line, 2nd Level: square into four equal parts with two lines). It is converted to percentages (see Fig. 2) and you get awards according to the accuracy. You have to use all the lines - even if it is possible with fewer lines. There are 60 examples of easy variant and 60 examples of difficult variant. In difficult level there are the places through which the dividing line cannot lead.

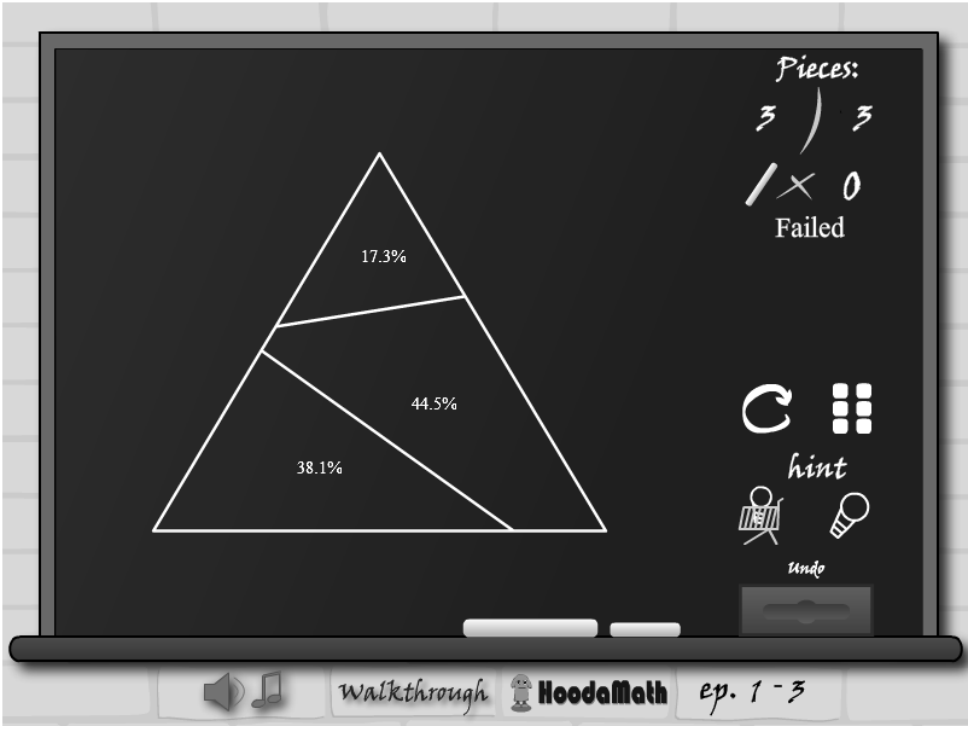

Figure 2: Slicegeom

Krácení zlomků (Reducing the Fraction)

The following example (Dobrý, 2013) is a variation of the classic game – pexeso (concentration game). In this variant we see all the cards at the beginning (see Fig. 3) and our goal is creation of all pairs. This particular game is for practice of reducing the fraction (or fractions in basic form).

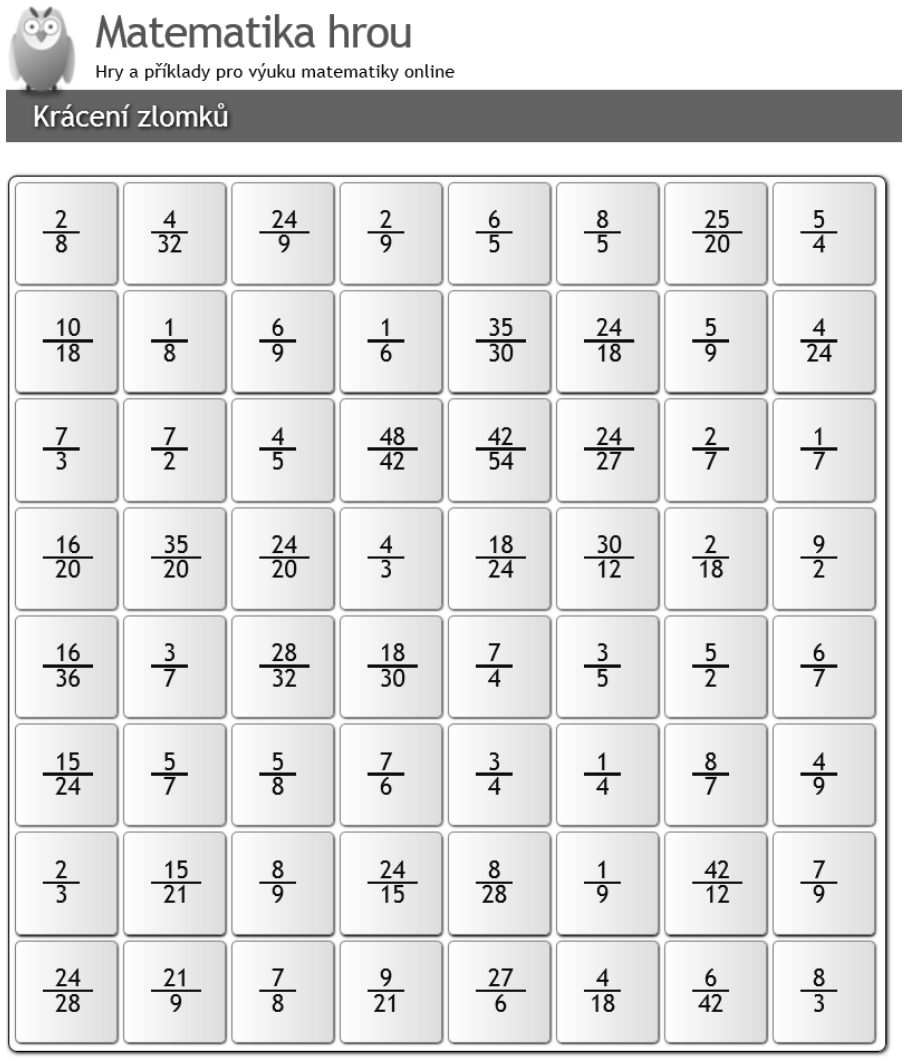

Figure 3: Reducing the Fraction

Jumping chicks

This game (Arcademics™, 2013) can be played by more players. It is a competition where winner must get to the destination first. You have to jump on the leaves, whose number is the number at the bottom in a frame. On the right bottom there is the position of opponents (see Fig. 4). This game is intended to train numbers 1 - 9. Advantage of this game is the option to play alone or more players.

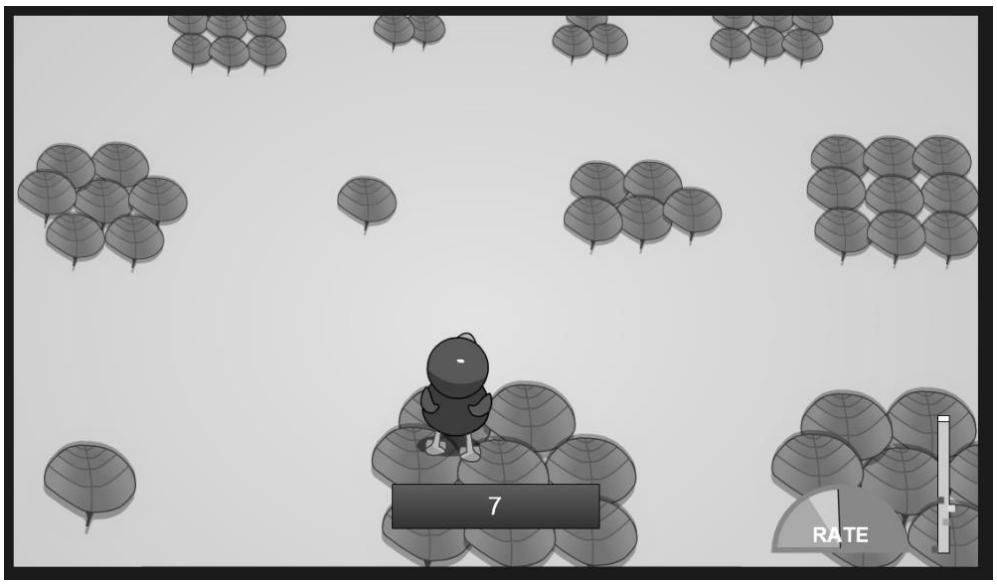

Figure 4: Jumping Chicks

Whales adventure math

This game (MATH NOOK, n. d.) allows you to practice the coordinates of points in the Cartesian coordinate system. Using the dial on the right bottom you determine, where the whale has to swim (using coordinate system, which is part of the board – see Fig 5). The task is to direct the whale to the finish. However, we have to minimize crashing on the bank, because it reduces the number of whale's life.

Figure 5: Whales adventure math

Instructional games in chemistry education

We do not usually come across with the use of instructional games in chemistry education in the Czech Republic. That can be caused by inaccessibility of the free chemical instructional games, much less of those in Czech language. We can more often find a game that has nothing to do with chemistry, but a motive (for example a chemist shooting balls). The increase of knowledge is not happening while playing these games. Correct instructional games include an analogue of classical games: pairs, filling gapes, criss-crosses and so on. These are used most frequently. Alternatively, we can have games inspired by local TV contestshows "Az-kvíz" (Az-quiz) and "Riskuj" (Jeopardy!) – see more in examples of instructional games.

Source of instructional games for chemistry education

There are many websites which can serve as a source of instructional games for chemistry.

Among the Czech sites we can name: ***www.studiumchemie.cz*** (2009-2013), portal of Faculty of Science of Charles University to support the chemistry education on basic and middle school: in category "*Výukové materiály*" (Educational materials) in the file *"Hry & kvízy*" (Games & Quizzes). There can be found for example games such as "AZ-kvíz" (AZ-quiz), "Riskuj" (Jeopardy!), concentration games, criss-crosses and filling gapes. Every game contains a description with a mentioned author or instructors, year of release and link. AZ-quiz and Jeopardy! are mentioned in detail in examples of instructional games.

Another Czech website is ***Škola Hrou*** (2008) of Faculty of Education of Masaryk University. There can be found many different types of motivation tasks such as various types of crosswords, puzzles, criss-crosses, word search, and filling gapes, rebuses, ciphers etc.

We will mention two foreign websites. Summary of the links for the chemical games can be found on the website ***Chemistry Games*** (Happy Chemist, n. d.). There are links for many flash and video games for kids and pupils from basic school and middle school. But we have to be careful, because not all the games are instructional games, but only related to chemistry. Pure instructional games are games like crosswords, puzzles, mastermind molecule, Chemical mahjongg, Find the alien and lot more…

Another foreign website is ***Creative Chemistry*** (Saunders, 2000-2013). Following instructional games can be found under "*Fun stuff"*: Crossword Puzzles; Impossible Mission Quizzes, Word Searches, Slide Puzzle, Chemistry Hangman puzzle, Chemistry Concentration Game, Chemistry Jigsaws, Chemistry Word Jumble or Chemistry Breakout Game.

Particular examples of instructional games for chemistry education

AZ-Kvíz (AZ-quiz)

This game is based on a TV show. It is played on a playing field in the shape of triangle created by a smaller fields marked by the letters A – Z (from here the name) or by numbers (see more in the figure 6) – this modification is used more often during the lessons. Every small field hides one question. If the question is answered in the right way, the field belongs to the contestant that gave the

answer. The goal of the game is to connect all the sides of the triangle through these fields. If the answer is not correct, the question is offered to the opponent. If the opponent does not give the right answer or if he is not interested in taking over this particular field, when someone asks for it again, there comes a alternative question which can be answered either Yes or No. In this case the field belongs to your opponent if you answer it wrongly. This game can be also played in a group. The game can be easily modified and used in all of the subjects and on all of the topics. This particular AZ-Quiz was created by Roštejnská (2007a) in the PowerPoint program and the questions are from biochemistry.

Figure 6: Playing filed of AZ-Kvíz

Riskuj! (Jeopardy!)

Also this is a modification of a TV show. This one was created by Roštejnská (2007b) in PowerPoint program. The playing field (see Fig. 7) is created by 25 quiz questions divided into 5 different areas. In this case it is (in the row): Saccharide, Protein, Lipid, Nucleic acid and Cell. The questions are graded by their difficulty: the easiest ones are worth 1000 points, the hardest ones 5000 points. The class is divided in 3 or 4 groups. Those groups choose a topic through their speaker from the playing field. The group which knows the answer asks to speak and answers the questions through a chosen player. If the right answer is given, the group gets corresponding number of points, if not, these points are deducted. The next question is chosen by the group that gave the last right answer. If nobody knows the correct answer the next question is chosen by the group that chose the last question. The button of the answered question changes its colour and is no longer used. The game is over as soon as all the questions are answered. The group with the most points wins. The rules of this game can be modified, for example we can find a variation where only the group that chooses a question can answer it and the groups take turn in a previously arranged order or there is no subtraction of points.

Sacharidy	Lipidy	Bílkoviny	Nukleové kyseliny	Buňka
1000	1000	1000	1000	1000
2000	2000	2000	2000	2000
3000	3000	3000	3000	3000
4000	4000	4000	4000	4000
5000	5000	5000	5000	5000

Riskuj – hrací pole

Figure 7: Riskuj! – Playing field

ChemGameTutor

ChemGameTutor is the most complex and the most comprehensive game which we found on internet. This game was developed by Lichten ([2012]) and is based on this story: "*Dr. Despair has gone and captured the 12 most famous scientists of all time! You have been dispatched with your knowledge of chemistry and mathematics to find them and set them free.*" Pupils save the individual scientists by fulfilling a various tasks from 11 chemistry topics: Significant figures, Matter & Energy, Atomic Theory, Periodic Table, Naming, Bonding, Reactions, Thermodynamics/Equilibrium, Acids & Bases, Electrochemistry and Organic Chemistry. In future there will be 13 topics, 2 of them are under the construction in this time: Solutions and Nuclear Chemistry. Each topic is divided into several parts in which pupil has to answer a specific number of questions or fulfil other task, scientist will be released afterward. There is no login required to play and teachers can create an account for students and keep track of student's progress.

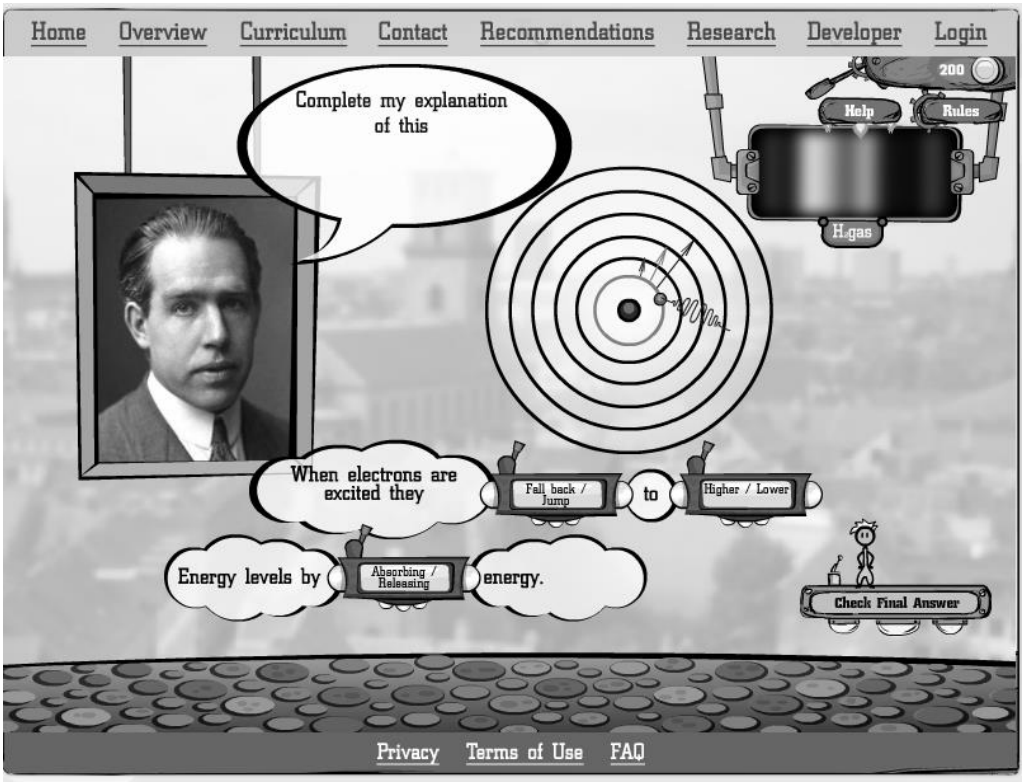

Figure 8: Task from Atomic models, concretely Bohr´s atomic model

ChemiCroc

Website ChemiCroc (n. d.) was developed for pupils of primary school. It contains chemical quizzes and simple games with chemical topic. It deals e.g. with various materials, difference between solid and liquid, reversible or irreversible process. The Figure shows instructional game solving problem – pupil should investigate what makes sugar dissolve more quickly. The website is only in English, which can be problematic for Czech pupils.

Figure 9: Profesor ChemiCroc asks the question and he helps pupils find the answer.

Periodic Table Game – Level 1

This is one of Element games from website Sheppard software (Chemical element games, n. d.). This game helps to practice name of elements, its chemical symbol and position in the Periodic table. After correct click on right place with searched element, you can see a lot of information about this element in left corner. If you answer incorrectly, the game alerts you. In the middle of the left side pupil can monitor his actual score. Other games are focused on naming element, put element in his correct position within the periodic table or detect element from its atomic number or atomic mass.

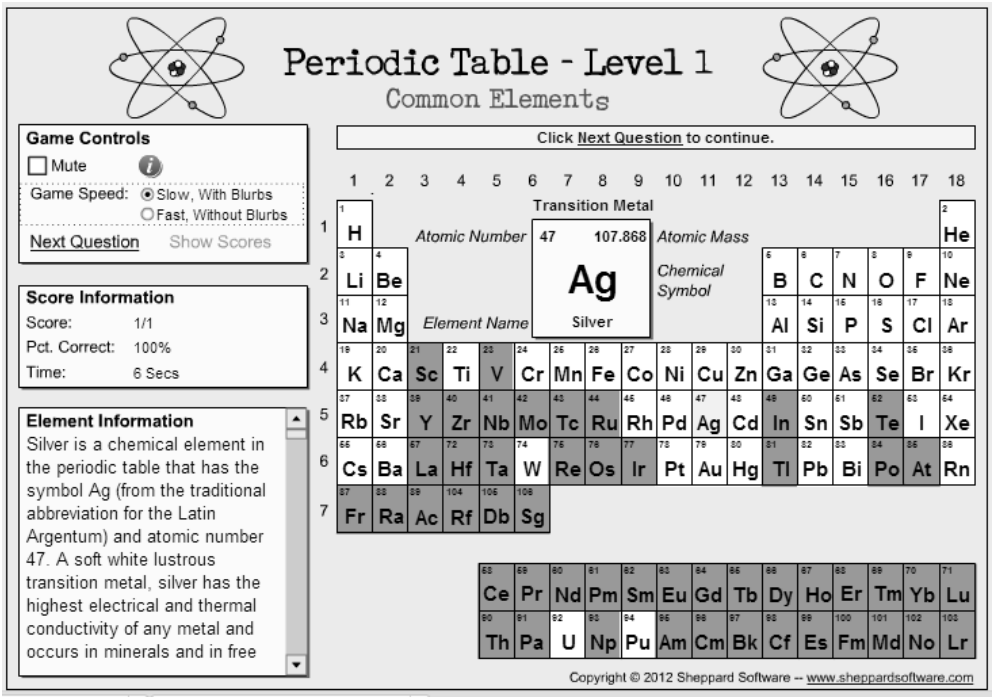

Figure 10: Periodic Table Game - view after correct answer

Chemical Mix–Up

This game is for kids. It helps them differentiate examples of elements, compounds and mixtures. Before each level kids can see an intro page with concrete examples which they should differentiate in this level. They get 100 points for right determination and lose 50 points for wrong one. First level includes three examples from each category; in next level they add one more example for each category. For now game includes three levels. (Chemical Mixup, [2013])

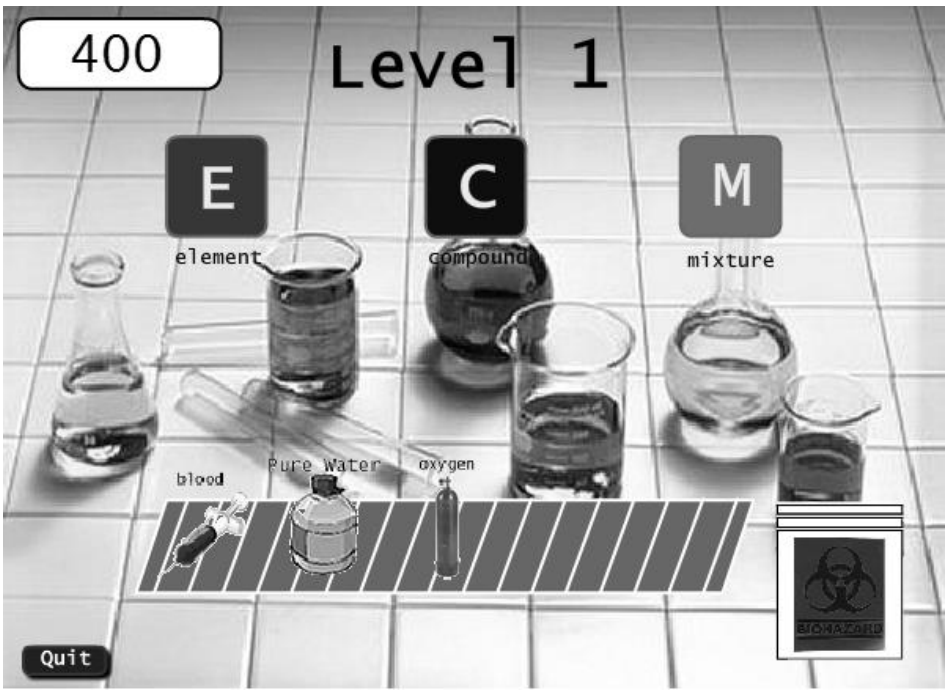

Figure 11: Chemical Mix-Up

Chemical Formulas Game

In this game you create common chemical formulas from offered elements and numbers. Game´s database includes 1366 compounds as oxides, acids, hydroxides, hydrides, hydrocarbons, complexes, salts, etc. For each formula you receive points. The longer the chemical formula is the more points you can gain and also more time, which is running out. (Sławomir, 2009)

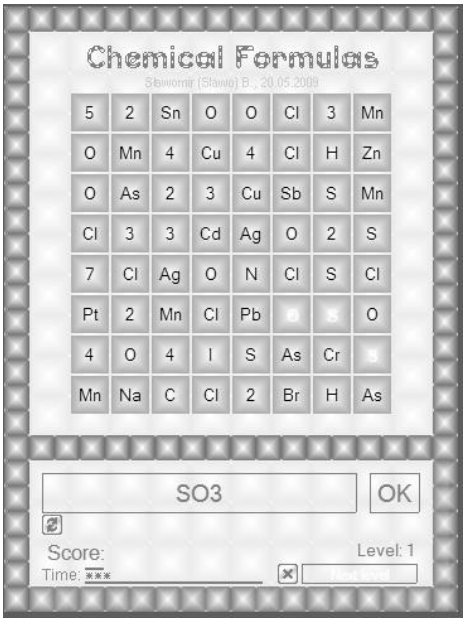

Figure 12: Chemical Formulas Game

Conclusion

The significance of the use of computers in lessons and during pupils' home preparation is recently growing rapidly. The main reason is the availability of information and communication technologies. Therefore, it is important to use these technologies during education and draw attention to their other function - educational. Instructional software is one of the possibilities. The second part of the chapter introduced particular examples of instructional games for mathematics and chemistry education. The chapter makes it obvious that most of them are useful for repetition and fixation. When we look at each subject, we can see, that most of mathematical instructional games are pursued for basic mathematical skills (for pupils aged from 6 to 10). It is probably caused by the traditional approach of education at the elementary school, where instructional games are used much

more in comparison with the upper classes. Educational games for pupils aged from 11 to 15 years old can be found, too, but in smaller numbers. The games are really rare for pupils at high school and on. Most games are made for a single player and only few allow a small number of multiplayer modes. There are much more Instructional games for mathematics than those for chemistry. Some of the instructional games for chemistry are purposed for kids, some of them can be used at high school. So it seems that for chemical instructional games there is relatively equal distribution of the curriculum. Again, there are games mainly for individuals. We can say that the most number of computer instructional games can be found on the English portals. Czech portals provide usually a students' works or documents shared by teachers. Often there are links to foreign games with added translated rules. And also it rarely includes summary of all the topics in the subject. Because of those deficiencies and neglect of instructional games in education, there is a huge space for development of other instructional games especially in the Czech language.

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5 ON A METHOD SOLVING SOME MATHEMATICAL PROBLEMS USING QUANTIFIER ELIMINATION

Lukáš Honzík

Abstract

Quantifier elimination over real fields is a discipline connected with mathematics, logic and computer science. Using so called cylindrical algebraic decomposition allows to simplify mathematical formulas with quantifiers into quantifier-free formulas. Since this is quite complex problem, programs of computer algebra (such as Mathematica by Wolfram Research) are very helpful. Many mathematical problems (for example equations and inequations) can be transformed into quantified formulas and the elimination is a way to solve them or find out if they are solvable. Therefore this method may be useful not only for mathematicians but for math teachers and talented pupils, too.

Key words: quantifier elimination, CAD, Wolfram Mathematica, QEPCAD.

Among "skills" of some computer algebra systems that are not usual and well-known to the ordinary users, there is a process called quantifier elimination or, more precisely, quantifier elimination over real closed fields. In this chapter we will subsequently find out what the quantifier elimination exactly is, show its history and emergence in brief and in the end its possible use, not only in the school mathematics.

Quantifier elimination is quite young mathematical discipline; its beginnings trace back to the beginning of the 20th century when Polish mathematician and logician Alfred Tarski dealt with this subject for the first time. Although Tarski tried to find an applicable algorithm for this problem (in his papers he even used a term "decision machine", which induces an idea of hypothetical machine that works according to an inserted program), he was not successful and had to admit that his method was too complicated and time-consuming. More information on this issue including Tarski's method can be found in [4].

The shift came in the second half of the 20th century in connection with the rapid development of computers. At that time American mathematician George E. Collins and his colleagues suggested an algorithm called Cylindrical Algebraic Decomposition (CAD) which, using a different approach, allowed to simplify the elimination. Collins and his co-workers published their achievements in 1974

in article [1]. In the coming years, the first implementations of algorithm appeared and in the 90's, when some of the improvements of the process were developed (e.g. partial CAD).

Let us continue with two motivational mathematical problems. Every student gets acquainted with quadratic equations in maths classes (usually in a form $x^2 + px + q = 0$) and it is necessary for him to calculate real roots or even find out if there are any and if the equation is solvable. The solution of this problem is quite simple, namely the discriminant $D = p^2 - 4q$ must be non-negative.

Using quantified mathematical formula in a different way, the situation can be described as $(\exists x)$: $x^2 + px + q = 0$ and the answer is in a form of quantifier-free formula $p^2 - 4q \geq 0$.

The transition process from quantified formula to quantifier-free formula is called the quantifier elimination and it is very important that both formulas are equivalent. In addition, the quantifier-free formula is usually simpler than the first one.

Quantifier elimination is very useful in proving some classes of mathematical theorems, propositions and statements, or finding such conditions under which they are forced to be true. But that is not all. Since there are many mathematical problems that can be transformed into quantified mathematical formula and expressed in this way, the possibility of using the quantifier elimination is quite wide.

For example, the following system of equations can be solved as follows.

$$x + y - z = 7$$
$$x^2 + y^2 - z^2 = 37$$
$$x^3 + y^3 - z^3 = 1$$

At first, we transform the system into quantified formula. It can be done in more ways, let us pick this one:

$$(\exists x)\colon x + y - z = 7 \wedge x^2 + y^2 - z^2 = 37 \wedge x^3 + y^3 - z^3 = 1.$$

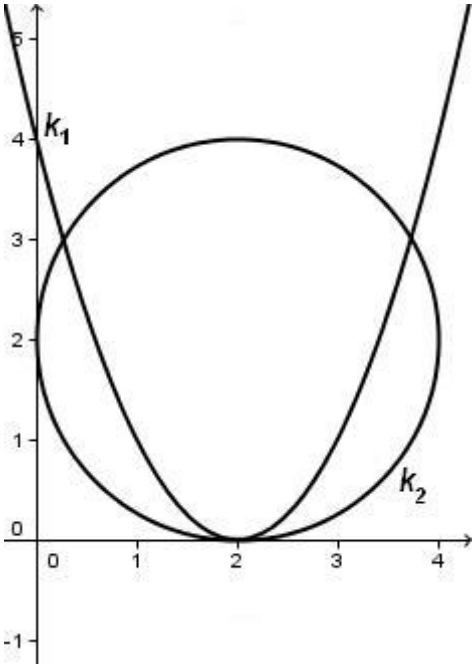
Then equivalent quantifier-free formula is $(y = 10 \wedge z = 12) \vee (y = 9 \wedge z = 12)$. The value of unknown x can be calculated easily and so we have two different results $[x, y, z] = \{[9, 10, 12], [10, 9, 12]\}$.

The best way of understanding the basic idea of CAD and how it works, is to demonstrate it on a simple example. Let us look at the following quantified formula $(\exists x)$: $y < x^2 - 4x + 4 \wedge (x - 2)^2 + (y - 2)^2 \leq 4$ which in fact contains a system of two inequations with two unknowns

$$y < x^2 - 4x + 4$$
$$(x-2)^2 + (y-2)^2 \leq 4.$$

The system, of course, can be solved in some other ways, but we will use the CAD to describe its process.

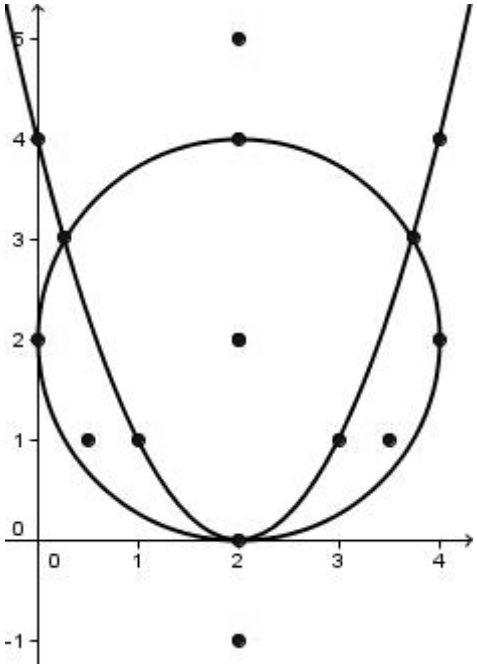
As shown in the picture 1, there are two boundary curves corresponding with the above-mentioned inequations; k_1: $y = x^2 - 4x + 4$ (a quadric function $f(x) = x^2 - 4x + 4$) and k_2: $(x-2)^2 + (y-2)^2 = 4$ (a circle with its center in $S = [2; 2]$ and radius $r = 2$).



Picture 1: Graphic representation

The goal is to make a decomposition of 2-dimensional space R^2 into a finite number of disjoint areas, so called cells. Then it is easy to verify if the formula is true or false in every single cell by picking up a suitable testing point in each cell. It is, of course, necessary to abide some important conditions at this point, especially the one that says that the sign of all polynomials coming from the above-mentioned inequations must hold in every cell. In general this is not a trivial thing, but dealing with quite simple polynomial equations and inequations only (unlike e.g. complex logarithmic or exponential equations and inequations) the condition is met.

Using the "human" approach, it is quite simple to perform the desired decomposition with the points of testing sample stated below.



Picture 2: Testing points

The sought list of testing points is

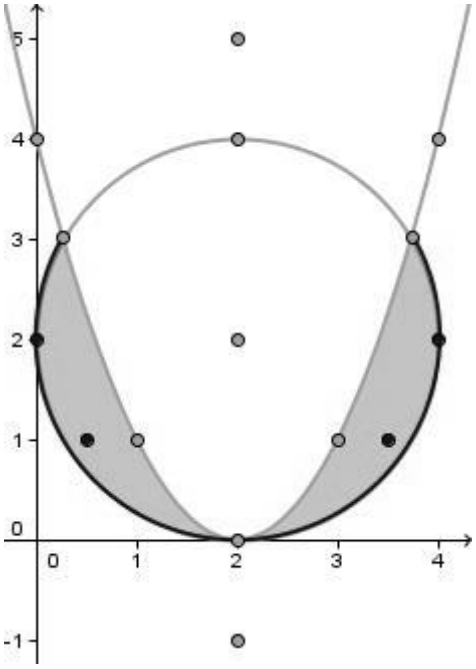
s = {[2; −1], [2; 0], [1/2; 1], [1; 1], [3; 1], [7/2; 1], [0; 2], [2; 2], [4; 2], [α; 3], [β; 3], [0; 4], [2; 4], [4; 4], [2; 5]}

where $\alpha = 2 - \sqrt{3}$ and $\beta = 2 + \sqrt{3}$.

By substituting values of all these points into inequations $y < x^2 - 4x + 4$ and $(x-2)^2 + (y-2)^2 \leq 4$ we find out for which ones of them the formula is true and for which ones false. If a point passes this test, i.e. the formula is true, it is also true in the whole cell and on the contrary, if a point fails and the formula is false, it is false in the whole cell too.

In our case, there are several points that pass the test and they are [1/2; 1], [7/2; 1], [0; 2], [4; 2].

The situation is shown in the picture 3 with mentioned points painted blue and with proper cells highlighted, too. This result can be used to construct an equivalent quantifier-free formula.



Picture 3: Result

The equivalent quantifier-free formula is $0 < y < 3$.

The above-mentioned process is purely "human" method using possibility of graphic interpretation which cannot be used in a multidimensional space (or in situation where there are more variables and parameters in the quantified formula). When talking about computer methods of quantifier elimination we must abandon this approach because the process of proving mathematical theorems and solving mathematical problems with computer is a bit different.

Appropriate computer algorithm consists of three phases called the projection base, the base phase and the extension base. First, a so called projection set is constructed, that describes a set of polynomials of input quantified formula in the projection phase, than the set of testing points is constructed in the base phase and finally an output quantifier-free formula is produced in the extension phase. The whole algorithm is very time-consuming and complex (especially its third part - the extension phase).

Let us leave the algorithm aside (the detailed description with flowchart can be found in [5] and [2]) and focus on the possible use of the quantifier elimination in school mathematics.

An invaluable aid is provided by computer algebra programs which are able to eliminate quantifier even in quite complex cases. Available programs nowadays

include Wolfram Mathematica by company Wolfram Research, Maple by Waterloo Maple and an application called QEPCAD.

Mathematica and Maple are complex mathematical systems with many other functions and tools besides the quantifier elimination, whereas QEPCAD is intended only to simplify entered mathematical formulas through the quantifier elimination. There are also some other differences, for example Mathematica and Maple are commercial programs available for MS Windows, Linux, Mac OS and Solaris; whereas QEPCAD is a free application, but available only for Linux. Furthermore, there is a different way how programs do the elimination; Mathematica and QEPCAD use CAD algorithm, Maple uses a triangular decomposition and sometimes it has troubles with the results and outputs.

Let us focus on use of Mathematica and QEPCAD.

There are some important expressions and commands in the Mathematica: expression **Exists [variable, statement]** represents quantifier $\exists$ and says that there exists a value of variable for which statement is true; expression **ForAll [variable, statement]** represents quantifier $\forall$ and says that statement is true for all values of variable, for example, the expression **ForAll [x, x*y == 1]** represents a quantified formula $(\forall x)$: $x \cdot y = 1$ and **Exists [{x, y}, x + y > 0]** stands for formula $(\exists x, y)$: $x + y > 0$; command **Resolve [expression]** (and command **Reduce [expression]**) is used to eliminate ForAll and Exists quantifiers in given expression. The mentioned expressions and commands can be written in more complicated forms where one expression or command is used as an argument for another expression or command, e.g. expression **Exists [{p, q}, ForAll [x, x^2 + p*x + q > 0]]** describes a quantified formula $(\exists p, q)(\forall x)$: $x^2 + px + q > 0$. In these cases, of course, you need to pay attention to keep the correct order of quantifiers and variables or parameters.

Let us have a look at some examples.

Example 1: Find the results for polynomial inequation $x^4 + 2x^3 - 21x^2 - 22x + 40 < 0$.

First, we try to find out if any result for the inequation exists at all. It can be done by eliminating quantifier in expression $(\exists x)$: $x^4 + 2x^3 - 21x^2 - 22x + 40 < 0$ for which the command **Resolve [Exists [x^4 + 2x^3 − 21x^2 − 22x + 40 < 0]]** is used. Mathematica's answer is **True**, that means there really is a value of x for which the inequation is true. To find that value, we must alter the command into **Resolve [ForAll [x, x0 < x < x1, x^4 + 2x^3 − 21x^2 − 22x + 40 < 0], {x0, x1}]** where **x0 < x < x1** is an additional condition and the command says we are looking for such interval (x_0, x_1) in which for all values of x the inequation is true. This time the answer is a bit complicated

(x0<–5&&x1≤x0)||(–5≤x0≤–2&&x1≤–2)||(–2<x0<1&&x1≤x0)||(1≤x0≤4&&x1≤4)||(x0>4&&x1≤x0). At first sight the result seems confusing but remembering the condition $x_0 < x < x_1$ and knowing the signs && and || stand for logical conjunction and disjunction, the meaning of answer becomes quite clear. The result is a union of intervals $(-5, -2) \cup (1, 4)$.

Example 2: Find the conditions for a quadratic form $2 \cdot x^2 + b \cdot x + 3$ to be negative.

Now there is a variable *x* and a parameter *b* in the quadratic form that can be according to the text of example transformed into inequation $2 \cdot x^2 + b \cdot x + 3 < 0$.

At first let us find out if the inequation even has any real result. We use command **Resolve [Exists [{x, b}, 2x^2 + b*x + 3 < 0]]** and the answer is **True**. That means there is at least one real value of parameter *b* for which the inequation is true. Using a bit modified command **Resolve [Exists [x, 2x^2 + b*x + 3 < 0]]** would produce an output in form of quantifier-free formula where only parameter b appears. The answer is **b<–2** $\sqrt{6}$ **||b>2** $\sqrt{6}$ and it represents the searched condition. In other words, the quadric form $2 \cdot x^2 + b \cdot x + 3$ is negative if and only if the parameter *b* belongs to union of intervals $(-\infty, -2\sqrt{6})$ $(2\sqrt{6}, \infty)$.

Example 3: Find the limit for $x \to \infty$ of a function $f(x) = \frac{5x}{3x-2}$.

First, we will use a definition of limit in a form of quantifier formula $(\forall \varepsilon > 0)(\exists x_0 \in R)(\forall x > x_0)$: $a - \varepsilon < f(x) < a + \varepsilon$. Rewrited to suit the example, the definition is $(\forall \varepsilon > 0)(\exists x_0 \in R)(\forall x > x_0)$: $a - \varepsilon < \frac{5x}{3x-2} < a + \varepsilon$.

Using the command **Resolve [ForAll [ε, ε > 0, Exists [x0, ForAll [x, x > x0 && a ∈ Reals, a – ε < 5x/(3x – 2) < a + ε]]], {a}]** the answer of Mathematica is **a==5/3**. So the limit of a function $f(x)$ for $x \to \infty$ is $\frac{5}{3}$.

Example 4: Find the global extremes of a function $f(x, y) = 2x^2 + y^2 - 2y + 5$.

The given function $f(x, y)$ represents a paraboloid, therefore finding its extreme (vertex) seems to be a nontrivial issue that needs to handle the differential calculus.

But let us use a definition of functional boundedness in a form of quantified formula $(\exists K)(\forall x, y,...)$: $|f(x, y,...)| \le K$. In our case, we can use a formula $(\exists K)(\forall x, y)$: $|2x^2 + y^2 - 2y + 5| \le K$ or more precisely – to find out if the function is bounded above or bounded below – two formulas $(\exists K)(\forall x, y)$: $2x^2 + y^2 - 2y + 5 \le K$ and $(\exists K)(\forall x, y)$: $2x^2 + y^2 - 2y + 5 \ge K$.

Using commands **Resolve [Exists [K, ForAll [2x^2 + y^2 – 2y + 5 ≤ K]]]** and **Resolve [Exists [K, ForAll [{x, y}, 2x^2 + y^2 – 2y + 5 ≥ K]]]** we get answers **False** and **True**. That means the function is only bounded below and has no global maximum, but there is a global functional minimum.

The functional value in the global minimum can be found easily, we just need to take away the quantified parameter *K* from the appropriate quantified formula. Then the command in a form **Resolve [ForAll [{x, y}, 2x^2 + y^2 – 2y + 5 ≥ K]]** produces an output **K∈Reals&&–4+K≤0**. Corresponding inequation $K \geq 4$ informs us that the function $f(x, y)$ is bounded below by 4 which is the functional value of the searched minimum.

This answer might be slightly unsatisfactory, we would probably like to know not only the functional value but values of both variables *x* and *y*, too. They can be found by substituting parameter *K* with polynomial with new variables x_0 and y_0 when we eliminate quantifiers from formula $(\forall x, y)$:

$2x^2 + y^2 - 2y + 5 \geq 2x_0^2 + y_0^2 - 2_0y + 5$. The command is now in form **Resolve [ForAll [{x, y}, 2x^2 + y^2 – 2y + 5 ≥ 2x0^2 + y0^2 – 2y0 + 5]]** and the output is **x0∈Reals&&y0>0&&2x0^2–2y0+y0^2≤–1**.

This means that the solution is an ordered pair $[x_0, y_0]$ for which a system of inequations

$$y_0 > 0$$
$$2x_0^2 + y_0^2 - 2y_0 \leq -1$$

holds, respectively it is an ordered pair of real x_0 and positive real y_0, for which an inequation $2x_0^2 + y_0^2 - 2y_0 \leq -1$ holds.

This is not a problem, the inequation can be transcribed as $2x_0 + (y_0 - 1)^2 \leq 0$ and there is only one ordered pair $[x_0, y_0] = [0, 1]$ that suits the inequation.

In other words, there is a unique global minimum at $x = 0$ and $y = 1$ and the functional value $f(0, 1) = 4$.

The same solution can be reached in a bit different way without the previous reasoning. Using paradoxically more complicated mathematical formula $(\exists x_0)(\forall x, y)$: $2x_0^2 + y_0^2 - 2y_0 + 5 > 2x^2 + y^2 - 2y + 5$ and a corresponding command **Resolve [Exists [x0, ForAll [{x0, y0}, 2x^2 + y^2 – 2y + 5 ≥ 2x0^2 + y0^2 – 2y0 + 5]]]** the quantifier-free output is **y0==1** and the variable x_0 can be easily calculated.

At the end we will show that quantifier elimination can be conveniently used even for solving mathematical word problems, such as simple optimization word problems.

Example 4: The coal from mines near Karviná and Most are being transported to Olomouc, České Budějovice and Brno. Every day 300 tons of coal can be exported from Karviná and 250 tons from Most, on the other hand 140 tons are needed to be imported to Olomouc, 200 tons to České Budějovice and 210 tons to Brno. In addition, the highest amount of coal transported from Karviná to Brno is 120 tons at most due to train lockout. Find the optimization of transportation with the lowest price with the prices of transport given in a table.

price in € for 1 ton	**Olomouc**	**Č. Budějovice**	**Brno**
Karviná	12	12	6
Most	8	7	9

At first, we need to put together an appropriate quantified mathematical formula. For this we will use unknowns x and y and some rearrangements.

The list of daily imports and exports is as follows:

from Karviná..... 300 tons
from Most ..... 250 tons
to Olomouc..... 140 tons
to České Budějovice ..... 200 tons
to Brno..... 210 tons

Further let us specify the amount of coal transported from Karviná to Olomouc as unknown x and the amount transported from Karviná to České Budějovice as unknown y. Then the amount of coal exported from Karviná to Brno is $300 - (x + y)$. This is going to be the first row of a table with data about the transported coal.

transported tons	**Olomouc**	**Č. Budějovice**	**Brno**
Karviná	x	y	$300 - (x + y)$

In a similar way we are able to complete data in the second row of the table concerning coal transportation from Most. 140 tons of coal must be transported to Olomouc which overall means $140 - x$ tons from Most. Similarly there are y tons transported from Karviná to České Budějovice, and so $200 - y$ tons must come from Most. Finally from Most to Brno it will be $210 - (300 - (x + y)) = x + y - 90$ tons of coal.

transported tons	**Olomouc**	**Č. Budějovice**	**Brno**
Karviná	x	y	$300 - (x + y)$
Most	$140 - x$	$200 - y$	$x + y - 90$

Considering the given problem, it is clear that all the written expressions must be non-negative. The conditions for the first row are

$$x \geq 0,\ y \geq 0,\ x + y \leq 300$$

and for the second row

$$x \leq 140,\ y \leq 200 \text{ and } x + y \geq 90.$$

Simultaneously, we must take into account the last condition about transporting the highest possible amount of coal from Karviná to Brno where $300 - (x + y) \leq 120$; after rearrangement $x + y \geq 180$.

At the end of this preparation is a function that describes the overall price for transported coal:

$f(x, y) = 12x + 12y + 6\cdot[300 - (x + y)] + 8\cdot(140 - x) + 7\cdot(200 - y) + 9\cdot(x + y - 90)$, or more simply $f(x, y) = 7x + 8y + 3510$.

Our goal is to find an extreme – specifically minimum – of two-variable function $f(x, y)$ under given conditions for values of variables x and y.

At first, we should find out if there is any solution at all. This can be done by quantifier elimination in formula $(\exists\, x_0, y_0,\ x_0 \geq 0,\ y_0 \geq 0,\ x_0 + y_0 \leq 300,\ x_0 \leq 140,\ y_0 \leq 200,\ x_0 + y_0 \geq 90,\ x_0 + y_0 \geq 180)(\forall\, x, y,\ x \geq 0,\ y \geq 0,\ x + y \leq 300,\ x \leq 140,\ y \leq 200,\ x + y \geq 90,\ x + y \geq 180)$: $7x + 8y + 3510 \geq 7x_0 + 8y_0 + 3510$ where conditions $x_0 + y_0 \geq 90$ and $x + y \geq 90$ may be omitted because there are stronger conditions $x_0 + y_0 \geq 180$ and $x + y \geq 180$.

The above-mentioned formula says there is at least one point $[x_0, y_0]$ in the defined area of plain that its functional value is smaller than the functional value of any other point of this area.

An appropriate command for quantifier elimination in Mathematica is **Resolve [Exists [{x0, y0}, x0 ≥ 0 && y0 ≥ 0 && x0 + y0 ≤ 300 && x0 ≤ 140 && y0 ≤ 200 && x0 + y0 ≥ 90 && x0 + y0 ≥ 180, ForAll [{x, y}, x ≥ 0 && y ≥ 0 && x + y ≤ 300 && x ≤ 140 && y ≤ 200 && x + y ≥ 90 && x + y ≥ 180, 7x + 8y + 3510 ≥ 7x0 + 8y0 + 3510]]]**. The program output is **True** which means that the statement is true and there is at least one solution $[x_0, y_0]$.

It would be nice to find the values of the two unknowns x_0 and y_0. Let us create a bit modified formula $(\forall\, x, y,\ x \geq 0,\ y \geq 0,\ x + y \leq 300,\ x \leq 140,\ y \leq 200,\ x + y \geq 90,\ x + y \geq 180)$: $7x + 8y + 3510 \geq 7x_0 + 8y_0 + 3510$. An answer to the command **Resolve [ForAll [{x, y}, x ≥ 0 && y ≥ 0 && x + y ≤ 300 && x ≤ 140 && y ≤ 200 && x + y ≥ 90 && x + y ≥ 180, 7x + 8y + 3510 ≥ 7x0 + 8y0 + 3510]** is an equivalent formula **(x0|y0)∈Reals&& –1300+7x0+8y0≤0**.

The searched point $[x_0, y_0]$ lies somewhere in the half-plane h: $7x + 8y - 1300 \leq 0$. It could be specified more precisely by finding intersection of h and area of plane restricted by given conditions. However, this way of solving is unnecessarily complicated.

Fortunately, there is simpler approach to the problem. If we use formula in a form where there is only one unknown without quantifier, e.g. $(\exists\, x_0, x_0 \geq 0, y_0 \geq 0, x_0 + y_0 \leq 300, \; x_0 \leq 140, \; y_0 \leq 200, \; x_0 + y_0 \geq 90, \; x_0 + y_0 \geq 180)(\forall\, x, y, \; x \geq 0, \; y \geq 0, x + y \leq 300, x \leq 140, y \leq 200, x + y \geq 90, x + y \geq 180)$:
$7x + 8y + 3510 \geq 7x_0 + 8y_0 + 3510$, it will not be so hard to interpreted the output.

The appropriate command for this formula is **Resolve [Exists [x0, x0 ≥ 0 && y0 ≥ 0 && x0 + y0 ≤ 300 && x0 ≤ 140 && y0 ≤ 200 && x0 + y0 ≥ 90 && x0 + y0 ≥ 180, ForAll [{x, y}, x ≥ 0 && y ≥ 0 && x + y ≤ 300 && x ≤ 140 && y ≤ 200 && x + y ≥ 90 && x + y ≥ 180, 7x + 8y + 3510 ≥ 7x0 + 8y0 + 3510]]]**, the computer output is **y0==40** and then the equivalent quantifier-free formula is $y_0 = 40$.

Finding the value of unknown x_0 can be done by counting with the value of y_0 or simply analogically by eliminating quantifiers in a similar formula $(\exists\, y_0, x_0 \geq 0, y_0 \geq 0, x_0 + y_0 \leq 300, x_0 \leq 140, y_0 \leq 200, x_0 + y_0 \geq 90, x_0 + y_0 \geq 180)(\forall\, x, y, x \geq 0, y \geq 0, x + y \leq 300, x \leq 140, y \leq 200, x + y \geq 90, x + y \geq 180)$:
$7x + 8y + 3510 \geq 7x_0 + 8y_0 + 3510$ where unknown y_0 is quantified and unknown x_0 is not. In this case, the program answer is **x0==140**, or better $x_0 = 140$.

For completeness, let us record the results, even with the rest of searched values, into a table.

transported tons	**Olomouc**	**Č. Budějovice**	**Brno**
Karviná	140	40	120
Most	0	160	90

Substituting the values into the price function $f(x, y)$ gives us information on the lowest price of transportation which is 4810 €.

At the end of this example, there are several important notes to take into account.

Note 1: Although all the results (transported tons and price) we have are integers, it would not be difficult to interpret any non-negative decimal number results. This is not ordinary; generally decimal numbers can appear in progress and the results and interpretation of the problem would not be so clear.

Note 2: It is obvious the problem supposed that the exported amount of coal is equal to the demanded import. If this condition is not met, for example the

export is higher than import, the solution is a bit complicated and some other conditions have to be stated.

Note 3: We took use of Mathematica's ability to include and work with conditions concerning the allowed values of the unknowns. Without this, the used command would have been written in a different and more complex way.

Note 4: Some changes can be made in preparation within the number of unknowns. It is possible to use more than two unknowns, more accurately six unknowns, each representing mentioned amounts of transported coal. The modified table would be as follows.

transported tons	**Olomouc**	**Č. Budějovice**	**Brno**
Karviná	u	v	w
Most	x	y	z

According to this change, the conditions and even the function would change appropriately:

$u \geq 0$, $v \geq 0$, $w \geq 0$, $x \geq 0$, $y \geq 0$, $z \geq 0$,

$u + v + w \leq 300$, $x + y + z \leq 250$, $u + x \geq 140$, $v + y \geq 200$, $w + z \geq 210$

and $f = 12u + 12v + 6w + 8x + 7y + 9z$.

Although this description of given problem seems to be more natural and synoptic, we need to realize that we have moved from two-dimensional space and two-variable function of price to six-dimensional space and six-variable function. Along with this, the appropriate quantified formula would change, too.

Nevertheless, finding an equivalent quantifier-free formula would not be a problem. It would only be more time-consuming and user without opportunity to gain advantage in a graphical interpretation would have to rely on the computer output.

QEPCAD program works in a similar way but it was developed specifically for quantifier elimination. Its name is an abbreviation for Quantifier Elimination by Partial Cylindrical Algebraic Decomposition.

Using QEPCAD and Mathematica for quantifier elimination differs only in a way of entering commands. When running the program, user has to enter a description of processed problem first (it is only an informal name, it really does not matter what the name is) than the list of variables has to be entered with free variables first and quantified variables at the end of the list, number of free variables is needed and at the end quantified formula is entered.

The formula must be written down in a form $(Q_1 x_1)...(Q_n x_n)$ $[T_1...T_m]$. where Q_i are quantifiers, x_i are quantified variables and T_j are statements in the formula combined with logical operators (for $1 \leq i \leq n$ a $1 \leq j \leq m$). This input must be followed by full stop.

The quantifiers are written as "key letters":

- (E x) means existential quantification,
- (A x) means universal quantification,
- beside these two quantifiers there are some others, for example (F x) is for "for infinitely many", (G x) means "for all but finitely many" or (Xk x) stands for "for exactly *k* distinct values".

Logic operators are represented by special symbols:

AND	OR	NOT	implication	implication	equivalence
/ \	\ /	~	==>	<==	<==>

Relational operators are the same as usual, only operator / = stands for $\neq$.

If there is any problem and the program does not understand the entered data, often because of some syntax mistake or ambiguity, it must be entered again correctly. If the input is all right, the process of quantifier elimination is commenced by using command **finish** or it is possible to go subsequently through all the phases (projection phase, base phase and extension phase) by using command **go**. In this case, the user has an opportunity to use some additional commands in each phase to gain more detailed data on the processed formula.

Let us show how the program works on a simple mathematical formula $(\forall x)$: $x^2 \geq 0$. After running the program the user has to enter data according to given instructions:

Enter an informal description between '[' and ']':

[second power]

Enter a variable list:

(x)

Enter the number of free variables:

0

Enter a prenex formula:

(A x)[x^2 >= 0].

After entering the command **finish** the program begins the elimination and then produces the answer:

An equivalent quantifier-free formula:

TRUE

The answer is also followed with completing information on the finished operation including time needed for the operation.

Let us have a look at some examples.

Example 5: Find the solution of the system of equations

$$x + y - z = 7$$
$$x^2 + y^2 - z^2 = 37$$
$$x^3 + y^3 - z^3 = 1.$$

The "human" way of solving the problem is a bit complicated. The sum $x + y$ needs to be expressed from the equation $x + y - z = 7$ and substituted in the second equation where a new equation in form $xy = 7z + 6$ is acquired. At the end, both equations are substituted in the third equation where the value of unknown z is found.

Before using program QEPCAD for solving this problem, the appropriate formula must be created. Assuming that there is at least one real value x which is a part of the solution, the formula would be in a form $(\exists x)$: $x + y - z = 7 \wedge x^2 + y^2 - z^2 = 37 \wedge x^3 + y^3 - z^3 = 1$. The input for QEPCAD would than look as follows.

Enter an informal description between '[' and ']':

[system of equations]

Enter a variable list:

(y,z,x)

Enter the number of free variables:

2

Enter a prenex formula:

(E x)[x + y – z = 7 / \ x^2 + y^2 – z^2 = 37 / \ x^3 + y^3 – z^3 = 1].

After finishing the elimination the output is **y – 9 >= 0 / \ y – 10 <= 0 / \ y z – 7 z – y^2 + 7 y – 6 = 0 / \ [y – 10 = 0 \ / y – 9 = 0]**.

The first two inequations state that the value of y lies in the interval $\langle 9, 10 \rangle$, the last part of output **y – 10 = 0 \ / y – 9 = 0** says that there are two solutions

$y_1 = 9$ and $y_2 = 10$. The remaining equation **y z – 7 z – y^2 + 7 y – 6 = 0** containing even the unknown z is to by used to find its value. It could be easily done for example by eliminating quantifiers from formula ($\exists y$):
$(-y^2 + 7y - 7z + yz - 6 = 0) \wedge (y = 9 \vee y = 10)$. Finally, finding the value of unknown x is a trivial matter.

There are two solutions – ordered triples [10, 9, 12] and [9, 10, 12].

According to the comparison given in [3], there are small differences between QEPCAD and Matehematica but in general we can say that QEPCAD is a bit slower in producing the output, on the other hand it can handle some formulas better than Mathematica and returns the results in a form of less complicated quantifier-free formulas.

At the end of this part of chapter, let us mention that the algorithm of cylindrical algebraic decomposition as it was presented above is useful even in some other mathematical disciplines then just quantifier elimination. For example, it can help in computer counting of double and triple integrals; CAD is used here to define parts of spaces where the value of the integral is to be found. We can use the following problem as an example.

Example 6: Find the value of a double integral $\iint_M 1\,dxdy$ on the set $M = \{\frac{x^2}{4} + \frac{y^2}{9} < 1\}$.

As a matter of fact, the searched value is a size of an elliptic cylinder with its height equal to 1. Its base is an ellipse laying in the plane defined by axes x and y and the equation of is $\frac{x^2}{4} + \frac{y^2}{9} = 1$.

The "human" way of solving the problem would include transforming a double integral into two integrals using Fubini's theorem. The computing looks as shown below:

$$\iint_M 1\,dxdy = \int_{-2}^{2}\left(\int_{-3\sqrt{1-\frac{x^2}{4}}}^{3\sqrt{1-\frac{x^2}{4}}} 1\,dy\right)dx = \int_{-2}^{2} 6\cdot\sqrt{1-\frac{x^2}{4}}\,dx = 6\cdot\pi.$$

In program Mathematica for example, the result can be produced by using command **Integrate [Boole [x^2/4 + y^2/9 < 1], {y, –20, 20}, {x, –20, 20}]** and the computer's answer is **6π**.

The solving includes a command **Boole** which finds an area where the equation or inequation (or their system) is true; in this particular example interior

of given ellipse; and then the output of the command is also true. After that, the integration in the found area follows; in our case for

$$-2 \le x \le 2 \text{ and } -\frac{3}{2} \le y \le \frac{3}{2}.$$

This may be a slight problem for computer, it has no “human idea” about the ellipse, or more precisely about the interval where the integral is to be counted. But the CAD algorithm can be used to solve the problem successfully and it is no surprise that the computer answer equals the value we obtained by “human” method.

Nowadays, when natural and technical disciplines faces the declining interest among students it can be quite helpful and motivational involving these relatively new procedures, such as solving some mathematical problems by quantifier elimination, into learning process.

Using the mathematical software and proving that it is a powerful tool to solve given problems is for students, among them the future programmers and teachers of mathematics and computer sciences, very important. They realize that computer programs would not work without algorithms for which a good knowledge of mathematics and a human ingenuity are indispensable.

On the other hand, we also come to the realization that the use of the quantifier elimination (but not only) carries with it certain difficulties. These can include mainly the computational complexity. It is important to realize that the elimination of quantifiers in a formula with, for example, five variables is very time and memory consuming.

Among other complications we also find the need of precise and correct formulation of commands entered into the computer. Even a small change or mistake (for example changed order of quantified variables) can lead to vastly different results due to misinterpretation of the command by computer. This is also certainly an undeniable benefit for users who are forced to express themselves accurately and correctly. If they are aware of such difficulties and know at least a little about the using of the programs, it is a good starting position to successfully use them as effective helpers.

It cannot be said by any means that above-mentioned method of solving should be preferred and used more than the “classical” methods. Despite this it can be assumed that in time mathematical programs and systems of computer algebra will be used more often as small pocket calculators are used nowadays. Moreover, any new way of solving, including this one offers possibility to reach the result even in cases where other methods fail or are complicated and time-consuming. In

addition, it is always good to be able to check that results gained by traditional way are true.

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6 IMPORTANCE OF NARRATION IN PRIMARY EDUCATION

Zuzana Chanasová

Abstract

The main aim of the paper is to characterize narrative attitude as an important component of primary education and describe its application through literary and drama methods. Its task is also to explain the importance of narration at seeking and clarifying the sense of things with children of early school age. The paper provides suggestions of literary and drama activities and a short survey in this field.

Keywords: early education, narration, primary education, literary, drama.

Introduction

Each little child loves to hear when someone talks. Story, or history, is a fascinating thing for him, coming through the voice of an adult. The story represents – at least till he reaches teenage years – huge complex flow, undivided into parts. The child of pre-school or early school age can only hardly differentiate between reality and phantasy, fairy-tale and true or story. In the pre-school age the child does not recognize terms like *the day before yesterday, near* and *far, tangible* and *invisible.* (Gillini, G. – Zattoni, 2001, p. 154)

Today, many teachers say and are verified by various pedagogical researches that, over the time narration gains more and more importance in the education. Pedagogy rediscovers the link between narration and experience. To enable a subject to narrate his experience means, from the pedagogical point of view, to offer him opportunity to arrange all what he has gone through and organize it for the listener in a logically understandable manner. (Pati, 2008, p. 33)

Value of narrativity in education

Narrative principle is one of the most natural methods of teaching. Teacher plays the key role in the system of factors participating on the level of education and good manners. (Jablonský, 2006, p. 50) Often it is his role, therefore, to convey to students new information through narration, new knowledge through stories, etc. The teacher represents the mediator and supporter of child's knowledge

formation. „He chooses methods that are based on problem solving and tries to stimulate and initiate children to activity, aiming to reach their appropriate development, while taking into account demand of natural child's learning in relation to the chosen activity." (Vargová, 2012, p. 18) The value of narration thus most of all conveys the voice coming from personal experience. The narration of one's story is therefore not realized in just a chit-chat or simple talking.

Its effects can be summarized into three points.

1. The narration helps narrator learn something about himself as an active subject able of decisions and actions.
2. The narration encourages reader/listener to ask and meditate upon experience of others and thus upon his own experience, too. It also enables him elicit instructions, helping him understand the world better.
3. The narration enables the reader or listener to reach into the depth of specific existential decisions. (Pati, 2008, p. 34)

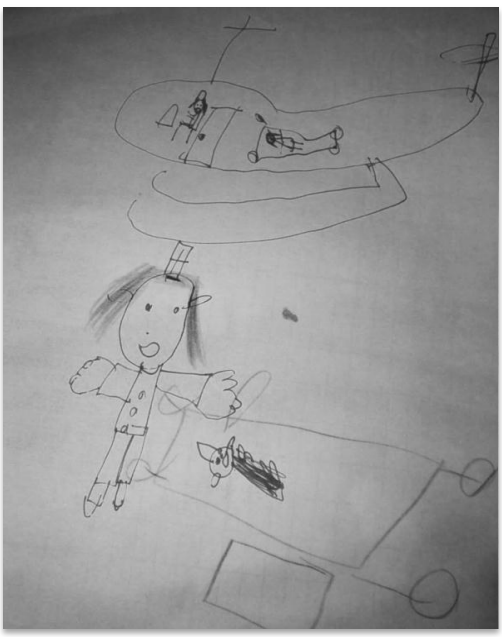
The narrator of a story is not only a representative of the story, he is also emotionally tied to it. Through the stories, a child starts to perceive his own small life and culture of his nation in connection with previous generations. Culture of each nation is expressed by knowing his ethnic-cultural traditions. Natural and non-intentional environment plays an important role at learning and keeping cultural values. (Uhrinová, Zentko, Hollá, 2010, p. 42) In this environment the narration facilitates learning about the national traditions. Grandparents, through the narration of stories, teach the children about the customs and traditions. Today, adults seem to have lost the sense and need of narration, this vital element of child's development. For even today the child is ready to leave the TV in exchange for hearing the true story. He enjoys hearing it either read from a nicely knitted text full of images, or narrated in a simple "street" language. (Gillini, G. – Zattoni, 2001, p. 156)

Why is the narration so fascinating for children? Because it builds and strengthens the relationship. It is a cyclical relationship. The narrator is dependent on his listeners. He catches their look, observes the level of concentration on their faces, perceives their mimics and emotions. There is a certain mutual interference present there: non-verbal communication of the narrator and listeners – it all interacts together. This process includes questions and answers, confirmation of interest in what has been said and loving reciprocity. It looks as if everyone in that process becomes a mirror for the other. This is not a one-way transition from A to B. The educator - narrator does not convey only particular information, standing

outside the relationship. This is both-way communication, turning also from B to A. This is where feedback takes on its significant role.

Successful understanding of what a person does, always lies in setting concrete stories into context of multiple narrated stories. Into the stories of the individuals and histories of environment in which the individuals act. It is exactly so, because we all live our individual stories and because we understand our life precisely because of our stories. „The form of a story is the appropriate form through which we can understand actions of other people. The stories, except novels, are lived earlier than narrated.“ (MacIntyre, 2004, p. 247) Often a man realizes that he is a character simultaneously in more stories, and some of them are even incorporated in others. The acting person is not only an actor, but also an author. „We are never something more (and sometimes we are less) than mere co-authors of our stories.“ (MacIntyre, 2004, p. 249).

When the tragedy at bridge building site in Slovakia happened few months ago, resulting in few deaths, it brought about many discussions. During those days I had my pre-school and early school age nephews on a visit. We adults were discussing, watching news and internet. We did not realize that it impacts the children, too. After my nephews left, I found a picture drawn by one of them (nine years old) using simple technics – pen (see Picture 1). There is a couple of persons: a pilot with a wounded person in helicopter, a person - probably a nurse - nursing a wounded person on the ground. The picture drawn by an early school age child gave a good illustration of the tragedy that happened. The child perceived the impressive story about the tragedy of workers without taking part in discussions, and felt the need to express it. Of course, “due to strong influence of information, surrounding us from every side, the functioning of society is being substantially changed, especially education.” (Karasová, 2012, p. 25) Besides the discussions of the adults, it was the media which played important role – they enhanced the strength of a story. It had such a strong impact on a child that she felt a need to express it through drawing.



Picture 1. Drawing of a child: tragedy at bridge collapse

Two aspects or narrativity

In the field of narrativity and story-telling, two aspects can be found. First of them is the man himself – me as a subject – and the second is all others who are part of his story.

A man should be ready to explain what he has done, what has happened to him, or what he has witnessed during his life. „During my lifetime from my birth till my death, on one hand I am who others legitimely consider me to be. On the other hand, I am the subject of a history, that concerns me and no other and history that has its specific sense." (MacIntyre, 2004, p. 254) Being the subject of a story from birth to death means taking responsibility for acting and events that constitute the narrative life. Each man not only bears responsibility for his own life, but can demand explanation of actions from others and others can demand the same from the others. And the stories are interlinked between each other. Thanks to other people we get to know ourselves. „Knowing ourselves depends significantly on what we learn about ourselves from others and even more on what those who know us well confirm about us." (MacIntyre, 2001. p. 92) Everyone is a part of a story of other people, just as other people are part of the story of that person. The story of each life is part of interlinked set of other stories. If a man were alone and isolated from other people, he would not be able to discover anything new. „The new comes always from interaction with others; this is the principle from which life came to be. We, too exist because others gave us life." (Giussani, 1996, p. 81) Everyone possesses something different and he offers it to others by narration. Thus he helps them ewoke the sense of something bigger.

Narrative search and drama story

It is important to realize that, the theme of virtues, the theme of living our life well is related to searching. The unity of human life thus becomes the unity of narrative search, which is sometimes unsuccessful and hopeless. A man sometimes gives up or fails. In the same way, human life can fail, too.

MacIntyre says that search does not mean looking for something clearly defined. He says that, the aim of the search becomes understandable only in the process of the search and also through how a man copes with individual hardships, dangers, temptations and complications that are present in each search in the form of episodes and incidents. „Search is always connected with recognizing the substance of what we are looking for and at the same time with learning about ourselves." (MacIntyre, 2004, p. 255) What MacIntyre calls history, is a drama story

where characters are authors at the same time. „The characters never start truly *ab initio*, they throw themselves *in medias res*, the beginning of the story has been created for them by the circumstances and people before them." (MacIntyre, 2004, p. 250) The difference between imaginary and real characters does not lie in narrative form of what they do, but more in the extent to which they are authors of this form and to greatness of their actions. Empirical research, introduced by human scientists, brings understanding to human life. (MacIntyre, 2004, p. 250) The main thesis thus seems to be the idea that, „man is, in his actions and practice, as well as in his fictions, substantially an animal narrating stories. He is not substantially a narrator of stories, claiming the truthfulness, but he becomes one during his history." (MacIntyre, 2004, p. 252)

A man enters human society with one or more characters that are assigned to him, with roles to which he was forced and he has to find out what the roles are. It is important that he is able to understand how others react to him and how they are going to interpret his reactions. By listening to the stories the children learn to know who is a child and who is a parent, which characters can act in drama, to which they were born to, and how the world goes. For example, in the story of prodigal son they can listen to the story of a son who wastes his heritage by wayward living, ending up broke, and this leads him to the point where his only access to food is by feeding pigs. Through this story children discover what can a man expect when he disobeys his parents and acts carelessly. Teachers specializing in elementary pedagogy say that, when we deprive children of the stories, they will become anxious beings, unsure in their actions and speech. „It is impossible to understand any society, including our own, by other way than through certain reserve of stories, which are its primary drama sources. Therefore, it is true what moral tradition tracing back from heroic society to middle-age heirs says, according to which the narration plays key role in our education to virtues. (MacIntyre, 2004, p. 252)

Research

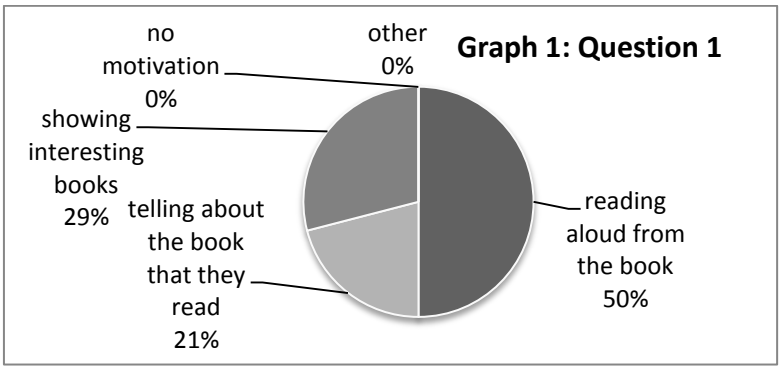
With the help of students of pre-school and elementary pedagogy we conducted a research among 62 teachers of kindergartens and primary schools. Nearly all of them were women. 66% of them were teachers of kindergartens and 34% teachers of 1st grade at elementary school. The table 1 shows that, according to the years of practice, the teachers came from all age categories – from beginner teachers to well experienced ones.

The research was focused on the topic of reading studying children of pre-school age and early school age.

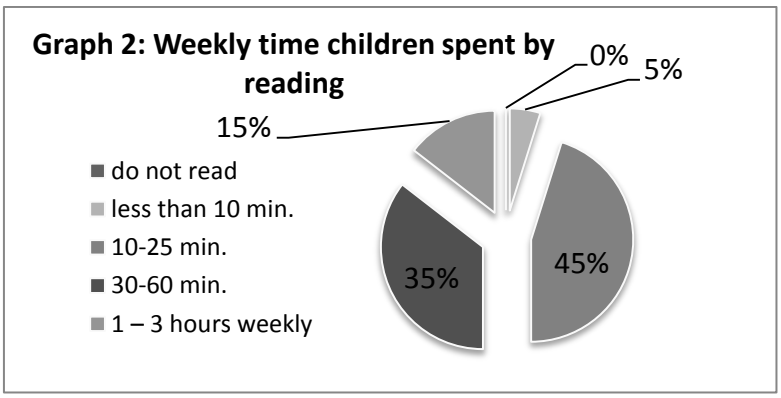
Table 1: Years of teacher's practice

	Years spent in practice	Number	%
1.	0 – 5 years	19	26,00%
2.	6 – 10 years	16	29,00%
3.	11 – 20 years	16	21,00%
4.	more than 21 years	11	24,00%
	total	62	100,00%

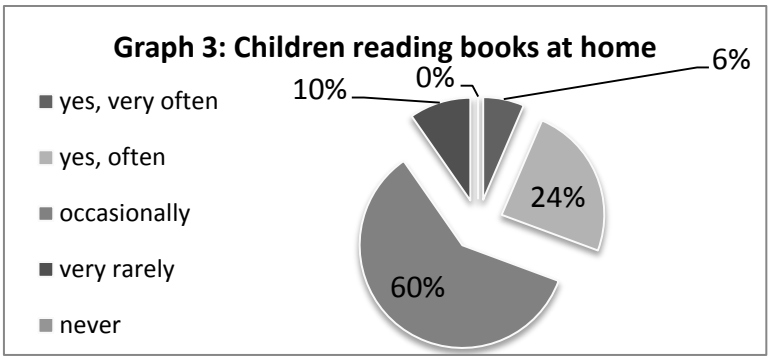
We were interested in extent and way of motivation of children towards reading, then in extent of time spent reading both by children and their parents reading to them, and in reasons of absence of children's reading. In the first question of the questionnaire we tried to elicit how a teacher motivates the children to reading. We saw that teachers most often motivate children to reading by reading them aloud excerpt from a book. This was stated by 50% of teachers. 21% stated that, they tell the children about the book and 29% that they show the interesting book to children. (see graph 1)



Second question focused on weekly time children spend by reading. Looking through the books by children of pre-school age was considered as reading, too. The most frequent response – 45% - was 10-25 min. (not counting the reading lessons). 35% read 30-60 min. and 15% more than 1 hour. When we make a daily average from the value 10-25 min., it turns out that nearly half of the children read averagely one and half to three and half min. daily. Positive fact is that, no response stated zero reading time.

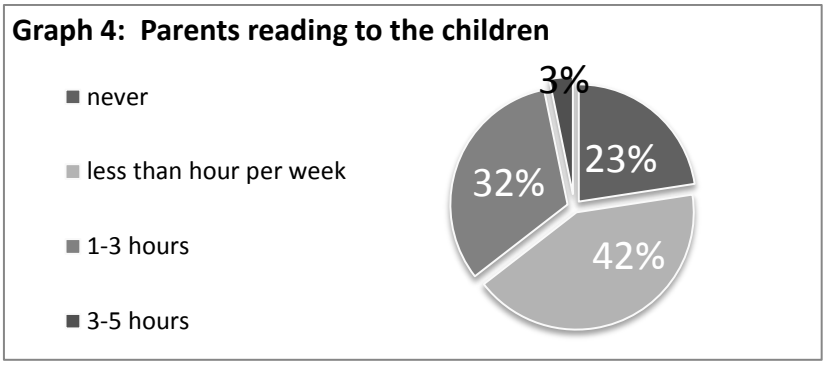


Further, we asked the teachers how often they think the children read at home. 6% teachers stated that the children read very often, 24% stated often, 60% stated occasionally and 10% stated the children do not read. We can say that the children read occasionally, rather than often.

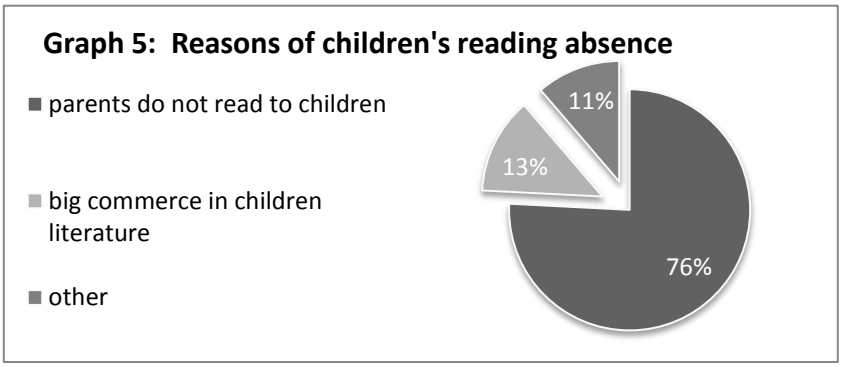


The next question was focused on how often per week do the parents read to the children – fairy tales, stories, etc. From our perspective, children's reading itself is influenced by parent's relationship towards reading and by the fact whether the parent used to read to the child in pre-reading phase.

We asked this again from the perspective of teachers. 23% teachers think that, the parents never read to children at home. 42% think that the parents read to them less than one hour per week (i.e. around 8 min. daily), and 32% stated that the parents spend one to three hours reading to the children per week. The option more than 3 hours was chosen by 3% of respondents.



In the fifth question we asked the teachers what they think is the most important cause of absence of children's reading. 76% teachers think that children do not read because parents do not read to them. 13% think that the reason lies in big commerce in children's literature and 11% stated other reasons.



Quite often we encountered the response that the absence of reading is caused by the lack of time of the parents who do not have time to read to the children, as they are very busy at work.

Conclusion

The mentioned portion of results of the partial research can be summarized in following points:

- Nearly half of children read averagely one and half to three and half min. daily.
- Teachers think that parents do not read to children at home, or that they read to them less than hour per week (i.e. 8 min. daily). This is considered by teachers as the reason why the children do not read themselves.

- Teachers try to motivate children and students towards reading mostly by reading them aloud from the book, by showing it to them or by talking about it.

Due to absence of parents' reading to children, caused probably by their busyness, it seems acute to increase the children's motivation through the teachers.

One of the methods that make the education process more interesting and more exciting various experiential methods. (Uhrinová, 2011, p. 38). The use of narrative approach itself in primary education thus proves to be necessary, as it offers children an experience. Aristotle, already back in the ancient times realized that, through transformation of someone's experience into an artwork, an artistic experience is being conveyed, turning this artwork into a means of knowledge. Stories of others were narrated within a dramatized form already at those times. "According to Aristotle, the pleasure from drama strengthens activity and enhances knowledge." (Aristoteles, 1964, p. 34) Man is the best simulator who gains his first knowledge by simulation. He simulates actions of others even if he only heard of them. Time dedicated to education of young generation is a time of wide-scope building of the future in correlation with aspect of individuality of single persons, as well as cooperation with family, school, society and church. (Sek, 2009) Knowledge learning becomes enjoyable not only to scientists, but to all people. With delight they look at the pictures, visit theatres, read books and listen to stories. During that watching or listening they learn and discuss what each thing or behavior means and represents. The thirst for knowledge is rooted in each man. Through the stories of others it is quenched, though never completely. Therefore it is important that the person whose task is to awake the desire for knowledge – i.e. educator/teacher – provides enough narrated stories. The educator cannot escape the unique assignment of narration; and it is appropriate that he prepares himself for that by reading, choosing materials, and exercising readiness towards demands, questions or additional information requests that the narration can evoke. "Children will never be full and the narrator will never be boring; they will always be grateful. With gratitude hidden in the question, 'When will you tell us another story?'" (Gillini, G. – Zattoni, 2001, p. 161)

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7 USE OF EDUCATIONAL SOFTWARE FOR MATHEMATICS AND COMPUTER SCIENCE

Ján Gunčaga, Janka Majherová, Hedviga Palásthy

Abstract

In this article we describe a proposal of the use of educational software as a motivational tool in education. We show some examples of computer aided education in subjects of mathematics and computer science. This teaching is connected to the goals described in the new Slovak Curriculum ISCED 2 for education of these subjects at the secondary education. The environment of different tools, such as GeoGebra, Imagine or Baltie as a tool to teaching geometry, modeling and algorithms will be discussed.

Key words: educational software, visualization, dynamic geometric software, modeling, algorithm, computer game, secondary education.

7.1 Introduction

The use of information and communication technologies (ICT) in the educational process can make it significantly easier for a teacher to prepare for the class and to improve the realization of teaching itself. The ICT help to achieve a higher quality, expertness and effectiveness compared to the teaching resources and tools, which have been used until now. This particularly includes the complex of following activities:

- Creation and processing of mathematical (or eventually other type of) documents through the user tools of ICT (e.g. appropriate pedagogical software);
- Creation of mathematical presentations, which can be used to concretize, simulate and visualize mathematical concepts and propositions;
- Creation of tests (knowledge evaluation) in the testing programs, which allows to control results of a teaching and provide teacher with very important feedback;
- Recording and evaluation of results of a teaching, evaluation of didactic tests, recording of grades and classification;
- Searching for and gaining of supplemental information sources for self-education in mathematics (e-textbooks, educational materials, applets, which exemplify given concepts and theories) from the web sites or eventually other sources;

- Exchange of information and experiences within the teacher's community through the communication tools.

Let's add one more comment to the didactic functions. ICT bring new opportunities to make school mathematics and its studies more attractive. It is possible to use the computer not only to review (practice) the study materials, to create and enhance the skills and habits for the algorithmic solving of different tasks, but it can also significantly facilitate the development of student's individual work through the individualization of tasks – it is possible to assign each student with a task of various difficulty and with different time amount, which is needed for its solution. It is also possible to use computers while solving application tasks from the actual practice, which are usually difficult because of time consuming numerical computations. These computations can be carried out by the computers with the appropriate pedagogical software, developing the chances which direct the education at understanding of discussed concepts together with their utilization in practice. The concepts can be actively sought by students, whether through the individual or group work.

7.2 ICT and visualization in education

An important advantage of use of ICT in mathematics and informatics' teaching is a reinforcement of a role of visualization. Its importance can be seen especially in the following three aspects (Gunčaga, 2008).

Firstly, the visualization can often provide a simple and effective approach to the discovering of the mathematical results, to the problem-solving and discovering of the structure of a mathematical model itself, whereby students get new information. The visualization of relations and causalities within a single model allows us to derive new results in other fields and areas of mathematics through models, which are isomorphic with the existing model (completely or partially).

A second aspect results from the necessity and importance of exploitation of various teaching styles within the teaching process. A geometric approach, which leads to the acquisition of skills and knowledge through the graphical objects and visual geometric realizations, can be an appropriate supplement (although not an unconditional basis) of verbal-logic style, which is often preferred by the teachers of mathematics. However, this style doesn't have to be the most effective when solving some mathematical problems.

Third aspects are the actual trends, which identify mathematics with the study of models that can be realized through the informational technologies of the computer algebra systems (Computer Algebra Systems, Dynamical Geometrical

Software). These systems help to easily discover the universal coincidences and rules followed by the model, what is often realized at the expense of decrease in the common algebraic thinking. However, they allow to dynamically change parameters of image (graphs of functions, geometric shapes), thus making it faster and easier for the students to find dependences while adopting new knowledge.

Concerning these relatively new challenges but also unprecedented opportunities of the ICT, a change in requirements for training and practical work of mathematics teacher is evident. It is necessary for teachers to be trained in the spirit of these new tasks as soon as during their teacher's education. They have to know not only new methods of using ICT for teaching mathematics, but also how to achieve the objectives of their subjects.

According to Oldknow and Taylor (2003) during the teaching process, the ICT can support creation and processing of teaching materials by ICT users' tools, creation of educational presentations and tests, along with an assessment of knowledge by testing programs, and evidence and evaluation of educational outcome.

An important aspect of the computer aided education is the visualization. Within the framework of science education, it can bring forward following points:

- An effective approach while looking for the results, solving the problems and discovering the very structure of the model.
- A visualization of relations in the model allows an inference of new results in other areas and fields of science subjects at school.
- Support of digital competences and basic competences in science and technology.

One of the main objectives of informatics teaching is the development and cultivation of algorithmic and logical thinking of students by means of typical algorithmic process teaching. Nowadays the objective is realized by the means of programming teaching in large measure (in actual programming language).

For students, the pedagogical software is a tool for learning, exploring, experimenting. A student, who is learning programming, needs to understand the issues and create the correct ideas of the used concepts. Otherwise he is unable to understand the ideas that are based on these concepts and apply them in practice. In the programming it is not possible to succeed with formal know-how obtained from the superficial, mechanical learning by heart.

Today this is being done by subjects of programming, where the students learn to write programs in the programming languages. Teachers of this subject should focus on solving the problems rather than on teaching the theory. Students like to study by playing games and therefore we recommend teachers to make

a good use of the many free-download games on the internet. Teachers can choose from many kinds of games according to the age, knowledge, skills and interests of the students.

7.3 Educational software

Now we briefly introduce the educational software, which we use in our work with pupils and university students- future teachers at lower secondary level.

GeoGebra connects features of a computer algebra system, dynamic geometric software and a spreadsheet. Its big advantage is a user friendly nature and possibility to create dynamic HTML websites with interactive pictures (see Hohenwarter, Lavicza, 2010). Materials developed by GeoGebra can be found on the website GeoGebra Tube or on the older website GeoGebra Wiki (There is the link on the GeoGebra Tube to Slovak GeoGebra Wiki).

The latter contains also some materials created in multiple languages (http://www.geogebratube.org). These materials and applets use the interactivity and dynamic character of software. Moreover, the materials follow different topics, for example calculus and geometry (e.g. topics of an exponential and logarithmic function, cube or hexagonal prism, constructions of triangles, parallelograms). Naturally, the website contains also materials for teaching natural science and computer science (fig. 1).

Figure 1 GeoGebraTube

The next educational software is Baltie. Baltie is an educational graphic oriented visual programming tool for kids, children, youth and adults. Baltie is also a name of the main character of this software - a little wizard keen to execute miscellaneous commands and to conjure pictures (tiles) in his environment (fig. 2).

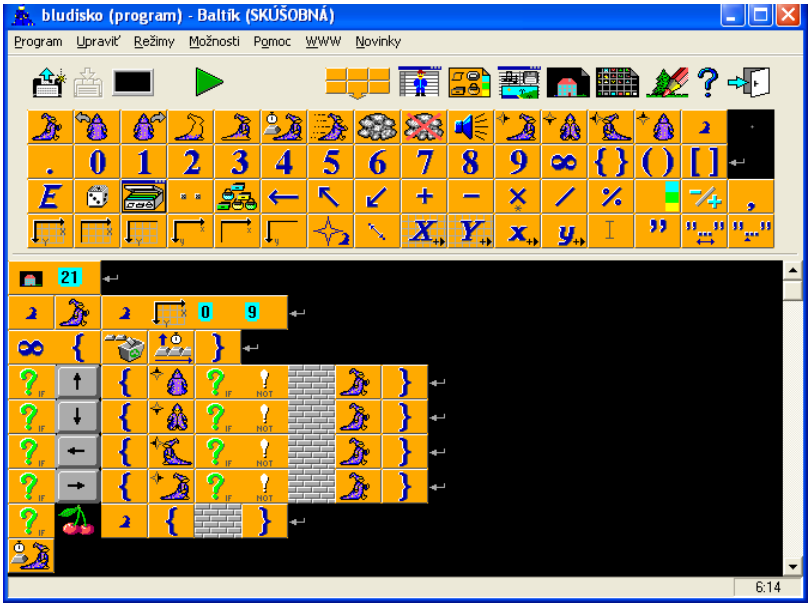

Figure 2 Environment of software Baltie

With Baltie's help, children will quickly realize how the computer program works. Baltie can be used also for exercising logical thinking. It makes no demands on child's knowledge, only requirements are playfulness and imagination. Baltie is a way of knowing a computer from the first touch, through the understanding how it works, to mastering the most important methods of software creation (http://www.sgpsys.com/en/whatisbaltie.asp).

The last software, which we will present, is Imagine. Imagine (http://imagine.input.sk/) originated in 2001 as an indirect successor to the Comenius Logo. It is a language which is completely based on objects, controllded by events. "The hero" (a main character) is a turtle, which can change its shape, draw to the area. The aim of the authors was to create a modern programming environment that is easy to control for an experienced user, but also for an absolute beginner – a pupil at primary and secondary school. The advantage for younger pupils is that they may not write a coherent program that focuses on the solutions of all possible situations, but many small sub-programs, sometimes referred to as one statement, that will be automatically called during various

events, for example a mouse click, drawing, collision with other objects, etc. It is possible to define different subroutines for various objects and their events. Environment has an integrated simple editor of background graphics, multimedia and internet (fig. 3).

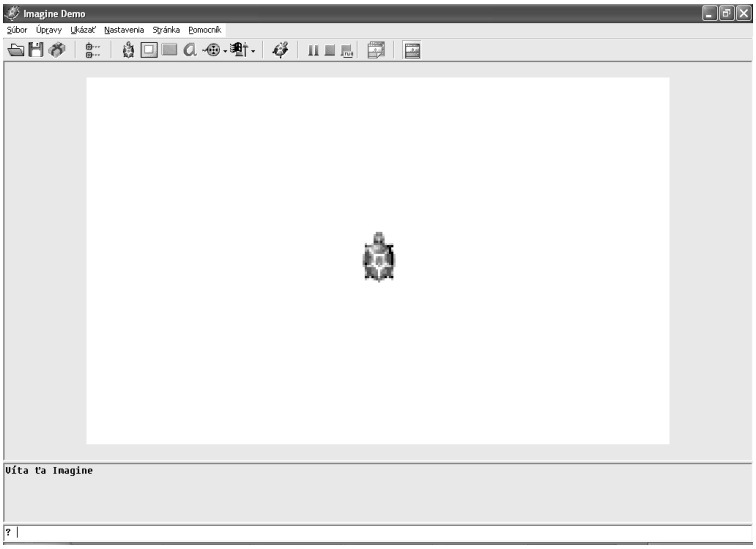

Figure 3 Imagine - basic environment

An interesting new feature is the possibility to publish the projects on the Web: using the Imagine plug-in, we can run the finished projects from the network in an Internet browser. The component of the Imagine is also a bitmap editor that is used to prepare the images, especially for the LogoMotion shapes of turtles, but also to create great-looking animations. Imagine has two language variations - Slovak and English.

7.4 Solving the geometrical tasks in GeoGebra

The new Slovak curriculum ISCED 2 for lower secondary level includes multiple educational competencies for geometry teaching. The pupils should be able e.g. to construct and describe the basic geometrical figures or to specify properties of their particular elements (a relationship of sides, diagonal, triangle inequality and so on). They should know basic geometrical transformations, axial and central symmetry, the relationship between figure and its picture in transformation and how to analyze and solve application geometrical tasks with a use of mathematical know-how (see ISCED 2, 2010).

Pupils obtain a geometric imagination as an ability to explore geometric figures and their properties, to abstract geometric properties from the particular objects, to have a perception of geometric shapes, and to be able to imagine geometric figures and their relationships.

Since the new curriculum in mathematics in Slovakia has been introduced only recently, textbooks satisfying these new rules are still missing. The materials from Wiki can help teachers educate in these new conditions. During this process of development, our aim is to cooperate with the teachers at schools, pupils and university students – future teachers. Some examples can be also found in works by Billich (2008), Tkačik (2007) or on the website http://geogebra.ssgg.sk.

Now we can present some works, which are applicable in teaching of geometry. These examples have been prepared by students from the training programs for teaching of mathematics at secondary school. The materials are focused to explain new notions with support of interactive GeoGebra applets.

The first example describes how to draw a cube in the plain using the rule that the side edges have the half length compared to the front edges (fig. 4). Playing the animated construction is an important advantage in this teaching unit (Kopáčová, 2003).

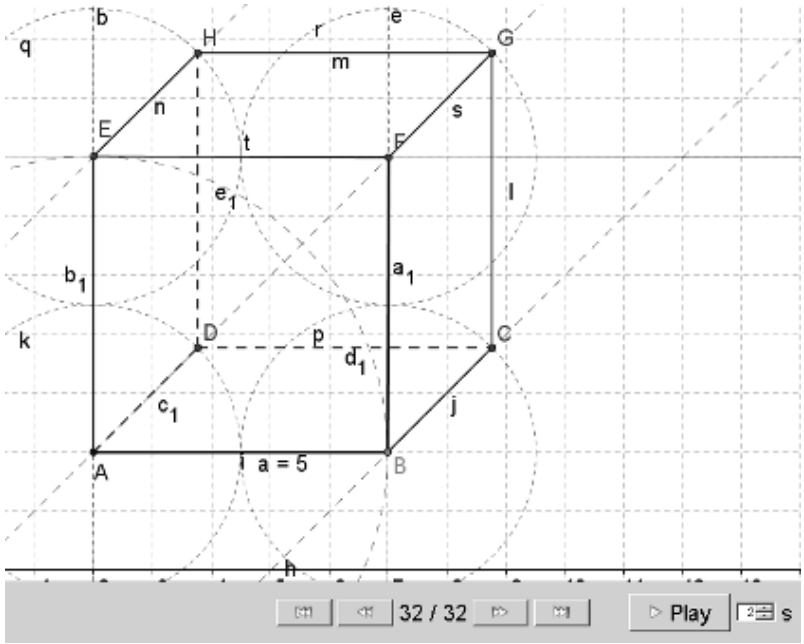

Figure 4 The cube with the bottom play

We present now the following example: Proof, that equilateral triangle inscribed in the circle has the same area than the half of the equilateral hexagon inscribed in the same circle (fig. 5).

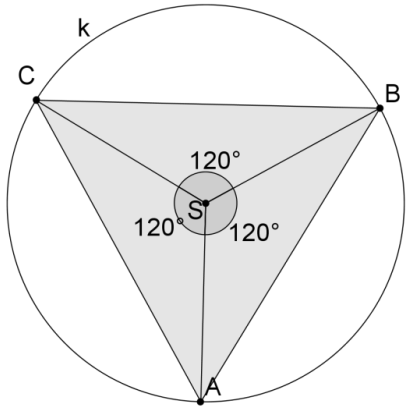

Figure 5 The equilateral triangle

Solution: If we have the circle with the centre *S* and radius *r*, we can use for the equilateral triangle *ABC* inscribed in this circle following expression for the area of triangle *ABS* (fig. 5):

$$S_1 = \frac{1}{2}r^2 \cdot \sin 120° = \frac{1}{2}r^2 \cdot \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{4}r^2$$

The area *S* of the whole triangle is

$$S_1 = 3S_1 = 3 \cdot \frac{\sqrt{3}}{4}r^2 = \frac{3\sqrt{3}}{4}r^2.$$

If we have one half of the equilateral hexagon - quadrilateral *KLMN* (see fig. 6), we can make the same algorithm for triangle *ABC*.

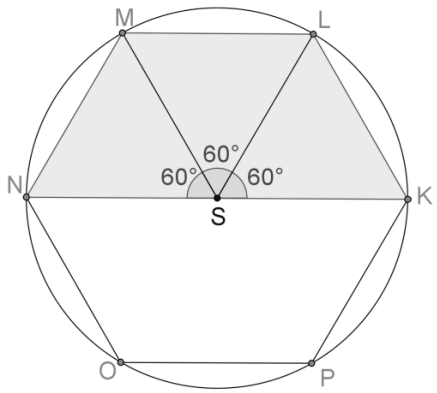

Figure 6 The half of the equilateral hexagon

The area of triangle *KLS* is:

$$S_2 = \frac{1}{2}r^2 \cdot \sin 60° = \frac{1}{2}r^2 \cdot \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{4}r^2$$

The area S_3 of the whole quadrilateral *KLMN* is

$$S_3 = 3S_2 = 3 \cdot \frac{\sqrt{3}}{4}r^2 = \frac{3\sqrt{3}}{4}r^2.$$

We get that $S = S_3$.

This example was could be solved in other ways, too. Both figures - triangle *ABC* and quadrilateral *KLMN* consist of three same triangles (*ABS*, *KLS*). For this reason it is enough to compare the areas S_1 and S_2. We can use now that $\sin 60° = \sin 120°$ and

$$\frac{1}{2}r^2 \cdot \sin 60° = \frac{1}{2}r^2 \cdot \sin 120°$$

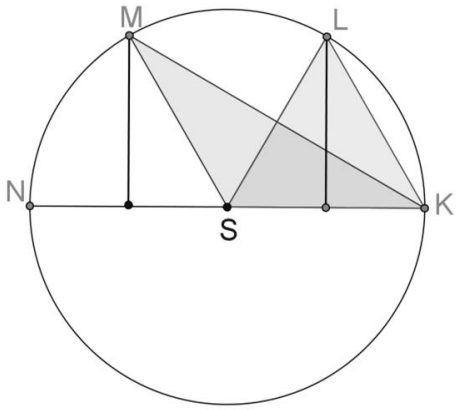

Figure 7 Triangles KSM, KLS

We can use also that the triangles *ABS*, *KLS* have the sides *AS*, *KS* with the same length *r* and height also with the same length. We can represent these two triangles in the same picture, because the triangles *ABS* and *KSM* are the same (see fig. 8). We can demonstrate that the areas of both figures - triangle *ABC* and quadrilateral *KLMN* have the same area.

Pupils have sometimes wrong interpretation of the Figure 9, that this is proof. We can show them cases where they can see that picture prepared by computer programme has wrong information.

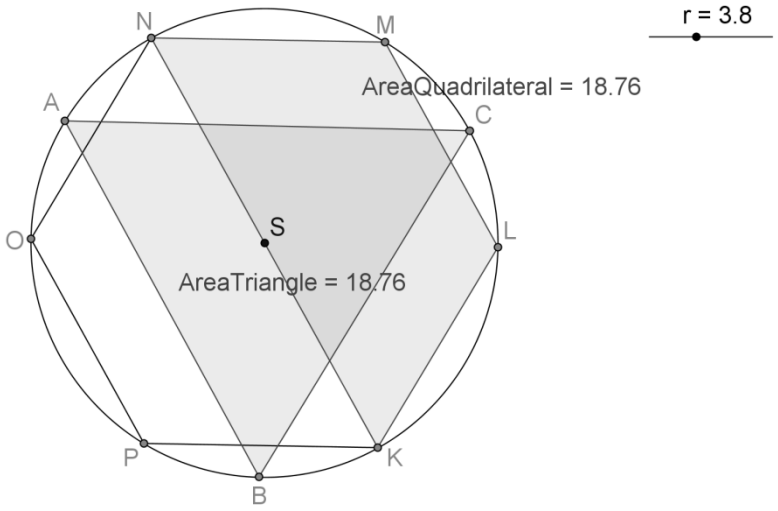

Figure 8 The triangle ABC and the quadrilateral KLMN in GeoGebra

We can solve following example according Gunčaga, Fulier, Eisenmann (2008):
Find the local minimum of the function

$$y = x^4 - \frac{1}{5}x^2 + 1.$$

We can prepare different figures by GeoGebra (fig. 9 and 10):

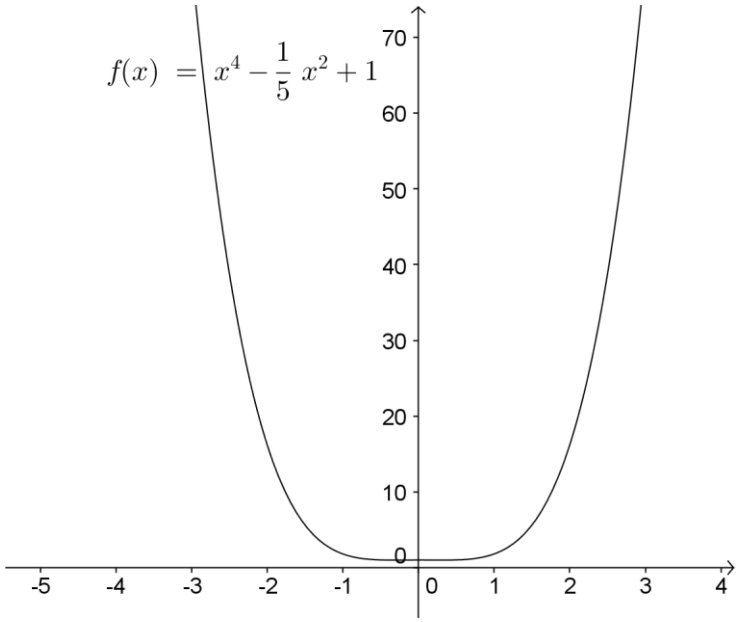

Figure 9 Graph of the function with wrong information about minimum

Pupils interpret figure 9 wrongly, saying that the function *f* has one minimum at point 0.

The figure 10 shows that in reality the function has two local minimums and there is a local maximum at point 0.

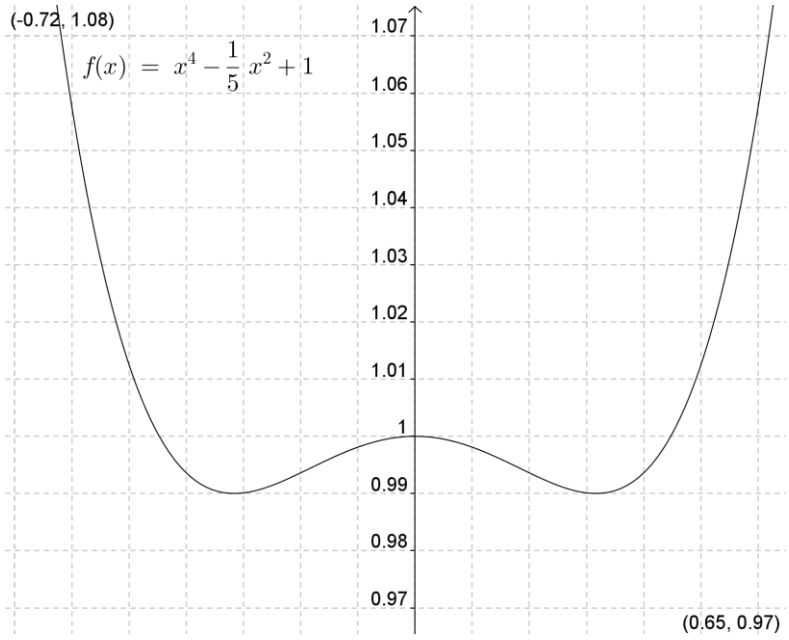

Figure 10 Graph of the function with two local minimums

The correct proof will be realized with help of the differential calculus (first and second derivative).

GeoGebra can be used as an effective tool to motivate pupils as it can visually represent a variety of mathematical notions and their relationships in a dynamic way. Within the interdisciplinary relationships, we can use GeoGebra also in teaching of computer science in secondary education.

7.5 Geogebra in teaching computer science

We used the GeoGebra program also in a computer science education. The pupils learned how to use toolbar, graphics and geometric window. Moreover, pupils were supposed to understand simple principles of graph theory, construct an algorithm of a given problem and write down problem's solution using the symbolic language (Baláková, 2011). After the lecture about the work with the program's environment, pupils were solving the following problems:

- To travel over all edges of graph by single path, which starts and finishes in the same vertex. The solution should be written down as a sequence of vertices (fig. 11).

- To find the shortest path in a graph such that all the vertices are connected (fig. 12).

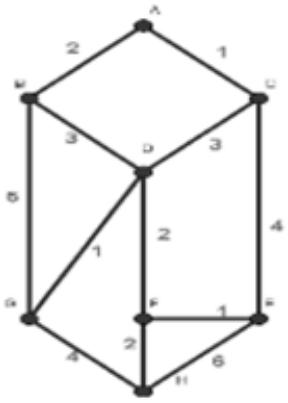

Figure 11 Graph in GeoGebra

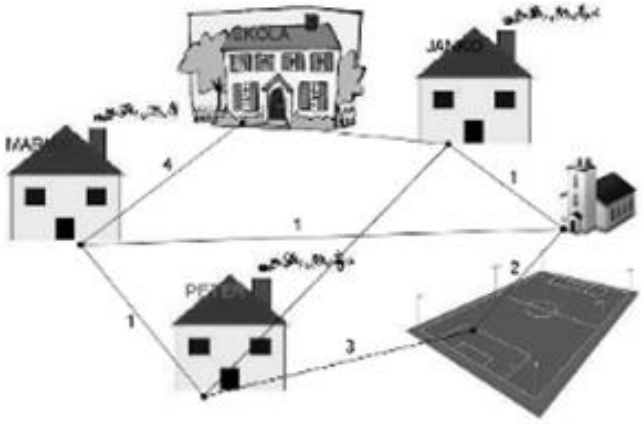

Figure 12 Shortest path in graph

The pupils experienced no problems while working with GeoGebra. They themselves were able to discover new features of the program, including options to change coloring, background or style. The assigned tasks were interesting for the pupils, who handled them without any major trouble (Gunčaga, Majherová, 2012).

7.6 Modeling of plants

The modeling in the science education basically means a bounding of certain part of reality for the particular reason, processing of its important features while neglecting the additional ones as well as its description and structure

determination. Natural phenomena can be represented by students through computer visualization. The objective is to help students to learn with and about the models and modeling in science (Louca, 2005).

Modeling is a reasoning skill, which refers to development of the ability to construct and improve models. We solve the tasks, which require the work with different representations of given problem. Tasks interconnected with this level of competence are not routine, but they comprise known or unknown elements. The students are trying to plan the strategies of solution and to use them in the tasks, which consist of several components.

In order to motivate to science education and modeling knowledge and skills we designed teaching of modeling of plants for secondary education. We connected mathematics, computer science and biology in secondary education. The aim of the lessons was that students had to create a simple model of the real world using information technology tools (Kelemenová, 2005). We have examined its conjunction with learning algorithms and programming.

We conducted the experimental teaching through the lessons of algorithms and programming at the first grade of a high school (Majherová, 2009). Pupils created a simple model of a flower. By the example of a plant's model, the pupils have understood the concept of the model and principle of its creation in computer - visualization. By the creation of the model, pupils applied also knowledge from geometry and biology (mutual relationships of geometric shapes, morphology of plants, etc.).

Pupils used a turtle graphics in programming environment Baltie 4 C#. Plant's models was created in the coordinate system with the help of procedures for the simple orders of movement forward, left and right. As a pattern of the originals, we have used the pictures of various types of flowers (fig. 13).

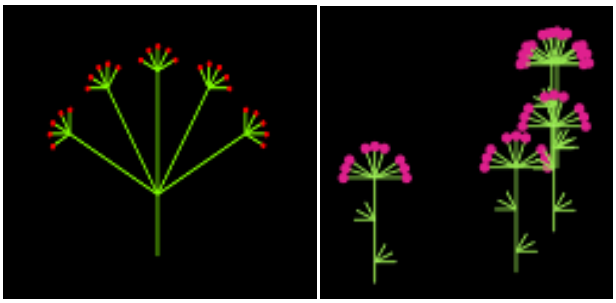

Figure 13 Models of flowers

By the creation of the plant's model we have determined following educational goals, which were assigned the code based on their location in hierarchy customized by Bloom's taxonomy (tab.1).

Table 1 The revised Bloom´s taxonomy dimensions

The Knowledge Dimension	**The Cognitive Process Dimension**					
	1. Remembering	**2.** Under-standing	**3.** Applying	**4.** Analyzing	**5.** Evaluating	**6.** Creating
A. Factual knowledge	List	Summarize	Classify	Order	Rank	Combine
B. Conceptual knowledge	Describe	Interpret	Experiment	Explain	Asses	Plan
C. Procedural knowledge	Tabulate	Predict	Calculate	Differen-ciate	Conclude	Compose
D. Metacognitive knowledge	Appropriate use	Execute	Construct	Achieve	Action	Actualize

During the education, the students have obtained the following knowledge and skills (Majherová, 2010):

- To design graphic model of the plant based on original – that means in customized Bloom's taxonomy to understand and apply real, conceptual and procedural knowledge (code **A2, A3, B2, B3**, **C3)** and also metacognitive aspect of the connection of knowledge from several subjects **(D2)**
- To use the instruction of the turtle graphics for realization of the plant's model – to apply conceptual and procedural knowledge (**B3, C3)**
- To use the element of the casualness by modeling – to apply conceptual and procedural knowledge (**B3, C3)**
- To realize graphical model of the plant on the computer – to create (**C6)**
- To change the properties of the model – to apply and analyze the knowledge (**C4, C5)**
- To use variables, cycles, methods in the program – to apply procedural knowledge (**C3, C4)**
- To create the project Modeling in informatics – to create, apply and analyze relationships among subjects (math–biology–informatics) (**C6, D3, D4)**

We are illustrating the dimensions of mentioned education goals in taxonomic table of revised Bloom's taxonomy (tab. 2).

Table 2 Dimensions of the educational goals in the creation of the plant's model

The Knowledge Dimension	The Cognitive Process Dimension					
	1. Remembering	2. Under-standing	3. Applying	4. Analyzing	5. Evaluating	6. Creating
A. Factual knowledge		X	X			
B. Conceptual knowledge		X	X			
C. Procedural knowledge		X	X	X	X	X
D. Metacognitive knowledge		X	X	X		

Within the frame of cognitive process, a student should obtain competences in all areas from memorizing up to valuation and creation of the new products. By qualitative analysis of pupil's programs and projects, we have found that all students have reached the levels of memorizing, understanding and application. Part of them has reached knowledge by analysis and some of them have showed level of independent analyses, evaluation and creation.

Some students used solely the information obtained in lessons. They designed a simple model of a plant, but they incorrectly added a part of an original flower. Other created correct model of plant, but didn't use its own procedure in program and didn't search for new information about the models. They reached the level of memorizing, understanding, application and partly analysis of reached knowledge.

Some students approached the construction of the model creatively, used new information from the internet about models and designed graphical plant's model in programming environment. They assigned the correct type of plant to the model and showed also the cognitive level of analysis and evaluation of knowledge.

7.7 Computer game in teaching algorithms

A growing number of researchers believe that playing computer games is developing the thinking of children in such a form that it should draw our significant attention. Children, who play computer games, obtain a brand new set of cognitive skills (see Facer, 2004).

These skills can be described as a parallel processing of information, better processing of graphical information, an experimental approach to the problem solving,

the active involvement of the pupil in the solutions, a development of imagination and creativity of the pupil and the understanding of technology as a friend.

Young people develop their skills of processing information incredibly fast from various sources, which are selected according to what is important to them and what is not.

The computer games became very popular over the past 20 years. Many experts wondered why these games are so popular. Prensky (2001) compiled several key characteristics of the games such as a management of certain rules, a definition of goals and ideas, results and a feedback for the players, responses to conflict / competition / challenge / opponents, interaction with other players or the computer and the representation of the story.

We often meet with the misconception of parents and sometimes even teachers that the games (so much fun) and learning simply can't go hand in hand (Facer, 2004, Círus, 2010). If we learn about something important, which we'll need later at written works and in the oral replies, we must not entertain and we must not simply be a good mood.

Using correct dimension of learning in the computer games is well designed and interesting motivation because thanks to it the learning becomes fun - because children want to play. This kind of education does not feel like a duty. Several studies, in the issue of games and learning (Facer, 2004), argue that a key factor in learning through games is developing the skills. Most important skills mentioned here are: communication and work in a team, problem solving and developing logical thinking and mathematical skills by special kinds of games.

The success depends on the correct use of logical reasoning in a logical game. Logic games are based on logical procedures that need to be applied. Such games develop logical thinking and force the player to think over next step creatively.

In the next section we present some logic games which we use in teaching a thematic unit “Algorithms and algorithmization”. It was conducted at the St. Andrew high school in Ružomberok for the first grade students. One part of the experiment was the introduction of online games, custom games and projects, which were programmed in the programming language, as well in the creation of student´s Imagine projects.

The issue of finding Euler track in a given graph can be effectively used in solving many problems not only in mathematics, but also in everyday life. One example can be drawing a picture with a single stroke or finding routes for sprinkle car in the city. In these cases the street is done just once. One touch Drawing is a simple game. The task of the player is to draw everything in one stroke (fig. 14).

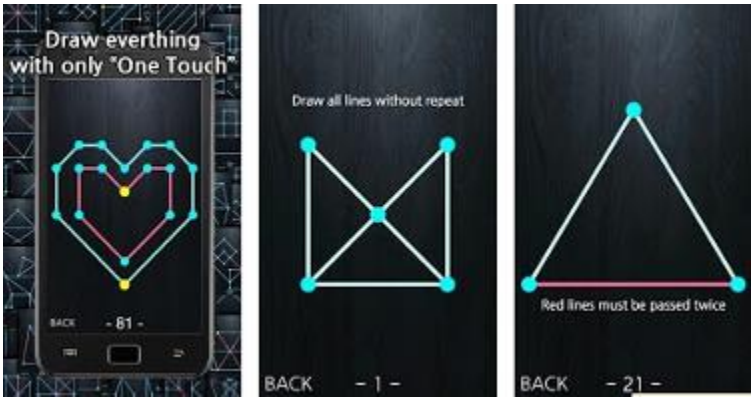

Figure 14 Game One touch Drawing

The next game was used for learning the basic commands in the Imagine programming language. There are two visible turtles on the desktop, one turtle is hidden. The first turtle has the shape of a small house. The task of the player is to get a second turtle in a small house using basic commands left, right, forward or backward (fig. 15).

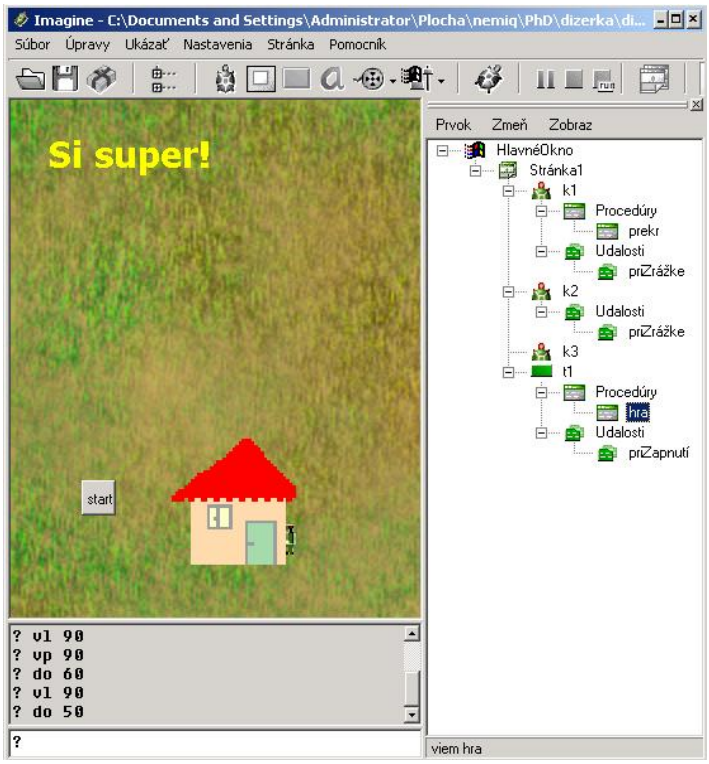

Figure 15 Example for the Imagine games

Although the principle of the game is simple, it takes the pupils attention. We showed the game to pupils and they created a simple game themselves.

Next game serves to clarify the conditions. There is a bottle on the desktop and in it a little bee. When we click on the bee, it will begin to fly and if it hits the bottle, bounces and flies in another direction (fig. 16). After several attempts the bee flies out of the bottle.

Figure 16 The little bee in the bottle

The computer games have a great success by the pupils in age 14-15 years. Most students prefer playing game to creating a program, in the formation of the final project. The output of the teaching shows that big group of students like especially computer gaming, competition in logical tasks in games. The pupils like mostly the games on the Internet. Big group of the teachers in secondary schools (60% according our questionnaire) think that pupils playing computer games are gaining computer skills or they improve logical thinking. Only 27% teachers used the game (computer or teaching) in education. Also, the logical games are good motivational tools for pupils in improving computer skills.

The introduction of logical tasks in the teaching process has a positive impact on pupils, particularly, on the interest of pupils and their subsequent tasks of joy. When pupils learn, they are more successful in resolving. Tasks do not constitute a stress factor for pupils, but they represent a form of entertainment. Their ability to think logically and algorithmically will develop gradually.

Conclusion

The relationships between mathematics, informatics and other subjects, which are supported by educational software, represent very important part of integration of ICT in education. In our paper we describe different examples of use of this software in teaching of mathematics and informatics in secondary level.

There are numerous possibilities for a visualization and simulation processes through a computer in mathematics, computer science and natural science teaching. Graphical possibilities of didactic software allow students to work with models of different objects. Students can apply knowledge gained in learning stage and at the same time look for solutions of different problems. Moreover, they can visually observe the result and thus understand and adopt basic concepts and notions more easily. Creation of the model and its visualization by computer allows pupils to gain specific experiences regarding the use of mathematics, science and informatics in a practical life.

The role of the teacher is strongly changed. He is no longer only instructor in the computer aided education of different subjects, but more a manager and moderator of pupils or students. He must prepare activities, in which the educational software and his visualization and modeling aspects can support construction of new knowledge by every pupil (see Krech, 2009).

Activities with program GeoGebra, Baltie and Imagine can effectively assist teachers in supporting pupils' cognitive process. Pupils can develop its formal and logical reasoning, cooperation and communication. They gain skills that are necessary for the research work, e.g. an ability to implement a simple research project, to formulate a problem, to look for the solution and cause context, and to learn how to use various methods of problem solving. The characteristic features for the new competencies are integration, connection and non-demanding extension of known subject, modeling and using different methods in problem solving.

Solving logical problems helps develop a logical and algorithmic thinking via modeling and educational computer games. The various tasks have various levels of difficulty and so we have to devote enough time for choosing the right tasks. They have many advantages: a visualization of algorithms, interactivity and a higher motivation of the student. GeoGebra and other types of open source software bring the teachers possibility to organize different activities for pupils via methods of cooperative learning. Nowadays it is very important that the pupils learn to work in team (see Jablonský, 2006). Our pedagogical experiments have shown that this kind of teaching is appropriate for students and for support and development of their creativity, and can be used also in other school subjects (see Albert, 2012).

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8 EDUCATION IN SMART CITIES

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Abstract

Computer and information technology tools have become an inseparable part of today's world. This resulted in some changes in people's lifestyles, habits, environments, and how people access information. One of the primary responsibilities of educators is to guide students considering all of these changes and their effects. In that sense, educators have to improve themselves in qualified information/knowledge (=what), ways to access information (=how), learner profiles (=who), proper tools and methods (=which & how), and environment (=where). Therefore, we aim to present valuable information for educators about all of these and relation between them.

Keywords: Information increase, Big data, Digital natives, Smart cities, Algorithmic thinking

Introduction

Rapid developments and changes in technology have resulted in new concepts, new life styles, and new generations. In such world, educators have an important responsibility. Indeed, it is among the main responsibilities of educators to make students know how to access information and what the valuable information is. There is a special attention on access to valuable information because there is much disinformation and is gradually getting much bigger. Also, it is the only thing to consider for educators.

The new generation who is born into such a digitalized world should not be expected to be the same as the generation before. Thus, there is a new generation, called digital natives who are the native speakers of the new digital world. The characteristics of digital natives is different from the previous generation, as well.

On the other hand, there is a new concept, smart cities; as the result of information and communication technologies to be integrated into city life. Thus, effective and efficient use of scarce resources in the city to make life more livable for individuals with renewable energy, which is a new living space, has given rise to the concept of smart cities. In that point, educators have a new responsibility to be a part of raising smart citizens for smart cities. Having the identity of being a

student and being a citizen, digital natives are the new learners and the new citizens. In that point, it is important to take into consideration who digital natives are and what are their needs.

In this study, we examine big data, digital natives, smart cities, and algorithmic thinking. Therefore, it should be possible to present a framework for educators to understand the new student profiles and new educational environments.

Big Data:

Today, information is getting more important than ever before. Data are also more important owing to improving technologies and the internet. Size of data has reached amazing amounts. Even one individual can produce a lot of data in his/her daily activities. Individuals are leaving traces (data) while they are shopping at supermarket, using any applications with their smart phones, surfing social networks etc. Thus companies can manage their marketing strategies, schools can update their curriculum, and web sites can improve their user activities.

Data can be defined as quantitative and qualitative features of variable(s). Generally data are measurement results of variables, graphics, images and observations. To gain knowledge, data are the lowest level. Raw data, i.e. unprocessed data, refers to a collection of numbers, characters, images or other outputs from devices that collect information to convert physical quantities into symbols (Davenport & Prusak, 2005).

When data are processed, organized, structured or presented in a given context so as to make it useful, it is called information. Data are useless until we have them organized into frameworks (Figure 1).

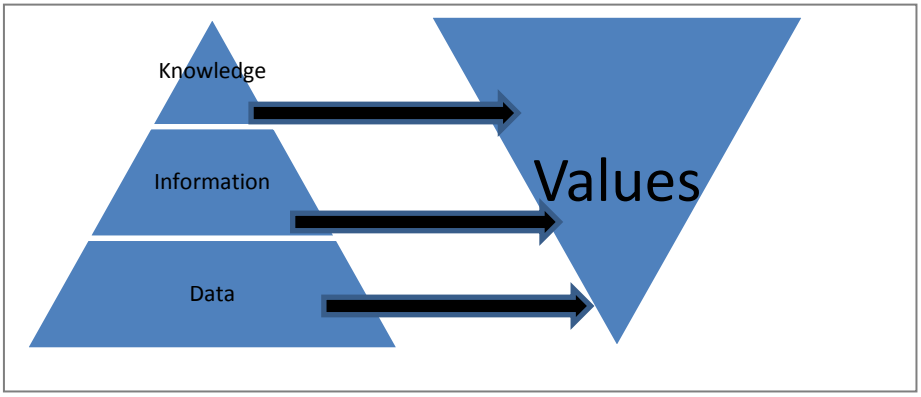


Figure 1: http://www.trada.com/blog/metrics-driven-startups/

It may become possible to see the size of data when data are organized. In 1950s, it were insurance companies who had the biggest data hoards. John Hancock Mutual Life Insurance Co. was one of the pioneers in digitizing customer information. The company had 600 Megabytes data belonging to two million customers. In 2010, it can be easily seen that Facebook's warehouses were over 100 petabytes of data a year (theregister.co.uk). About 2.5 exabytes of data are created each day (McAfee & Brynjolfsson, 2012). 90% of all the data in the world has been created in the last two years alone (Hess & Speaking, 2013). There are 25 Petabytes created every day and thrown into the internet. This is 70 times larger than the Library of Congress (Kouri, 2012). In Table 1, size of data is summarized.

Multiples of bytes				
SI decimal prefixes		Binary usage	IEC binary prefixes	
Name (Symbol)	Value		Name (Symbol)	Value
kilobyte (kB)	10^3	2^{10}	kibibyte (KiB)	2^{10}
megabyte (MB)	10^6	2^{20}	mebibyte (MiB)	2^{20}
gigabyte (GB)	10^9	2^{30}	gibibyte (GiB)	2^{30}
terabyte (TB)	10^{12}	2^{40}	tebibyte (TiB)	2^{40}
petabyte (PB)	10^{15}	2^{50}	pebibyte (PiB)	2^{50}
exabyte (EB)	10^{18}	2^{60}	exbibyte (EiB)	2^{60}
zettabyte (ZB)	10^{21}	2^{70}	zebibyte (ZiB)	2^{70}
yottabyte (YB)	10^{24}	2^{80}	yobibyte (YiB)	2^{80}

Table1. http://en.wikipedia.org/wiki/Petabyte

More examples can be given to understand how the size of data is mentioned. The current NASA Earth observation satellites generate a terabyte of data every day. This is more than the total amount of data ever transmitted by all previous observation satellites. The Human Genome project is storing thousands of bytes for each of several billion genetic bases. It is estimated that there are over 650 million websites. There are over 900 million users of Facebook, with an estimated 3 billion postings a day. It is estimated that there are around 150 million users of Twitter, sending 350 million tweets each day (Bramer, 2013).

Increased size of data has brought a new definition: Big Data! The internet and smart phones play an important role in increasing the size of data. Also, other growing technologies are affected to reveal definition of big data. Big data is defined as any kind of data source that has at least three shared characteristics: Extremely large volumes of data, extremely high velocity of data, and extremely wide variety of data (IBM Red Books). According to many authors big data is “new oil of the future”. And we live in data-driven age. We can collect more data in less time. Thanks to new methods, data analysis process is getting shortened. Hereby, the results of an analysis may lead to some changes in our knowledge.

To better understand the scientific importance of big data, an example from astronomy can be given. Pluto was discovered in 1930 by an astronomer from the United States. Pluto was known as the smallest planet in the solar system and the ninth planet in the order of distance from the sun. Today, Pluto is called a "dwarf planet." A dwarf planet orbits the sun just like other planets, but is smaller. A dwarf planet is so small that it cannot clear other objects out of its path. Pluto is in a region called the Kuiper (KY-per) Belt. Thousands of small, icy objects like Pluto are in the Kuiper Belt. In 2003, an astronomer saw a new object beyond Pluto. The astronomer thought he had found a new planet. The object he saw was larger than Pluto. He named the object Eris. Finding Eris caused other astronomers to talk about what makes a planet a "planet." There is a group of astronomers that names objects in space. This group decided that Pluto was not really a planet because of its size and location in space. So Pluto and objects like it are now called dwarf planets. Pluto is also called a plutoid. A plutoid is a dwarf planet that is farther out in space than the planet Neptune. The three known plutoids are Pluto, Eris, and Makemake.

Astronomers use telescopes to discover new objects like plutoids. NASA learns about Pluto from pictures taken with telescopes. Pictures from the Hubble Space Telescope helped scientists find the moons Nix and Hydra. Hubble has also taken pictures of Pluto's surface. The pictures show dark and light areas on Pluto. Pluto is so far away that even pictures taken by telescopes in space are a little fuzzy.

NASA sends spacecraft to other planets because exploring space is exciting. It helps people learn new things. Spacecraft have visited every major planet in the solar system. Studying places like Pluto may help scientists learn how planets form (nasa.gov).

Today “Big Data” has become one of the really popular topics. Results of big data studies will affect practices of education and teaching, and educational resources will be revised and rearranged.

Digital Natives

We have been living in a world that is covered with the internet for the last decades. It is not the same world anymore. The internet has given birth to such a different world that people are connected to each other globally and there is no time or place dependency. As a result of such a connected world, it became possible to reach information anytime and anywhere, for anyone. When we look at the internet usage in the world in the first half of 2013, as shown in the Figure 2, we see that the percentages are very high, except for one or two country. It may be said that these numbers are really high when we consider that the technological infrastructure opportunities provided by the governments may not be high in every country.

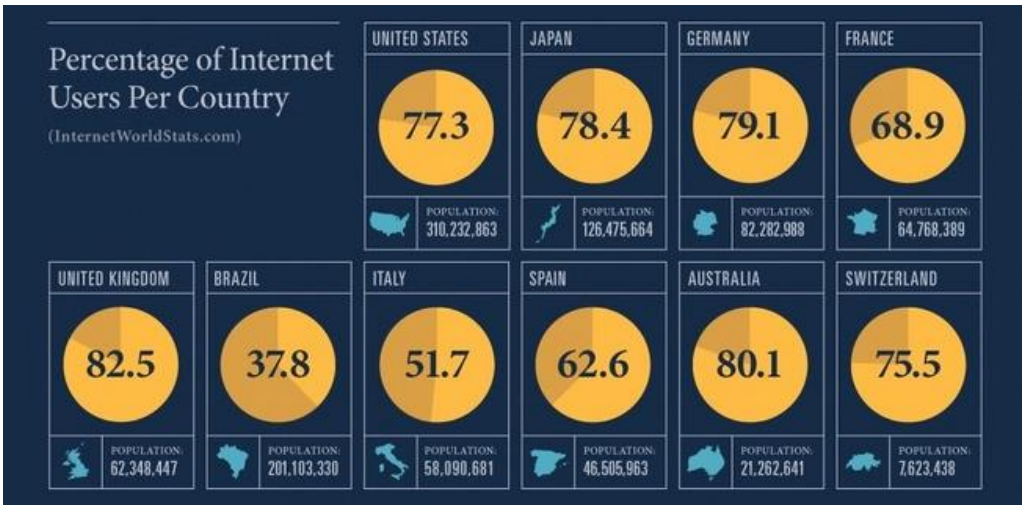


Figure 2: How the world uses social networks (infographicb2b.com, 2013)

In the Figure 3, the map shows the distribution of internet users in the world by countries in 2008-2012. The darker red areas show the higher rates of internet usage.

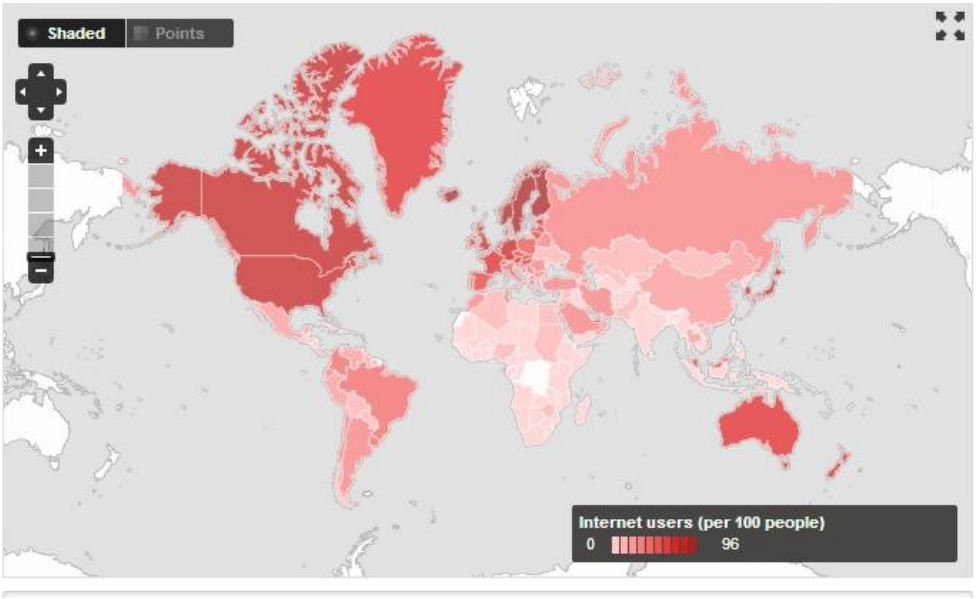


Figure 3: Internet users (worldbank.org, 2013)

In the Figure 4, the map shows the distribution of mobile cellular subscriptions in the world by countries in 2008-2012. The darker red areas show the higher rates of mobile cellular subscriptions.

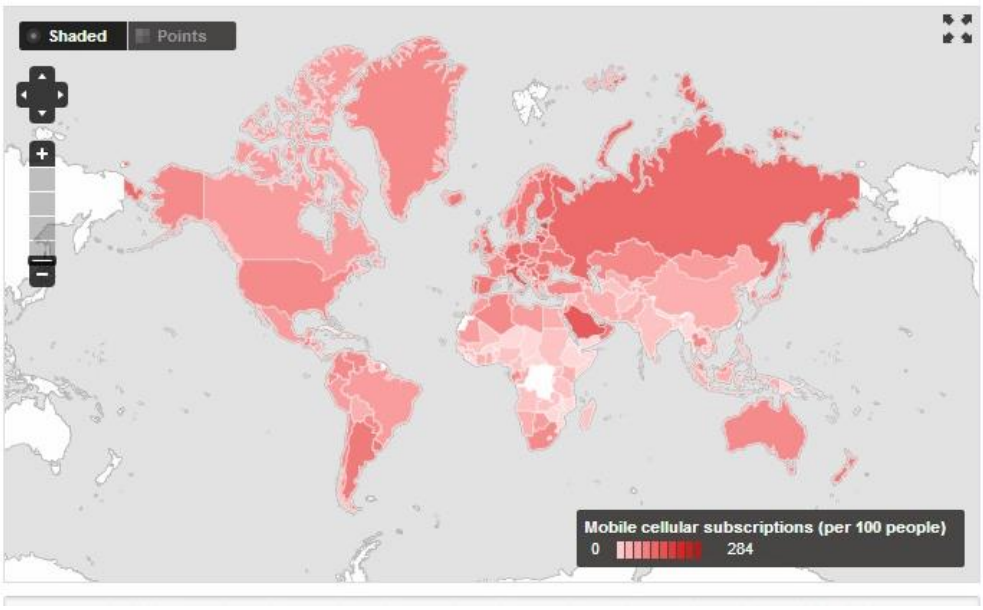


Figure 4: Mobile cellular subscriptions (worldbank.org, 2013)

All these figures show that the world is covered with the internet and people around the world are connected to each other. In such a digitalized world, the dynamics of life has changed. As Toffler (2008) said, the world has begun to change as a result of digitalization and this is the third wave. Indeed, the third wave describes the information age. The information age has emerged in the early 1970's (Duff, 2000) and it has been gaining acceptance since the early 1980's (Karvalics, 2007).

In the information age, there are changes in every area of life. The newborns of the information age come from a different generation than those born in a digitalized world. This different new generation has got many different names. They are called, "Net generation" (Tapscott, 2009); "Digital generation" (Jukes et al., 2010); "Y-generation" and "Z-generation" (McCrindle & Wolfinger, 2010); "I (Internet) generation" (Rosen, 2010); "M (Multitasking) generation" (Wallis, 2006); "Millennium generation" (Lancaster & Stillman, 2010; Howe & Strauss, 2000); "Technology generation" (Lancaster & Stillman, 2010); "Media generation" (Cvetkovic & Lackie, 2009); and "Digital natives" (Prensky, 2001).

Although all of these namings point out a new generation with technology being inseparable part of their lives, we focus on the digital natives definition. Prensky (2001) defines digital natives as "native speakers of the digital language of computers, video games and the internet". Digital natives are the generation who were born after 1980 and surrounded by digital media and other digital technologies. Digital natives have different characteristics from the previous generations. Prensky (2001) lists the features of digital natives as the following: "they are used to receiving information really fast, like to parallel processes and multitask, prefer their graphics to their text rather than the opposite, prefer random access, like hypertext, function best when networked, thrive on instant gratification and frequent rewards, and prefer games to 'serious' work".

When we consider digital natives' use of technology, we may say that the rate of internet usage among children is also very high. For example, as shown in the Figure 5, internet usage among 6-15 age group in 2013 in Turkey is 50.8 %; the percentage of mobile phone usage is 24.3 %.

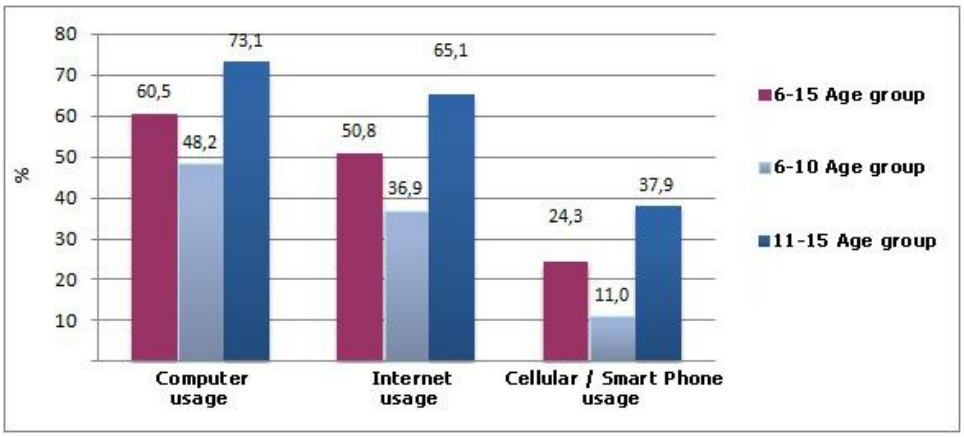


Figure 5: Computer, internet, and mobile phone usage (tuik.gov.tr, 2013)

Furthermore, the research done by Ugras (2012) shows that the rates of having internet connection among digital natives with the ages of 13-17 in Istanbul are very high and close to each other with regarding the age (which is between 88-93 %); the gender (which is between 88-94 %); and socio-economic status (which is between 86-97 %).

Similarly, it's possible to observe high rates in the use of technology among digital natives in other countries, for example in the USA (Rideout et al., 2010), in Britain (Helsper & Enyon, 2009), and in the Middle East and North Africa (Melki, 2010).

There is another concept called as digital citizenship, which comes along with the information age. Digital citizenship is "the norms of appropriate and responsible technology use" (Ribble, 2013). Digital natives are also digital citizens.

It's obvious that digital natives are users of digital technologies. But the uniqueness of digital natives (i.e. digital natives' difference from previous generations) does not rely upon being only digital technology users. Being a digital native is beyond being a digital technology user. Digital natives differ in their view and and perception of the world because they think and learn in a different way. They have non-linear thinking style (Prensky, 2001); they learn best on the game-based environments (Prensky, 2007). Therefore they are new learners; new citizens.

In conclusion, it is essential for digital natives to be treated as they are. In that sense, it is inevitable to get to know who they are. Educators and ministry of education in countries should take into account the characteristics of digital natives while developing instructional designs for them. Also, governments should consider the needs of digital natives, especially when developing strategic plans.

Algorithmic Thinking and a Sample Tool: Scratch

Algorithm is defined as a specific and ordered way for solving a problem. That concept is included not only in problem solving approach in mathematics and computer programming, but also in daily life. Many basic actions in daily life may contain algorithms, such as putting on a pair of socks.

Example: Let's try to find out the algorithm in putting on a pair of socks.

Firstly, you should open the drawer, full of socks, then choose one pair. Then, you should check the socks whether they are paired or not. If they are not paired, then you should search for the socks until you find a pair. These daily action contains an algorithm; let's specify the steps.

Pseudo Code	Flowchart

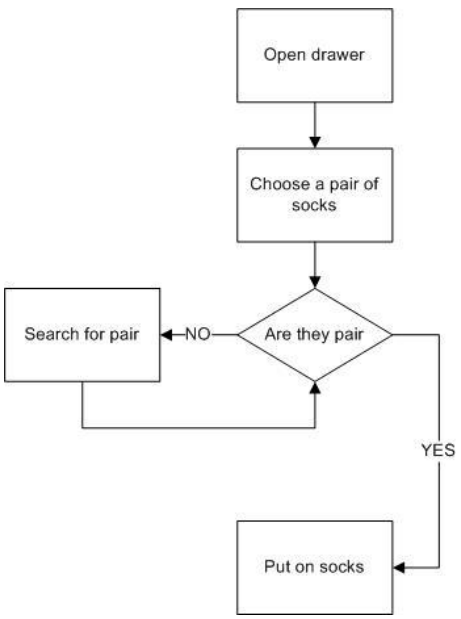
Open _drawer
{
Search (a_pair_of_socks)
If (they_are _pair)
Put_on (socks);
Else
For sock1=sock2;
Search for_pair;
}
	

Table 2. Algorithm in putting on a pair of socks

Likewise algorithm of putting on a pair of socks, many daily actions may contain a hidden algorithm steps. The basic point is to understand and clarify those algorithm steps. The typical problems in teaching algorithmic thinking are abstract thinking and reflecting that thinking on programming environment (Futschek & Moschitz, 2011). On the other hand, choosing right/suitable tools and activities for teaching algorithmic thinking needs to be carefully considered. Bell et al. (2009)

have much research about teaching algorithmic thinking on K-12 students. They managed to teach that thinking style by using many activities without computers.
To choose just any programming language may not give successful results in teaching algorithmic thinking to new generation. Thus, the research of Guzdial (2004) shows that the programming languages have many difficulties for beginners because of unsuitable interfaces and deepness in abstract structure. Likewise, Resnick et al. (2009) ordered the factors of failure in programming:

- Early programming languages were too difficult to use, and many children simply couldn't master the syntax of programming;
- Programming was often introduced with activities (such as generating lists of prime numbers and making simple line drawings) that were not connected to young people's interests or experiences;
- Programming was often introduced in contexts where no one could provide guidance when things went wrong or encourage deeper explorations when things went right.

In spite of the natural ability of new generation in technology usage, they are beginners while learning programming language. So they can have some difficulties. Resnick et al. (2009) stated that though they interact with digital media all the time, few are able to create their own games, animations, or simulations. It's as if they can "read" but not "write".

Not only being users of digital world but also being producers, there are some programs for those generation. The most known programs are Logo, Alice, Baltie, and Scratch. Those programs provide manipulation of visual objects by commands.

Scratch

Scratch is designed supporting many different types of projects (stories, games, animations, simulations), so people with widely varying interests are all able to work on projects they care about (Resnick et. al., 2009).

Scratch was developed in MIT Media Lab with support of National Science Foundation in 2003. It was announced in 2007. The Scratch web site is http://scratch.mit.edu.

Scratch has three core design principles: Make it more tinkerable, more meaningful, and more social than other programming environment (Resnick et. al., 2009). The developers can easily use different type of media tools such as pictures, sounds, and music. They can also share their projects on YouTube and/or Facebook.

Programming with Scratch is like Lego playing. There is a collection of graphical “programming blocks” that children snap together to create programs. As with Lego bricks, connectors on the blocks suggest how they should be put together. Children can start by simply tinkering with the bricks, snapping them together in different sequences and combinations to see what happens. There is none of the obscure syntax or punctuation of traditional programming languages (Resnick et. al., 2009).

The scripting area in the Scratch interface is intended to be used like a physical desktop (Resnick et. al., 2009). There are three main parts in that interface. The left part contains blocks, which are used for programming. The middle part is for putting and ordering blocks and creating programs; it is just like syntax writing area. The right part is a stage for developed programs, and developer can watch his/her project. Figure 6 illustrates the interface of Scratch.

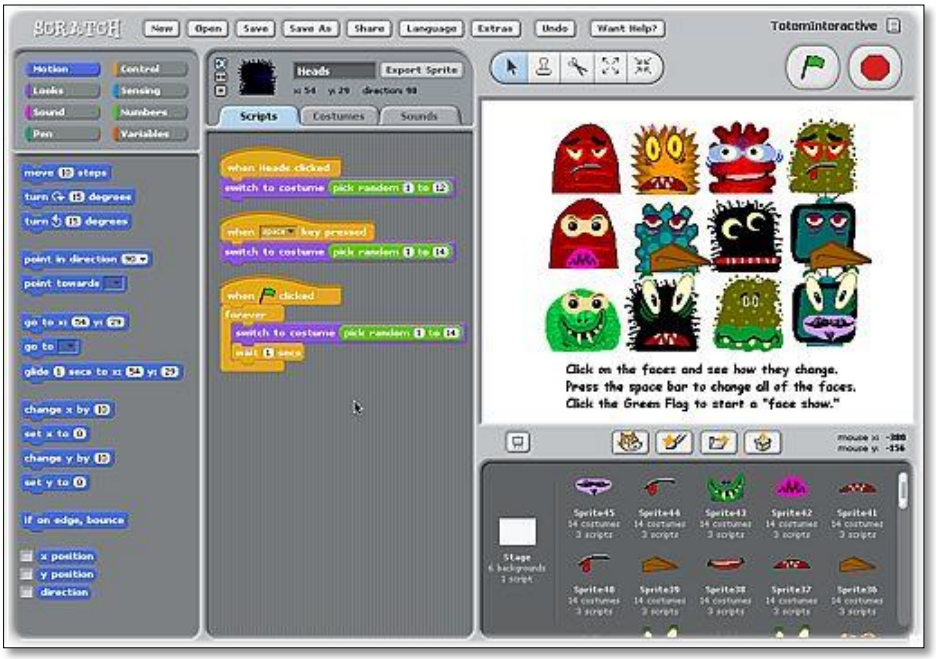


Figure 6. Interface of Scratch

There are also several options for characters, which are used for animating. User can also create his/her character. Scratch blocks are shaped to fit together only in ways that make syntactic sense. Control structures (like forever and repeat) are C-shaped to suggest that blocks should be placed inside them (Resnick et. al., 2009). Figure 7 illustrates the blocks of Scratch.

Figure 7. Blocks of Scrtach

Blocks that output values are shaped according to the types of values they return: Ovals for numbers and hexagons for Booleans. Conditional blocks (like if and repeat-until) have hexagon-shaped voids, indicating a Boolean is required (Resnick et. al., 2009). Figure 8 illustrates the Boolean blocks of Scratch.

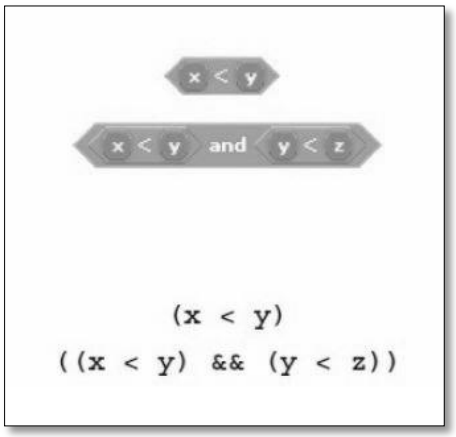


Figure 8. Boolean blocks of Scratch.

Scratch is designed to be highly interactive. Just click on a stack of blocks and it starts to execute its code immediately. Developers can even make changes to a stack as it is running, so it is easy to experiment with new ideas incrementally and iteratively (Resnick et. al., 2009).

Smart Cities

Urbanization concept refers to the lives of people in a given community order. However, the increasing number of people and running out of natural resources make city life and its control harder. The major cities of the future need to find effective and unifying solutions to meet the needs and requirements (Bach at all, 2010). According to IBM (2012), there is going to be an increase in supplies as

well as demands of vital services of city's infrastructure such as transportation, health services, education and public safety, especially in the cities having high populations. In this point, there is a need for solutions supported by ICT (Information and Communication Technology) to both existing and foreseen problems (Ferreira & Afonso, 2011).

The educational systems of today's world also face several problems and this is a barrier for efficiency in learning. Thanks to use of ICT in education, it is possible to change easily the teaching and learning environments, curricula and methods as well as the way of interaction between students and teachers. Students are getting more and more independent from teachers. This is both an advantage and a danger. When we start to use smart applications, the danger will transform to an advantage. Therefore, the principal responsibility of teachers today is to be aware of smart city and smart application concepts as well as to train students how to use such applications in order to become citizens of smart cities.

According to literature a technical definition of smart city is: Intelligent environments with embedded ICT creating interactive spaces that bring computation into the physical world (Steventon & Wright, 2006). As Alobaidan (2009) stated, we can give four different definitions for a smart city from for different perspective:

- **Academic:** The amount of IP (Intellectual Property) which the city produced to enhance the city lifestyle compared to other cities globally.
- **Provider:** The amount of data traffic a citizen can generate or receive per second in MB (cyber city).
- **ICT:** Diversity of different technologies intelligently integrated to provide seamless smart applications and services on different access networks.
- **Citizen:** Service, Care, Price, Quality, Availability and Speed.

The "smart cities" concept, which is getting more popular recently, has been taken into account by the European Commission. On July 10, 2012 the European Commission launched the Smart Cities and Communities European Innovation Partnership. The partnership proposes to pool resources to support the demonstration of energy, transport and information and communication technologies (ICT) in urban areas. The energy, transport and ICT industries are invited to work together with cities to combine their technologies to address cities' needs. This will enable innovative, integrated and efficient technologies to roll out

and enter the market more easily, while placing cities at the centre of innovation. (European Commission 1, 2013).

What makes cities smart are the infrastructure and smart applications.

Smart City Applications

A smart city application could have following 7 elements (She, 2013):

- **Sensible** - sensors sensing the environment
- **Connectable** - A networking devices bringing the sensed information to the web;
- **Accessible** - The broader information of our environment is published on the web, and accessible to the user (web);
- **Ubiquitous** - The user can get access to the information through the web, but more importantly through mobile devices any time, any place (mobile);
- **Sociable** - The user can publish the information though his social network
- **Shareable** - The object itself must be accessible and addressable (not just the data) in a true peer to peer networked manner.
- **Visible/augmented** - To retrofit the physical environment, make the hidden information seen not only through mobile device by individual, but seen with one's eyes in more broader range of the physical places like street signs.

On the other hand, a smart city application could be based on the following themes:

- Smart Manufacturing, New production tools (home produced food, energy, micro- manufacturing, 3D printing)
- Collaboration / sharing of resources via the Internet
- Urban farming
- Apps relating to Open data
- Apps relating to Smart energy
- Apps relating to Smart transportation
- Smart health
- Technology (especially related to open source hardware and s/w)
- Culture
- Sustainability
- Art

If we try to give a formula for an application from smart cities it can be like the following (She, 2013):

Application for smart city (City as a platform) = Intelligent places + Data + Mobile apps + Community + Services

In the following list there are some examples of applications for smart cities which are the winning solutions from the Living Labs Global Award (LLGA, 2013);

- Barcelona (Spain): Turning empty Space into an opportunity by 3Space
- Boston (USA): Underground Technologies Elevation Units by Quality Water Products
- Christchurch (NZ): Philips Lighting Control systems- a solution for the new Christchurch by Philips Eindhoven (The Netherlands): Contactless tags to bridge real and virtual worlds by Connecthings
- Fukuoka (Japan): Guidebook by Guidebook
- L'Hospitalet (Spain): NANA (Novel Assessment of Nutrition and Ageing) by NANA
- Lagos (Nigeria): Wireless Lagos: Free & Far Reaching by OTG Playa Entity LLC
- Lavasa (India): Enabling Livelihoods by LabourNet
- London (UK) 1: Realtime Energy Opportunity System (REOS) by Brighter Planet Technology Services
- London (UK) 2: Delivering Scalable Energy Efficiency in Global Cities by First Fuel
- Maringá (Brazil): Modern Urban Transport Information by Clever Devices

Smart applications in the city of Istanbul

There are many smart city applications in Istanbul. Some of them are completed. We can give the following examples of completed applications:

AkYolbil : Satellite Tracking and GPS Fleet Control Management System

This project records public transportation vehicles, which belong to IETT (Istanbul Public Transportation Agency), their locations and geographic coordinates (GPS data). Thanks to real-time GPS position information of vehicles (BELBİM, 2013):

- Passengers, who are in vehicle or waiting on a stop, can get information about position of the vehicle.
- Head office can control fleet especially when fleet plan needs change.
- Trip changes can be transmitted to passengers at the same time.
- Thanks to traffic data in the past, passengers can access estimated arrival time of vehicle.

- Arrival times of vehicle, shown at the smart stops, are updated due to real-time vehicle positions. Therefore, passengers can see real-time changes at the smart stops.

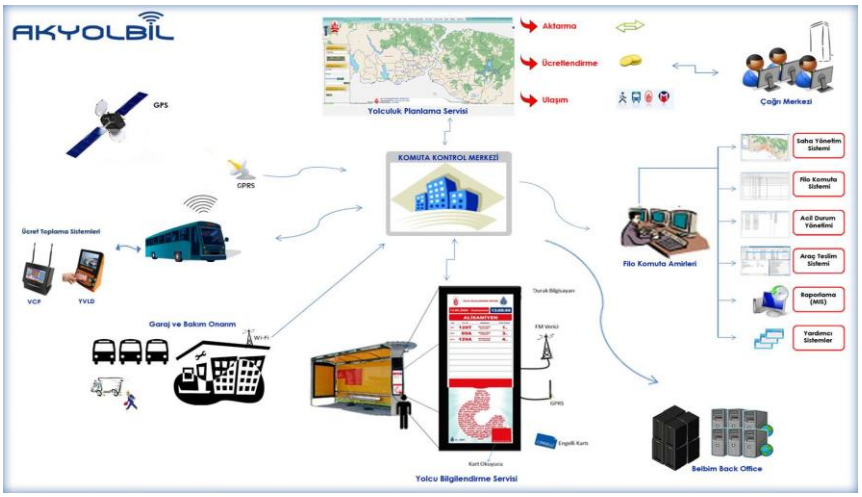


Figure 9. Structure of Akyolbil Project

Traffic Density Map

Traffic density map contains information of traffic densities, traffic jams, statistics, meteorological observation sensors and sensor points (IBB, 2013).

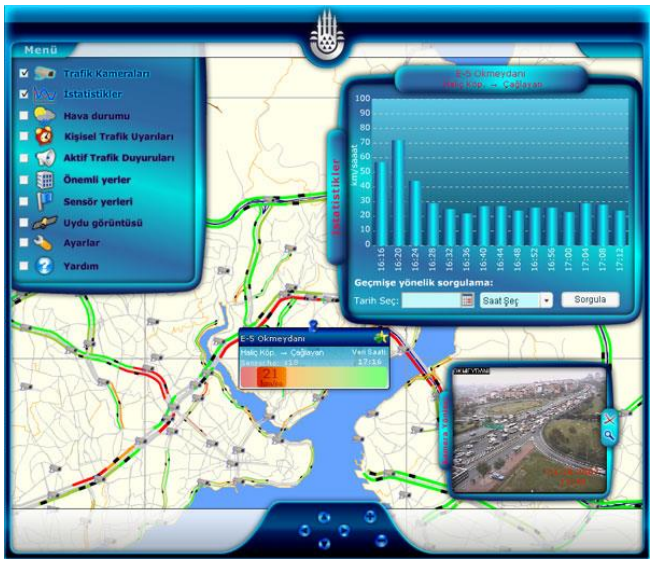


Figure 10. Traffic density map

MOBESE - Mobile Electronic System Integration

MOBESE is a "City Information and Security System". MOBESE was developed by Istanbul Police Department with the support of Istanbul Governorship. Aim of this project is to improve public services, ease the management and reduce the number of the crimes (IEM, 2013). This project contains subsystems such as plate recognition system, custodial prison monitoring, wireless camera monitoring, transfer of helicopter images, vehicle tracking system, mobile vehicle query system, navigation system, neighborhood automation system and mobile control vehicle.

Figure 11. MOBESE Project

CitySDK Project

CitySDK project is part of European Commission's Connected Smart Cities concept. CitySDK compiles a toolkit for the development of digital services for the cities. Toolkit includes open and interoperable digital service interfaces enabling

more efficient utilization of the expertise and know-how of developer communities in the city service development (European Commission 2, 2012).
Istanbul is part of the CitySDK project and the project still continues.

Figure 12. The CitySDK project has 23 European partners in 9 countries

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9 EDUCATION OF THE PUPIL FOR LIFE IN THE COMPLEX SOCIETY AND THE ROLE OF TEACHER IN THIS PROCESS

Giuseppe Mari

Abstract

I intend to face up to the subject by focusing on the three references composing the title: the education of the pupil, our complex society, the role of the teacher. Iin the folowing contribution we would like to support this triple thesis: 1) in order to educate the pupil, it is necessary to be aware of the peculiarity of educational practices compared with the others ways of child's care; 2) the current social complexity produces this pedagogical challenge: not to fragment the education – we cannot consider the education as a mere technical activity because it is peculiar to human beings only; 3) for this reason it is necessary to pay attention to teachers' training: teachers must be aware of what distinguishes educational practices.

Key words: complexity, educational philosophy, school competences, challenges to pedagogy

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1) in order to educate the pupil, it is necessary to be aware of the peculiarity of educational practices compared with the others ways of child's care;
2) the current social complexity produces this pedagogical challenge: not to fragment the education – we cannot consider the education as a mere technical activity because it is peculiar to human beings only;
3) for this reason it is necessary to pay attention to teachers' training: teachers must be aware of what distinguishes educational practices.

9.1 Education vs. child's care in general

What makes a difference between human creatures and the other animals? Many things, in particular this one: only the human being looks after adult people in trouble as well as the children. Why? Because only the human creature is aware of everyone's value regardless of the benefit to the group. In fact the other animals take care of their cubs because they are the future of the drove and reject the fully-

grown animals when they are sick, because they are the past: only instinct leads animals to their acts.

Thomas Aquinas stresses the human self-consciousness of one's own inalienable value by declaring that the human creature is the only animal able to recognize purposes by him/herself: "in a more special and perfect way, the particular and the individual are found in the rational substances which have dominion over their own actions (*habent dominium sui actus*); and which are not only made to act, like others; but which can act of themselves (*per se agunt*); for actions belong to singulars. Therefore also the individuals of the rational nature have a special name even among other substances; and this name is 'person'"[1]. For this reason, "the very way in which the intellectual creature was made, according as it is master of its acts, demands providential care whereby this creature may provide for itself, on its own behalf (*ipsa conditio intellectualis naturae, secundum quam est domina sui actus, providentiae curam requirit qua sibi propter se provideatur*); while the way in which other things were created, things which have no dominion over their acts, shows this fact, that they are cared for, not for their own sake, but as subordinated to others. That which is moved only by another being has the formal character of an instrument, but that which acts of itself has the essential character of a principal agent. Now, an instrument is not valued for its own sake, but as useful to a principal agent. Hence it must be that all the careful work that is devoted to instruments is actually done for the sake of the agent, as for an end, but what is done for the principal agent, either by himself or by another, is for his own sake, because he is the principal agent. Therefore, intellectual creatures are so controlled by God, as objects of care for their own sakes; while other creatures are subordinated, as it were, to the rational creatures (*Disponuntur igitur a Deo intellectuales creaturae quasi propter se procuratae, creaturae vero aliae quasi ad rationales creaturas ordinatae*)"[2]. It is not a discovery due to the "Doctor Angelicus". Much earlier Clement of Alexandria says: "Man, then, whom God made, is desirable for himself (*autòn airetòn*)"[3]. This statement reveals in advance not only Thomas' convincement, but also the general view of the Second Vatican Council about the human being "who is the only creature on earth which God willed for itself (*propter seipsam*)"[4].

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1 Thomas Aquinas, *Summa of theology*, I, q. 29, a. 1, *resp.* (http://www.newadvent.org/summa/1029.htm).

2 Thomas Aquinas, *Summa contra gentiles*, III, cap. 112, 1, *resp.* (http://dhspriory.org/thomas/ContraGentiles3b.htm#112).

3 Clement of Alexandria, *The Instructor*, I, cap. 3 (http://www.earlychristianwritings.com/text/clement-instructor-book1.html).

4 Second Vatican Council, pastoral constitution *Gaudium et spes*, n. 24.

This doctrine is very important from the cultural point of view because it is the same idea asserted by Kant's "categorical imperative": "Act in such a way as to treat humanity, whether in your own person or in that of anyone else, always as an end and never merely as a means" . The explanation is the same given by Thomas: "The basis for this principle is: rational nature exists as an end in itself"[5]. For this reason both Christians and non-religious people can share the same value of the human life: it is very important in our complex society.

Why is the human being value by him/herself? Because only the human creature is free. Mankind did always wonder at human originality. Since the human creature began to inter or burn dead bodies, it meant to show a very difference from the behaviour of the other animals. Actually, long before the human originality came out clearly, when our ancestors made choppers by dressing symmetric stones: in fact this making is not only useful but also expressive from the aesthetic point of view.

This attitude comes from our freedom. In fact, to be free does not mean only to be able to choose, because even animals are able to. Actually the human creature is able to go beyond material needs. It is the peculiarity of human beings compared with the others animals, because – ever since Aristotle it is clear – the nature is always at work in a functional way[6]. Only for the human creature it is possible to leave beyond biological needs: that is why each man and each woman have dignity, not a price as in Kant's statement about the difference between the human being and the other things. The same idea can be found in Thomas' thought, according to whom "'Person' signifies what is most perfect in all nature – that is a subsistent individual of a rational nature" [7].

What has that got to do with children's education? Very much, because we can note that when someone is born, does not show this aptitude: the baby cries when is hungry as well as sleeps when he/she is tired… so everything happens only according to the satisfaction of needs. It seems so, but actually it is not, because we know that human creature is guided from his/her freedom to what Greeks call "egkráteia" that is the "self-government": moreover, to be free means not to be obedient to instincts. How do we achieve this aim? Through education.

It is not natural to control instincts: the younger someone is, the more he/she acts on instinct. Nevertheless the human being, unlike the other animals,

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5 I. Kant, *Groundwork for the Metaphysic of Moral*, II (http://www.earlymoderntexts.com/pdf/kantgrou.pdf).

6 Aristotle, *Generation of Animals*, II, 5, 741b 5.

7 Thomas Aquinas, *Summa of theology*, I, q. 29, a. 3, *resp.* (http://www.newadvent.org/summa/1029.htm).

has the possibility to reach self-control. To be free means to be able to break free from the tyranny of needs. Ever since the ancient Greek philosophy it was clear that the challenge for the human education is to prefer the best to the worst: that is why – according to the *Iliad* – Achilles' educator is Chiron too, not only Phoenix. Chiron is a centaur, i.e., half-man and half-horse. This duplicity means the duplicity of the human freedom, because the human being is always skating on thin ice: he/she can reach the best or the worst. The *Speech on the dignity of man*, by Giovanni Pico della Mirandola, is very effective: "At last, the Supreme Maker decreed that this creature, to whom He could give nothing wholly his own, should have a share in the particular endowment of every other creature. Taking man, therefore, this creature of indeterminate image, He set him in the middle of the world and thus spoke to him: '`We have given you, o Adam, no visage proper to yourself, nor endowment properly your own, in order that whatever place, whatever form, whatever gifts you may, with premeditation, select, these same you may have and possess through your own judgement and decision. The nature of all other creatures is defined and restricted within laws which We have laid down; you, by contrast, impeded by no such restrictions, may, by your own free will, to whose custody We have assigned you, trace for yourself the lineaments of your own nature. I have placed you at the very centre of the world, so that from that vantage point you may with greater ease glance round about you on all that the world contains. We have made you a creature neither of heaven nor of earth, neither mortal nor immortal, in order that you may, as the free and proud shaper of your own being, fashion yourself in the form you may prefer. It will be in your power to descend to the lower, brutish forms of life; you will be able, through your own decision, to rise again to the superior orders whose life is divine'"[8]. However Pico della Mirandola is not the first. Before him it was Plotinus to say: "humanity, in reality, is poised midway between gods and beasts, and inclines now to the one order, now to the other; some men grow to divine, others to the brute, the greater number stand neutral" [9].

This situation is under tension just like the one described by Paul in his *Letter to Galatians*: "For the flesh has desires against the Spirit, and the Spirit against the flesh; because these are opposite to one another" (5:17). To educate means to be under tension, because the educator leads boys and girls to become men and women as adults, i.e., mature people. What does "maturity" mean? To be

[8] Giovanni Pico della Mirandola, *Speech on the dignity of man* (http://vserver1.cscs.lsa.umich.edu/~crshalizi/Mirandola/).

[9] Plotinus, *Enneads*, III, 2, 8 (http://www.ccel.org/ccel/plotinus/enneads.pdf).

able to choose the best from the moral point of view. At the same time, to be able to opt for the right decision: this is the challenge in our complex society.

9.2 Complexity: a challenge to pedagogy

What does the word "complexity" mean? Obviously many things, but – first of all – that it is impossible nowadays to explore things only by one kind of approach. Actually, from this point of view we are beyond the Modernity today because we have been over the Modern idea of the method. Nowadays "the" method is no longer available, we have recognized that it is not the same to study the natural or the human world, the body and the soul… everything must be explored *iuxta propria principia*, i.e., according to its peculiar identity. Actually there are many methods, many ways in order to reach the knowledge.

This is the challenge of complexity: to embrace the pluralism without embracing the relativism. It is not a slogan, but a task. What is the difference between pluralism and relativism? Both these attitudes are related to many ways to face the world, but the first by discussing with each other, the second without any kind of dialogue. According to the ancient Aristotelian definition concerning what is the human creature, men and women are "animals provided with 'lógos'" [10]. What does it mean, the vocable "lógos"? We know that it means "thought" and "word", but it is not enough to clear what is involved in the idea of "lógos". For this aim, a further linguistic analysis is necessary. From which word does the vocable "lógos" come? From the verb "leghéin" that means "to collect". For this reason to have the "lógos" means to be able to unify themselves trough the thought and to unite with the others trough the word. That is why the relativistic attitude is not congruent to the human nature: it means to refuse that the human creature is structurally open to the others. On the contrary, the pluralistic attitude can lead to debate with the others.

Jacques Maritain offers this interpretation of the pluralistic attitude in his book *Integral Humanism* (1936) where he says that "pluralism" is the antonym of "totalitarianism". In fact the second word identifies the political systems according to which all opinions are included in the State system; on the contrary, under pluralism, there are many political expressions in the society. According to Maritain's thought, the pluralism is a political methodology. That is why it is not a value in itself, but only if it involves the comparison among different opinions in order to seek the truth.

[10] Aristotle, *Politics*, I, 2, 1253a 10.

Today's cultural complexity shows two challenges: on one hand it is necessary to recognize the diversity of opinions as a source of wealth, on the other this attitude can destroy the unity of knowledge and make the human being feel lost in the world. In which way can we deal with this problem? The most intuitive way is to improve specialized studies: the more we face many kinds of knowledge, the more attention we put on the details – we could think of it as of mosaic. This strategy is helpful but it was always clear that life is strictly related to the unity of being. For this reason the need of unity marks pedagogical thought. For example: Plato's school is in favour of dialectics; Aristotle says that it is necessary to connect unity and variety; Plotin puts at the edge of the world "the One"; the "University" was born in Medieval Age; Comenius speaks in favour of the pansophism; the Enlightenment sends the *Encyclopaedia* to press; today it is common to look for synergies… the challenge is the same every time: not only to recognize the differences but also to unify them.

For this reason the specialization of knowledge is not enough. It is an ancient problem. When the specialization began to rise, immediately the problem became clear. At first the specialized studies rose in the Alexandrian Museum: Euclid published his *Elements*, Ptolemy his *Almages*, Dionysius Thrax his *Art of Grammar*... It was clear that the culture was getting more and more specialized. Well then, in the face of this trend, Cicero complains about "men of not great culture that discuss subjects only in pieces, not globally". He closes his speech in this way: "They divide their words from their thoughts as they were the body and the soul: for this reason they face certain death"[11]. The problem became more difficult century after century until us. What can we say today? We are in the face of the same challenge: to put side by side unity and differences. I think that – nowadays too – the ancient Aristotelian doctrine o the multivocity of being is still useful. In his *Metaphysics* he says: "The term 'being' is used in various senses, but with reference to one central idea and one definite characteristics, and not as merely a common epithet"[12]. In other words: there are many kinds of beings, but their existence is common to them all. Today it is important above all not to reduce the existence only to functional criterions, because the functionality is related to the specialization and looks at each problem as a singular, isolated, problem. On the contrary, as Romano Guardini says, each "concrete-living" is in "polar opposition", i.e., the living world is a synergistic world (*Der Gegensatz*, 1925). From the pedagogical point of view, the key-role is teacher's role, because teacher's task

[11] Cicero, *On the orator*, III, 24.
[12] Aristotle, *Metaphysics*, IV, 2, 1003a 30-35.

is to educate through culture to the unified vision of the world. Recently, in order to show school mission, the frequent reference is to “competences”. What does it mean?

9.3 The challenge of school competences

Over the last years the problem of school results became very important, especially because there is the aim to compare the quality of national school systems within the international scene. I think that this is a chance, but it is necessary not to make things too easy. In fact the comparison among schools is done through the data collection. Obviously it is a rational proceeding, but it regards only one kind of rationality: the general (impersonal) kind. How can it be right when the issue of comparisons is the human education, i.e., the maturity of human freedom? This is a very big problem but there is something more to consider.

Technology is very strong in our society as well as its attraction from the social point of view and on someone’s concrete life. Over the XXth century the problem of technology was emphasized by many philosophers like Horkheimer, Heidegger and Guardini. It is interesting to notice that these authors are very different from the ideal point of view, but they all agree about the same problem: how to control and guide the technology in service of the human being? Today the attention to technology is getting bigger and bigger, young people are very interested in technological systems, they begin to deal with computers very soon… from the pedagogical point of view the attitude to stress the usefulness of knowledge is growing. Especially we often speak of “competences” as “to be able to do” and the educational goals are frequently identified with operative competences. In Italy, for example, the reformed high school started in 2010. Over the planning period (lasted almost ten years) the majority government changed four times, but – in spite of the alternation of parties (the Left and the Right) – none called in the question the link between the school and the world of work.

I want to be clear. I don’t want to despise the work: working is very important to the dignity of men and women, but it is more important to remember that we work in order to live and not vice versa. In fact slaves live in order to work (as Aristotle says very clearly in his *Politics*), but free people do the opposite. We must remind ourselves that the English word “school” (as well as the Slovakian word “škola”) comes from the Greek word “scholé” that means “free time”. In which sense? This one: the time free from useful activities, i.e, free from the job. Equally we must not to forget that the same Greek word is at the root of the Latin

word “schola”. What did they teach at the “schola”? It was the high school and young Romans there learnt “liberal arts” (like Music, Astronomy, Rhetoric…). What are they? They are kinds of knowledge not useful to survive, but useful to educate themselves as free people. For this reason, during the Second World War, Maritain spoke about the “liberal education” in order to guide the reconstruction of school systems in Europe.

It is clear that, from this point of view, there is no possibility to identify the “liberal education” and the “competence” in a strictly operative conception. Actually, even from the international documents on education we can get an idea of “competence” not merely functional. Let’s read, for example, a passage from the Delors Report published by Unesco to focus on the aims of schools: “Education has to face this problem now more than ever as a world society struggles painfully to be born: education is at the heart of both personal and community development; its mission is to enable each of us, without exception, to develop all our talents to the full and to realize our creative potential, including responsibility for our own lives and achievement of our personal aims”[13]. Things being as they are, it is wrong that the interpretation of the school competence as a mere factual thing, or else how it would be possible “to develop all (…) talents” and “to realize (…) creative potential”? Not only are they operative talents/potentials, but also existential talents/potentials for “personal aims”! Clearly it is necessary to offer a larger interpretation of the concept: larger and deeper - I mean a moral interpretation of the concept of “competence”, utility inclusive, but not the one identified with the usefulness.

As a matter of fact, the word “competence” comes from the Latin expression “cum petĕre” that means “make up one’s mind at the suitable time”, because “cum” does not mean only “with” but also “in” from the chronological point of view: Latin word “quando” (“when” in English) comes from fusion between “cum” and the Indo-European suffix “do” which means “from”[14]. For this reason the word “competence” means “to be able to decide the best in the right moment”. It is interesting to note that this is the meaning of the Aristotelian concept of “phrónesis”, at the root of the moral idea of “prudentia”. What does it mean – according to the Aristotelian philosophy – to be prudent/wise? To be able to choose the best means in order to reach the aim in the concrete situation.

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[13] J. Delors (Ed.), *Learning: the Tresaure witnin*, p. 17 (http://www.unesco.org/delors/delors_e.pdf).

[14] G. Semerano, *Le origini della cultura europea. Dizionario etimologico della lingua latina,* Firenze, Olschki, 1994, t. II.

I think it is very important to recognize that "competence", being "human" competence, must have in the first place a moral meaning, and only in the second place a technical meaning. To have competence means to be able to act well from the moral and from the technical point of view, but the second must be inferior to the first. Over the Western Civilization this idea is a recurring theme. According to Cicero, the good is always usefull too, but not vice versa (*On duties*). We find the same idea in Newman's and Maritain's philosophy (respectively *The Idea of a University* and *Education at the Crossroads*): the liberal education as the education to the good as well as to the usefull, but – first of all – to the good.

It is always the same problem: we must recognize the freedom of the human being and – at the same time – needs, material needs. To say that the human creature is free does not mean to neglect his/hers needs, but to put them under the challenge of freedom as the possibility to go beyond material needs. That is why, from the pedagogical point of view, it is necessary to make use not only of descriptive data, related to the human being as an "object", but also of a kind of knowledge starting from the identification of the human creature as a "subject".

We must not forget this attitude when we deal with our children and students. The point at issue is not to stuff their heads with notions, nor to make them learn only what is useful. First of all it is necessary to have a clear vision of the human identity, based on human freedom and consequently to recognize the peculiarity of *being* a person, but this means not to educate only or principally in a functional way.

Maria Montessori, that studied childhood for life, calls the child "mankind's father". What does it mean? Not only that the adult comes from the child, but also that the general treatment given to the human being comes from the treatment given to the child. It is clear that, in European countries, there is assistance and help to childhood, but – at the same time – there is a clear tendency to make our children grow too early. For example, in Italy, there is a very strong tendency to teach writing and reading at 5, i.e., during the last year of Infant School: it is not wrong in itself, but I think it becomes wrong when it involves less attention to make the child play, express his/her corporeity, draw freehand and colour… in one word: to show a kind of life not subordinated primarily to functionality. Huizinga has clearly told that the essence of playing is freedom. Plato speaks about the eternal child in everyone and Erasmus coined the verb "repuerescere" to affirm the necessity of not forgetting the childhood. Jesus' statement, "Let the little children come to me, and do not hinder them, for the kingdom of heaven belongs to such as these" (Mat 19:14) signifies a deep truth that pagan civilization recognized only indistinctly. Consequently we must be vigilant to take care of childhood and to

contrast the tendency in favour of a too much functional school. This idea could be suitable to face today's cultural complexity, but we must underline that complexity is always related to the human originality and that this one is strictly related to the human freedom. For this reason – now and always – the challenge is not to confuse the good life with the useful life.

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10 CURRICULA AND VALUES IN TEACHER TRAINING

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Abstract

The paper aims to discuss the topics of values and culture with specific focus on European values and culture. It reflects that values and culture are incorporated in various ideological approaches to education. From this point of view, the teacher education and training represents a platform where culture and values are absorbed, acquired and developed. The transmission of values is exposed to different influences and impacts of society.

Key words : Values, culture, curriculum, ideological framework, teacher education

Introduction

Values are defined[1] as "deeply rooted, abstract, motivation factors, which have a leading role in the formation and explanation of standpoints, norms, ideas and people's actions. Values are *persuasive*, cognitive structures, which relate to emotions, especially when they are in the state of activation. Values are synonymous to *desired aims* (e.g. social equality, fairness). Values are of transcendent nature; for they transgress particular activities or situations (obedience and honesty are values relevant at work, school, sport, and politics, with parents, friends, and foreigners). This characteristic differentiates values from more particular terms, such as standpoints or norms, which relate to specific objects, situations, or actions. These values serve as *standards,* or criteria, and in this respect they direct the selection and evaluation of people, events and activities. Values are structured according to their importance. The set of values forms the system of priorities and according to this system, individuals or the whole culture can be characterised. Relative importance of values for the individual *regulates* his/her behaviour".

The theory of S. H. Schwartz[2] belongs to the most elaborated concepts of the contemporary psychology of values and it reflects intercultural specifics of value orientation. According to this theory81 *values are beliefs* connected

[1] Európska sociálna sonda (ESS) 4. kolo na Slovensku. Universum Prešov 2010, ISBN 978-80-89046-65-2, p. 43

[2] Schwartz, S. H., 2012.

inseparably to emotions, and not just "objective" cold ideas. Values are stimulating constructs – they relate to all aims that the people wish to achieve. Values extensively supersede specific actions and situations. They are abstract aims, which differ substantially from other concepts, such as norms and standpoints, which usually relate to specific activities, objects or situations.

The impact of one's own values on everyday decisions is only seldom conscious. Human values form a command system of preferential values, which subsequently characterise them as individuals. Therefore it is possible to ascertain the way people evaluate behaviour of the others, which aspects of behaviour they ascribe more importance to, whether to justice or to success, originality or tradition, material wealth or spirituality. This hierarchical aspect differentiates norms from attitudes.[3]

The teacher education and training is indispensably framed by values of the community and takes place in a cultural surrounding. The purpose of the teacher education lies in point that students teachers would adopt and develop and serving teachers would acquire and develop set of general and European values, as the content of teacher study programmes and the continuing training programmes incorporates clear and hidden references to European identity.

Values, Standpoints and Virtues

Values respected by the society are not some accidental clusters, but they are highly organised. *Organisation of values of the individual represents a value system of the individual.* Interconnection of the value system of the individual with the one of the society is not linear. Research in the value system of the individual has pointed out that it can be (but not always) identical with the value system of the society. *The value system of the individual does not necessarily have to include all social values, but only those ones, which the individual respects and which motivate him. At the same time, it expresses the evaluation relationship of the individual to the society.* The value system can have the shape of a pyramid with one value at the top, or the shape of an ashlar, with multiple, often similar values being placed next to one another. At the top of the pyramid are *impersonal values* (e.g. being useful) i.e. higher than personal values (e.g. having money, property, pursuing a career).

[3] Jablonský, T., Kolibová, D., Matúšová, S., 2012, p. 62

Values and standpoints differ for *standpoints are on the onset of value-creation* (both positive and negative ones). Individuals can take a number of standpoints in the social value system:

- engagement – an active expression of positive relationships to particular value system,
- conformity – accommodation and agreeing with a given social value system,
- indifference – expression of indifference and disinterest in a given social value system,
- denial – rejection of certain social value system,
- active resistance – against generally accepted and respected social value system.[4]

Virtues are slightly different from values and standpoints. We can believe them to be certain enforced inclinations of the individual to a just (moral) behaviour, or habitually conditioned behaviour, which grows into the characteristic of the subject through its strengthening. Virtues, at the same time, represent values of the society, which the individual has adopted as part of his/her identity. The beginnings of virtues formation should be searched in the Antiquity, or even before that.[5]

In the Christian tradition, the divine or theological virtues are represented by hope, faith and love. We distinguish *natural virtues* – such as wisdom, justice and moderation – believed to be the cardinal virtues of man (as the fundament of the natural law, which reflects the law of God), and above them are the three divine, i.e. Christian virtues – faith, hope and love, which always stem from the Grace of God, the *theological virtues*.

The virtues were re-discovered during the period of early and developing capitalism of the 19th century. As the most important capitalistic virtues, which are true in in certain social circles even now, are the so called *virtues of the bourgeoisie*:

- *industriousness (hard work),*
- *thriftiness* (*i.e. being economical),*
- *respect for education,*
- *punctuality,*

[4] Boroš, J., 2001, s. 135
[5] Cf: Aquinas, T.

- *preciseness,*
- *efficiency,*
- *cleanliness, or hygiene,*
- *orderliness (sense of order around oneself and in the society).*

These virtues are also referred to as the "practical ethics of capitalism", for they are the inevitable prerequisite for creating a good existence of the middle classes in the market economy. Also nowadays, a successful individual is characterised by such stimuli of building of one's own life and career, such as the motivation for long studies, ability to wake up early every morning and go to work, long-term planning of one's own professional career and personal finances, a systematic overcoming of obstacles and perceiving of one's life in a perspective, i.e. living not just for today.

In modern psychology there is currently a developing tendency of the so called positive psychology, which preaches the inevitability to replace the tendency of pointing out the personal dysfunctions by the tendency of pointing out the functioning of healthy and stable personality. Publication[6] *The strengths of the character and virtues* lists 24 virtues of the personality, which the author divided into *six groups of virtues,* which proved to have "a surprising degree of similarity across the cultures and significantly indicate historical and intercultural convergence". They attempted to express this fact by adding to particular virtues important personalities coming from different parts (cultures) of the world. Virtues and the character strengths were divided into the following six groups, forming the so called core virtues:

1. wisdom and knowledge represent strong ability for acquisition and use:

- creativity (Albert Einstein),
- curiosity (John C. Lilly),
- open-mindedness (William James),
- love of learning (Benjamin Franklin),
- prospective and wisdom*:* coordination of knowledge and experience and their intricate application in order to improve the state of the personality (Ann Landers).

2. courage contains the strong sides, which will enable the individual to attain the results despite the opposition:

- bravery (Ernest Shackleton),

[6] Peterson, Ch. – Seligman, M. 2004

- persistence (John D. Rockefeller),
- integrity (Sojourner Truth),
- vitality (Dalai lama).

3. humanity represents strong characteristics, which relate to care and friendly help:

- love (Romeo and Juliet),
- kindness (Cecily Saunders),
- social intelligence (Robert Kennedy).

4. justice embodies strong characteristics, which form strong community:

- active citizenship/social responsibility/loyalty/team work (Sam Nzima),
- fairness (Mohandas Ghandi),
- leadership.

5. temperance represents strong characteristics, which protect from excesses:

- forgiveness and mercy (Pope John Paul II),
- humility and modesty (Bill W., founder of Anonymous Alcoholics),
- prudence (Fred Soper),
- self-regulation and self-control (Jerry Rice).

6. transcendence - represents strong characteristics, which form connection with the outside world and also form meanings:

- appreciation of beauty and of excellence (Walt Whitman),
- gratitude (G. K. Chesterton),
- hope (Martin Luther King, Jr.),
- humour and playfulness (Mark Twain),
- spirituality (Albert Schweitzer).

The overview proves that the authors preferrably included people of high reputation, generally well known globally, but mainly of Anglo-Saxon origin (and last but not least, the majority of them speaking English). The open question remains which personalities would be included into the above list when viewed from the European perspective.

It could become a question which should be answered by teachers themselves and/or with the support of their teacher trainers. The answers could bring a numerous other historical or living examples of virtues and strong characters, which originated from regions and countries in Europe and elsewhere. Some of them may represent what we call and design „European culture“.

Pillars of European values and culture

European culture is built on a set of pillars, which were brought to life in the antiquity, but despite a number of variations and controversies they have remained up to this date.[7] European culture currently also goes through a process of the so called cultural globalisation. Although the European values are stable, they are subject to modification. The extent of modification can become critical, and thus excercise influence upon the direction of European values.

It is universally believed that European culture stands on three pillars – Greek philosophy, Roman law and the Christian moral system. Greek philosophy gave rise to a number of principles of European culture, especially the following ones:

- individualism (perception of man as an individual),
- activism (understanding of human history),
- epistemological standpoint (people try to grasp the fundaments of the world – nature and society and pursue free and objective research),
- rationalism (belief that nature and the world are governed by principles of rational nature),
- humanism (human being is believed to be the highest value).

The Roman civilisation developed the approach that law is the highest principle of human organisation (with the highest degree of perfection, moral and organisational power). Christianity contributed to the development of European culture by the following three inputs:

- monotheistic belief system, i.e. a belief in one transcendent being, to which the world and humans are subjects (this belief stemmed also from the European perception of the world as a hierarchically organised unit),
- Christian moral system, i.e. the Decalogue in the Old Testament and other principles in the New Testament, which have become fundaments of European legal systems,[8]
- Christian iconography (symbolic expression of the world and the content of conscience).

In the 1950´s Europe began its political and economic integration processes. From the economic point of view, they are a part of the globalisation process, which is irreversible. From the political point of view, it is the search for

[7] Mistrík, E., 2003
[8] Mistrík, E., 2003

the course of Europe on the basis of an agreement. The pragmatic and uniting reasons are the economic prosperity and security. A weak link of the integration processes are its ideology and culture.

To this day, there are not clear definitions of the European cultural identity, although it is generally claimed that the cultural identity of Europe is formed by cultural and ethnical diversity, richness of traditions and the ability to be mutually inspired, as it has been the case throughout European history. It would be wrong to supress this diversity for some virtual unity.[9] From the political point of view, Europe has never been one entity,[10] although there were attempts to conquer its major parts. Geographical conditions and historical development led to the formation of numerous and independent European nations that would become superpowers of large territories even outside Europe from time to time.

It is stated[11] that Europe in the antiquity acquired and kept such a position in the world, which surpassed its area and population. This hegemony became obvious in the 19th and 20th centuries, where there were only a handful of territories in the world free of European dominance. Particular European nations created large colonial empires, a number of times greater than the mother country, (e.g. the British Empire). The dominance of Europe led to various corruptive examples of Euro-centrism, which was only stopped by the world wars in the 20th century.[12]

On the other hand, a new and specific phenomenon of European states is highlighted, i.e. their formation on the basis of the ethnic principle. Since the 18th century, their creation is associated with the mighty revolutionary way, under the slogans fatherland, nation, liberty, democracy, right to self-determination, etc.

The tradition of nation-states is strong even these days, and it disables creation of a united European state. The contemporary stage of European integration is characterised by the principle of transfer of part of the powers of the member states to the supranational community (the European Union), in accordance to the adopted treaties (the Lisbon Reform Treaty) and the characteristics of the achieved level of full economic (and partially monetary) integration through the single currency. The contemporary European integration

[9] Hečková, J., 2007, p. 4
[10] Hečková, J., 2007, p. 3
[11] Hečková, J., 2007, p. 4
[12] Pečenka, 1997, p. 13

project also leads to a political integration, fact that the member states demonstrate their own sovereignty in each occasion. The process of European integration greatly influences the system of globalisation. Globalisation, from the cultural point of view, can be defined as a change in the acceptance of common values, which the people and the community accept. Their expansion is only a precondition, their change only takes place when such values are accepted and applied in the life of an individual, or group of people. Cultural globalisation becomes exterritorial, when a selected part of European culture is partially exported into other countries or globally into the majority of continents. (An example of extraterritorial transfer of part of European culture is the European opera, its prominence or renaissance in a number of continents, where it is accepted by new communities). Globalisation can also be directed towards Europe, when the European culture is accepted and strengthened en masse, but at the regional and communal level it is differentiated for the sake of individualisation and regionalisation.[13] Or expressed differently, contemporary Europe strengthens the European identity and also the identity of regions, groups and individuals. Multicultural character of Europe is becoming more prominent, the common pillars being the basic ones of European culture, but not the particular manifestations of it, for they tend to be rather differentiated.[14]

Extensive tolerance and openness (postmodernism) can also lead to spiritual and value emptiness, for it would seem that everything is possible. "However, human beings need solid values and value hierarchy, and they are beginning to look for them now."[15] The situation is changing again in Central Europe. Individualistic and active approach is important again and represents an ever more solid fundament of the activity of individuals, groups and (political) groupings than in the past. A belief in one, transcendent being is also shared by other, non-Christian belief systems, even by "various polytheistic types of beliefs and pre-religious ideas."[16] Christian morality is being greatly diminished, especially the normative function of the Decalogue, and other moral principles of the Bible. This knowledge is a challenge, imploring us not to give up on our own heritage. If we are unaware of our origins, it is difficult to find out destination.

[13] according to Mistrík, E., 2003
[14] Mistrík, E. 2003
[15] Mistrík, E. 2003
[16] Mistrík, E. 2003

At the end of 20th century, the Council of Europe began discussion on the direction and support of culture and intercultural policy of Europe, the findings of which were put in the publication *In from the margins* (1997). The document introduces four key principles of European cultural policy, as they are developed in Europe:

- development and support of cultural identity (as a process and relational system),
- support of cultural diversity (i.e. development of intercultural understanding and cooperation),
- support of creativity in arts, research and education,
- support of participation in cultural activities, not only as passive recipients, but also from the point of view of participation in personal qualities development in order to perceive artefacts.

It attempts to answer the question, "*what role can culture play in development*". The contribution of culture may be incorporated in the three main aspects:[17]

1. *Culture as a contribution to better human knowledge and understanding* („human growth"): If the culture is perceived from the point of view of a better understanding, a changing perception of the world and the introduction of innovation into practice, then art and the associated activities are equal source to science and technology. Art should be acknowledged as an ability of sustainability, and this in two directions, in association with the upkeep of balance among humanities and other sources (e.g. science and technology, religion) and within equality among generations (formation of heritage and cultural opportunities for the next generations).
2. *Economic and social outcomes of culture from the mid and long-term point of view, especially paying attention to changes in the value systems.* The positive or negative influence of art on the economic, political and social life, creation of gross national product, employment, balance of import and export, happiness with the social environment, increase or decrease of tolerance or intolerance, orientation of people to spending of their leisure time. Also, what is their educational and improving effect, or do the positive or negative changes influence the people (moral, democratic process, orientation toward work, attitude to people of different ethnicity, creed, colour, etc.)?

[17] In from the Margins, 1997 (Slovak version: Z okraja do stredu, 2004, pp. 28 – 29)

3. *The function of culture as a means of people's activating* – art and functioning activities should not be perceived only as a social source or means of government, but as a real or potential means of development of human capital. It is generally an accepted notion that art and culture improve and expand general cognitive and intellectual abilities of people, which they acquire through education and experience, helping their flexible adapting to new circumstances. From the practical point of view this means that it would be beneficial to research the possibilities of using both art and culture for the support of disadvantaged groups of people, by giving them access to new opportunities.

At the same time it introduces the problems that the contemporary Europe goes through (especially small nations) in the process of economic and cultural globalisation and the increasing dominance of cultural production of multinational conglomerates. The European model of diversity becomes the target of globalisation and the commercial power of the American culture, which enters each and every sphere of European life, evident in social behaviour, fashion, eating habits, not mentioning film and television. Reaction to this is the trend known as *glocalisation*, believing in and preferring something local and different. (Also multinational corporations are aware of the fact that strategies for the global market must be also international and local).

Ideological framework of pedagogical documents

The analysis of pedagogical and curricular documents related to education from the field of European values and culture has to also respect the ideological framework of educational reality, since the *social reality along with the educational reality has also an ideological framework,*[18] which is understood in the non-pejorative meaning. *Psychology* defines ideology as an "interpretation of the world, in which a social group is trying to interpret it and support its own interests."[19] *Sociology* understands ideology as an "extensive set of ideas and opinions on the world, shared by some groups of people."[20]

Therefore, *educational ideology can be understood as a "set of ideas and opinions on education, shared by a group of people.* "[21] History of the 20th century

[18] Prokop, J. 2009, p. 35
[19] Hartl, P., Hartlová, H. 2000
[20] Meighan, R. 1992.
[21] Prokop, J. 2009, p. 35

demonstrates that a number of major schools of thought have contributed to the perception of education, which persist to influence the educational reality. They include the following ideological schools:

- religion (Catholicism, other Christian denominations, Judaism, Islam…),
- conservatism,
- liberalism,
- agrarianism,
- nationalism,
- socialism,
- totalitarianism,
- others.

Comparison of various systems of classification makes it possible to state that contemporary education can be perceived and interpreted from the point of view of three key aspects[22] -conservatism, liberalism and critical democratism. These ideological aspects have their own dominant features, understanding of which contributes to the correct perception of a number of tendencies enshrined in the contemporary concepts of the school development, processes and phenomena in Slovak and European schools. In the context of thinking about the European values and the cultural heritage, the principles of the said ideological schools and their demonstrations in the educational policy and functions of school and education are significant. By comparing of their particular segments and their application in the analysis of the selected curricular documents (primary and secondary schools) of the Slovak Republic from the point of view of the European values and culture, we might get to the conclusion that despite the declared political points of departure, in the process of Slovak educational policy formation not one ideological intention in the realising outline of the educational policy will dominate (e.g. politically declared liberalism), but on the contrary, particular segments of the contemporary educational policy of Slovakia and especially its realisation will be backed by a number of ideological frameworks, not excluded conservatism and critical democratism.

Conservatism as a contemporary educational theory is characterised by the following principles:[23]

- principle of *cultural transmission,*

[22] Prokop, J. 2009, p. 40
[23] Prokop, J. 2009, p. 40

- concept of an organic society,
- significance of traditions,
- respect for the past,
- mistrust of novelties,
- ethnocentrism, patriotism,
- strict formation of children,
- pro-religious attitudes,
- and others.

a) *Cultural transmission* from the point of view of conservatism means that *school is an institution of cultural transmission,* "a means of passing on values, which should ensure permanence, stability and smooth functioning of the society. The state should control its citizens through the traditional educational system."[24] Conservatism emphasises the need to ensure a high level of formative and educational unity, unified curricula of the school educational systems (concentrated around the common cultural standard). It sharply criticises a free selection of educational programmes by children and youth. The common programme core should enable the students to learn an identical "set of knowledge", i.e. carefully selected terms, ideas, facts and information. This represents and inevitable precondition for the renewal of the cultural level of the national community."[25]
b) *The concept of an organic society* clearly declares that there cannot be a symmetric relationship between the educator and pupil. It is primarily because conservatism believes *formation to be an intergenerational message,* with a clearly defined responsibility and the role of the "adults" (parents and teachers) for the formation of the young generation.[26]
c) *Fundamental function of the educational programme,* according to conservatism, is *passing on culture in the general extent to all members of the society,* as well as ensuring of appropriate education for the particular social strata. Education should include learning of the basic skills expected in the majority of learning programmes (reading, writing, counting), imprinting belonging to a community (which is often identical with the nation state) and loyalty to it through the appropriate literature, which illustrates important cultural issues and problems. Teaching of history enables the students to look into the development of culture and its heritage. Arts, music and physical

[24] Prokop, J. 2009, p. 40
[25] Hirsh, E.D.1987
[26] Prokop, J. 2009, p. 42

education teach the students the richness of the cultural heritage. Appropriately defined cultural values are the fundaments of behavioural formation, which should be in accordance with the traditional norms. If possible, conservatism recommends that the process of formation or development of character take place in a religiously embedded context.[27]

Liberalism can be defined by the following principles:[28]

- freedom – fundamental value,
- market principle in school,
- educational pluralism,
- principle of equal opportunities,
- principle of individualism,
- free selection of school,
- symmetric relations of partnership,
- decentralisation of school system,
- and others.

It is obvious that after 1989, liberalism found its way to the educational policy and practice. Professionals point out that in the same way as conservatism belongs to the contemporary world (which has not been bettered in many cases), in applying the principles of liberalism, one can encounter a number of its limitations and problems. A whole range of questions is initiated by e.g. the principles of introduction of market mechanism in schools, educational pluralism, alternative schooling or the freedom of choice of one's own educational path.[29]

a) *Concept of freedom* in liberalism stems from a natural right of individuals, who have to protect their freedom from arbitrary force. So, freedom of the press, and freedom of assembly, according to liberalism, means the minimisation of power, which is exercised by the following institutions – government and churches. The concept of freedom relates to education in a principal way – as an academic freedom of scientific work and the right to enjoy its results in education (teachers), such as the freedom of researching controversial matters, expressing of opinion and problem solving (pupils), introduction of scientific methods in education (teachers). It rests upon the assumption that there is no a

[27] Prokop, J. 2009, p. 42
[28] Prokop, J. 2009, p. 42
[29] Prokop, J. 2009, p. 43

binding opinion, which could not be changed, that they are no spheres of research which could not be researched.[30]

b) *Education policy* of liberalism leans upon two requirements – so that power is clustered and subject to mechanism ensuring upkeep of political balance, and so that this balance is kept. That is why, e.g. in the USA, in accordance with the American constitution, administration of education is done at the federal level, decisions relating to the educational policy are adopted by particular American states, and the local school councils make decisions and support the education school programmes of schools drafted at the local level. "Such decentralisation of power protects schools from a monolith, from a policy enforced from above, and from excessively harsh reforms!"[31]

c) *Rules in the school environment,* according to the liberal concepts, should be exercised in accordance with the well-defined and broadly accepted procedures. In the school environment, certain procedural habits should be strengthened, such as respect for the effects of other children, or their adherence to the system when playing with a toy, etc. It is possible that teachers continue in the liberal approaches, they allow the groups to come up with their own rules, provided that they will adhere to them. At secondary schools, the liberally oriented students form their own various organisations, clubs and associations, the elected members of which chair their meetings according to their own procedures, with the norms of conduct being transgressed to the environment outside of school and later to the civic life. Supporting of self-government and self-discipline leads to the belief that school is an important social institution within the liberal system.[32]

Critical democratism can be characterised by the following principles:

- dehumanisation, estrangement,
- reproduction of the power structures by the school,
- emancipation,
- school as a place of indoctrination,
- school legitimising social inequality,
- school as the factor of changes,
- hidden school programme, and others.

[30] C. f. Prokop, J. 2009, p. 44
[31] C. f. Prokop, J. 2009, p. 44
[32] Prokop, J. 2009, p. 44

Critical democratism is different from conservatism and liberalism in its diagnosis of the society being primarily critical. Its proponents claim,[33]that the societies of highly developed countries, and the Western culture, including the school system, is going through a major system crisis. Their statements relating to school are expressed by the terminology such as *hegemony, social control, hidden education programme, de-schooling, emancipation, liberation, etc*. They are aimed at the analysis of the dominance mechanisms and not at the criticism of dominance in education and culture.

One of the groups is represented by the so called *theoreticians of reproduction* (B. Bernstein, P. Bourdieu), who describe the contemporary situation and believe that education is doomed to conduct transmission of what is good and bad in the society, and it can introduce only good modifications and corrections. The second group consists of the so called *theoreticians of transformation* (P. Freire, H. Giroux, N. Chomsky), who believe that schools can become active factors of social changes, since a certain autonomy of schools results in the ability of schools to speed up (or slow down) social changes and become a factor of social transformation.

a) Critics and school

The critics are of the belief that schools represent a tool of cultural policy and contribute to the escalation of the social conflict by controlling schools, using the dominant social strata. Therefore, schools are not neutral academic institutions, but a tool of political fight, for they shift some groups closer to the position of power and some further from it or block them altogether. Knowledge passed on by schools serve the privileged classes to keep their position. Pupils originating in the non-privileged classes are led to the belief that they live in a society where institutions function "without objections".[34]

b) School education

Representatives of critical democratism strive to identify the strategies and tools, through which creators of the educational policy deprive the teachers of their independence. It is evident in standardised tests, evaluation of the competence of teachers, the central system of school management, in which control of planning and realising of the educational process is done by other, non-teaching staff, i.e. school clerks, officials or law makers. Teachers, as "intellectuals

[33] Prokop, J. 2009, p. 45
[34] Prokop, J. 2009, p. 47

engaged in the process of transformation", are put in the position, in which they are to fulfil numerous tasks, such as the following ones:

- discuss and analyse with the students critical analysis of the social problems,
- open contacts with the parents and cooperate within local communities,
- initiate cooperation with other teachers in order to improve quality of teaching,
- promote an authentic school reform, in which the teachers conduct control over education,
- limit the role of the clerks in formulating the educational policy and move a part of their authority onto teachers, pupils and parents.[35]

c) Education programme

Critics assess the educational programme as overt or covert. *Overt education programme* is criticised for it contains competences and curricula, which they believe to be the tool, through which the governing minority keeps the status quo and which ensures their privileges. In order to keep the existing division of power, they use the selected content of particular subjects (literature, history, geography, social sciences), as well as the instruction in one language, which lowers the chances for social success of the pupils whose mother tongue is different from the official language (and of instruction) in the given country.

Covert (hidden) education programme, through which ethical standpoints and behaviour is formed, is the subject of criticism for it helps the process of the upkeep of the economic status quo, for it emphasises the significance of the competition and private property, along with consumerist attitudes. They also criticise formation of homogenous groups at school, which are of hidden significance, for homogenous groups strengthen the differences among the pupils (although it is publically claimed that the sole criterion for division are the school results).[36] Critical theories believe that multicultural education and learning the origins of civilisations are of extreme significance. They support cultural diversity, by which they are in conflict with the (neo) conservative postulate that the education programme should be backed by the richness and origins of the Western civilisation.

[35] Prokop, J. 2009, p. 47
[36] Prokop, J. 2009, p. 48

Values and culture in the context of key competences

European values and culture are linked to the functions of school and education, education aims, education curriculum, as well as the competences and advantages of education. The main aim of the school[37] is, besides other things, to educate and form children and youth, support the upkeep of generational continuity, strengthen stability, cooperation and sustainable development of the society, as well as to enable the upcoming generations to enrol in the civic and working life. School participates in the cultivation of the personality of the pupils, in the formation of their *values, standpoints and behaviour*, in the specifically organised and equipped environment, in the outlined time and space. It supports the development of personal and professional competencies of the individuals.
Values and culture and their inclusion in the education system can be explored from the aspect of aims and function of education. Aims and functions of education contribute to the cultivation and profiling of the personality. They can be displayed in the following manner (Table no. 1):[38]

Table no. 1: Aims and functions of formation

Aim	Function	Means of realisation
Development of human personality	Personally developmental	Caring for health, cultivation and exercise of individual abilities, physical, mental and sensual development
Brokering of historically originated culture, enabling of continuity in time, development of national identity and protection of cultural heritage	Cultural transmission	Knowledge in science, technology, arts, work-related skills, spiritual and moral *values*
Protection of the environment and the upkeep of sustainable	Ecological	Knowledge about the environment, formation of

[37] Walterová, E. 2009, p. 112
[38] Walterová, E. 2009, p. 114

development of the society		relationship to nature and ability to form a healthy environment
Strengthening of the cooperation within the society	Socially integrating	Enabling of just access to education for everyone, removal of disparities, human rights education.
Education toward partnership, cooperation and the globalising society	Intercultural and globally integrating	Formation towards tolerance, cultivation of relations to differences and otherness, learning the European and global context
Improvement of competitiveness of the economy and prosperity of the society	Economic	Development of human resources, support of flexibility at work, utilisation of new technologies, development of managerial capabilities
Improvement of employability	Qualifying	Development of creativity, independence and responsibility, strengthening of the share of general education, a broad range of professional education, development of key competences (skills), working with ICT, critical thinking

Contemporary society designs new required school functions, such as ethical, methodological, socialising and personalising, qualifying, integrating, selective, diagnostic, cultivating, economic and political:[39]

- *Ethical function* points out that school functions as a system of values, the way it interprets the contemporary world, the way it presents the important matters to pupils. From this point of view, contemporary world should be presented as diverse and multicultural, in its various shapes and characteristics.
- *Ethical function and the value dimension of school are the key ones for the identity formation of pupils.*
- *Integrating function* emphasises the need to keep cooperation of the society. It leads toward forming standpoints and skills enabling *social interaction and communication in varied and multicultural society.* It cultivates a tolerant relationship with differences, respecting differences and individual peculiarities in school and in the broader environment. School also forms the skills and capabilities necessary for the integration of the individual in the society and handling unexpected, socially tough situations.
- *Function of cultural transmission* points out that for the preservation of national identity, culture and national education level, it is important to be acquainted with national culture, protection and upkeep of cultural heritage. Function of cultural transmission at school strengthens international and intercultural dimension, especially orientation towards Europe and the preparation for life in the European environment.

European identity and a Europe of values

Under European identity (belonging to Europe) one should understood mainly belonging to a European cultural area. A characteristic trait of European culture, which has been developing for millennia, is the richness of thoughts and ideas, a variety of perceptions of human existence, of life and creativity. A vast majority of scientific discoveries were made in Europe, or they were the fruits of European thinking. Therefore, it was stated, that[40] Europe

- is rather a peninsula of the Eurasian continent,
- has no clearly defined Eastern boundary,
- has a highly diversified topology,
- is not a geographical entity…

[39] Walterová, E. 2009, p. 114-115
[40] Duerr, K. 200?, p. 9

But Europe

- is one civilisation with many cultures, languages, scripts, beliefs,
- is an "idea" rather than a geographical entity,
- exercised strongest influence on the development of humanity through its cultural, philosophical and artistic achievements,
- is –*therefore*–generally *understood*as a separate continent.

This can be considered as a dominant framework of further contemplation about European values in the context of European culture. Number of other characteristics contribute to better understanding of European identity.

The formation of values presupposes a good climate in school, collegial and opened management, a good relationship among school's management, teachers, pupils, parents, because "in an authoritarian school system, democratisation will have zero effect". The formation of values is based on the fact whether the school is able to pass on to the pupils/students:

- Understanding geographical variety of Europe and its natural social and economic characteristics,
- Political and social conditions in Europe,
- Historical issues that were shaping Europe and supported European thoughts on legal and illegal state and of the rights of men to freedom,
- Developmental and characteristic phenomena of European culture in its unity and diversity,
- Linguistic variety and cultural richness,
- History of thought of Europe and direction of Europe since 1945,
- Tasks work methods of European institutions,
- The need to accept economic, ecological, social and political challenges and a common European reaction.

The question is, which pieces and how should they be selected, and in what relationship and in what proportionality should they have local, regional, national, European and global aspects. The question could also be formed as follows: *What should the pupils know, what standpoints and values should be developed, in order to build their relationship with Europe?*

This question is referred to in three ways in the curriculum:[41]

1. a multidisciplinary approach: pieces of knowledge about Europe are divided among particular disciplines,
2. a transversal approach: cross-curricular issues are put into objectives, content and evaluation of results of education, which are applied as a progressive trend in most of the European Union, and which require a team work of teachers,
3. a transdisciplinary approach: as introduction of the so called synthetic disciplines (social sciences, natural sciences, ecology, aesthetic education), which require a special preparation of teachers, and therefore this perspective approach is applied only very rarely, e.g. in international educational institutions (European College in Brugges, European Academy in Berlin). Fundamental part of this educational approach is represented by general terminology (e.g. growth, continuity, sustainability of growth, unity, diversity) or values (e.g. freedom, tolerance, pluralism), and therefore they are characteristic more of the humanities.

Cultural establishments' mission in cultural identity formation

Cultural establishments currently form an extensive network, which includes a number of complex institutions, and also small centres and particular historical sights. Cultural establishment is a non-profit organisation serving the society, which acquires, keeps, explores brokers and exhibits material evidence of human beings and their environment, in order to carry out studying, educating, forming or having mere pleasure.[42]

According to this definition, cultural establishments include the following:

- archaeological, historic and ethnographic sights,
- botanical and zoological gardens, aquaria and vivarium,
- centre of science and technology, planetariums,
- galleries of art, and exhibition rooms,
- natural reservations,
- international, national and regional or local museum expositions,
- institutions dealing with restorations, research and educational activities relating to museums,

[41] Matúšová, S. 1998, p. 140
[42] Jůva, V. 2009, p. 285

- institutions dealing with caring for material and immaterial sources of heritage, including digital creative activities,
- further institutions dealing with museum research, formation and education.

Cultural facilities include in particular libraries, cinemas, theatres, galleries (museums of fine arts), museums, historic sights (castles, stately homes, churches, monasteries and sacred sights), exhibitions (of fine arts and architecture), planetariums, musical ensembles, ZOOs, botanical gardens and arboreta and community centres.

Cultural facilities, especially museums, become a source of cultural identity formation. They are a tool for the visitors to realise the changing social values. Some museum pieces are not only sacral relics, their exhibition represents new pilgrimage sites. Studying of cultural heritage in the form of cultural tourism enables individuals to acquire the knowledge about their own predecessors, about their successes but also about their mistakes and failures.

A special model of modern facility is represented by the *children's museum*, which "oscillates between purely educational and leisure-oriented institutions and greatly stimulates children's learning, for free, object-based activities have central position, such as – manipulating, examining, comparing and revealing. The basic educational means of children's museums are interactive exhibitions, which initiate learning through all senses and attempt to explain to children the complex world and its culture."[43]

Educational function of cultural facilities and museums has led to the origin of special pedagogic discipline – cultural pedagogy. *Cultural pedagogy* is a science dealing with educational activities, mainly of cultural institutions. Its basic function is to reflect on and develop the aims, forms and methods of cultural education in non-school cultural institutions. On the other hand, *museum pedagogy* is the theory and practice of education in a museum and its application. It studies and develops the processes of learning in the specific environment. A prerequisite for successful activities of cultural facilities from the point of view of passing on values and culture to children and youth are mainly the following:[44]

- orientation to humanistic and peaceful aims,

[43] Jůva, V. 2009, p. 283
[44] www.unesco.org

- intentions of cultural work on a particular human being, not on an anonymous structures,
- functioning of cultural work as “lobbyism”, intended to satisfy the cultural needs of children and youth,
- emphasis put on high professionalism and quality of cultural work,
- support of the plurality of values and worldview, as well as the autonomous status of the employee.

Education process also consists of extra-curriculum part, the so called *cultural education*. The key requirements of cultural education on children and youth include the following:

- an effort to prepare projects integrating art, social and individual dimension,
- it enables social integration and social teaching,
- cooperation with schools of all levels, with other spheres of extra-school education and between particular culture institutions.
- an emphasis on public financing of programmes intended to children and youth,
- participation of children and youth in the constitution of immediate communicational environment,
- support of dialogue between generations, f
- respect for equal rights of girls and women,
- integration of disabled children and youth.[45]

Conclusion

The objectives of eudcation with regard to European values and culture dimension in the curriculum are formulated in three components:[46]

1. Standpoints and values mean to adopt and to develop skill of

- understanding and respecting of cultural heritage,
- appraisal of European values, especially of democracy, tolerance and equality,
- development of empathy and an awareness of life in a multicultural Europe,
- stimulation of better understanding and an active cooperation,

[45] Jůva, V. 2009, p. 285
[46] Shennan, M. 1991.

- understanding of responsibility of European citizens,
- formation of constructive standpoints to urging matters of peace and human rights.

2. Skills mean the adoption and the development of skills to

- learn to speak at least one European language, so that one can converse functionally,
- acquire social and cultural skills, which support functional communication,
- provide opportunities to pupils, so that they are able to practice their political skills in preparation for an active citizenship.

3. Knowledge mean the adoption and the development of skill to

- understand Europe and the fundamental differences and similarities of the environment, culture and lifestyles,
- understand the differences in human settlement and the forms of production,
- explore political and economic trends and their possible impacts on the European society,
- understand interaction among people, nature and the environment,
- understand continuity and changes of Europe in time,
- boost direct experience and simulation of knowledge of European cultural heritage,
- acquire information on European plurality and the effort of organisations supporting cooperation and conflict solving,
- understand the structures, institutions and their functions, as well as the ways of problem solving in the contemporary European society,
- understand international trends and patterns of behaviour, which are influencing the changes in Europe and will influence the future of children in their adulthood.

School education should support fundamental political, social and individual values, especially the following ones:

- interest in European diversity and its upkeep,
- maintenance of particular cultures within the European culture,
- respecting of European law,
- acceptance of compromise for enabling coexistence,
- protection of ecological balance,
- support of freedom, democracy, human rights, justice and security.

The inclusion of European values and culture in the curriculum of primary and secondary schools differs in the ways of its implementation. There are trends that emphasise historical, geographical or socio-cultural aspects, or the said aspects converge.[47]

The key question, representing the European dimension from the historical aspect is the relationship *among national, European and world history and the explanation of the processes uniting and dividing Europe over centuries*. Despite the application of a number of approaches to this topic (e.g. cultural-historical model, national-comparative model, global model, European history of geopolitical regions), none of them have been fully introduced so far. This is also because a "balanced perception of European history requires a good sum of geographical knowledge and cultural and contextual thinking". This request is also very well applicable to geographical and socio-cultural aspect.

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[47] Walterová, E. 2009, pp. 137-140.

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11 INTRODUCTION TO COMPUTER ANIMATION AND ITS POSSIBLE EDUCATIONAL APPLICATIONS

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Abstract

Animation, which is basically a form of pictorial presentation, has become the most prominent feature of technology-based learning environments. It refers to simulated motion pictures showing movement of drawn objects. Recently, educational computer animation has turned out to be one of the most elegant tools for presenting multimedia materials for learners, and its significance in helping to understand and remember information has greatly increased since the advent of powerful graphics-oriented computers.

In this book chapter we introduce and discuss the history of computer animation, its well-known fundamental principles and some educational applications. It is however still debatable if truly educational computer animations help in learning, as the research on whether animation aids learners' understanding of dynamic phenomena has come up with positive, negative and neutral results.

We have tried to provide as much detailed information on computer animation as we could, and we hope that this book chapter will be useful for students who study computer science, computer-assisted education or some other courses connected with contemporary education, as well as researchers who conduct their research in the field of computer animation.

Keywords: Animation, computer animation, computer-assisted education, educational learning.

I. Introduction

For the past two decades, the most prominent feature of the technology-based learning environment has become animation (Dunbar, 1993). Mayer and Moreno (2002) state that animation is a form of pictorial presentation - a definition which also refers to computer-generated motion pictures showing associations between drawn figures. Things which correspond to this idea are: motion, picture and simulation. As far as videos and illustrations are concerned, these are motion pictures depicting movement of real objects.

The birth of pictorial forms of teaching has been observed to have developed as a counterpart to verbal forms of teaching (Lowe, 2004; Lasseter et al., 2000; Mosenthal, 2000). Although verbal ways of presentation have long

dominated education, the addition of visual forms of presentation has enhanced students' understanding (Mayer, 1999; Sweller, 1999). In fact, some disciplines are taught in universities which deal with dynamic subject matter, and animation or graphic illustration is more favoured as a way of addressing the difficulties which arise when presenting such matters verbally or numerically (Lowe, 2004).

Even though such multimedia instructional environments hold potential for enhancing people's way of learning (Lowe, 2004; Lasseter et al., 2000; Mosenthal, 2000) there is still much debate surrounding this area; indeed animation presentations are less useful for the purposes of education and training than was expected. Moreover, little is known about the way animation needs to be designed in order to aid learning (Plötzner & Lowe, 2004) and not to act solely as a way to gain aesthetic attraction. For instance, some animators who work in the entertainment industry create animations for the sake of entertainment and they are therefore unlikely to be interested in helping to build coherent understanding using their work (Lowe, 2004).

In some cases, animation can even hold back rather than improve learning (Campbell et al., 2005), and may even not promote learning depending on how they are used (Mayer & Moreno, 2002). Animation may possibly require greater cognitive processing demands than static visuals as the information changes frequently, especially critical objects, and thus cognitive connection can be lost during the animation (Hasler et al., 2007).

As noted by Hegarty (2005) in *Learning with Animation: Research Implications for Design*, "the current emphasis on ways of improving animations implicitly assumes a bottom-up model animation comprehension… Comprehension is primarily a process of encoding the information in the external display, so that improving that display necessarily improves understanding." Similarly, Lowe noted in his work *Learning from Animation Where to Look, When to Look,* that the main problem that the developers of multimedia learning materials face is the lack of principled guidance on how some elements of such materials should be designed in order to enable comprehension.

Mayer and Moreno (2000) examined the role of animation in multimedia learning; they also presented a cognitive theory of multimedia learning and were able to summarize the programme of their research. They come up with seven principles for the use of animation in multimedia instruction. Some of these principles were multimedia principles; students learn more deeply when narration and animation come together than narration or animation alone. Learners can easily create mental connections between corresponding words and pictures when both animation and narration are presented. The other principle was the

coherence principle; they say that students learn more deeply from both animation and narration especially when irrelevant words, sounds (even music) and clips are not present. This is due to the chances of the learner experiencing difficulty in building mental connections because of fewer cognitive resources between relevant portions of the narration and animations (Lowe, 2004).

Hasler (2007) investigated the effect of learner controlled progress in educational animation on instructional efficiency. Based on her paper, three audio-visual computer animations and narration-only presentations were used to teach primary school students the determinants of day and night. One of the animations was system-paced using an uninterrupted animation. The results of the experiment showed that the group which had a two learner paced groups displayed higher test performance compared with the other two (Hasler, 2007). Table 1 provides an overview on the works done in this field.

Table 1. Brief comparison of the previous work done in the field of educational animation

Author/Year	Paper Title	Aim of the Paper	Concise View of the Study (Findings/Problems)	Conclusion
Mayner & Moreno (2002)	Animation as an aid to Multimedia Learning.	Examine the role of animation in multimedia learning.	*Multimedia instructional messages* and *micro-worlds* were defined; giving rise to argument on "How should animation be presented to promote understanding of multimedia explanation?" Took *Information Delivery Theory* into account; Presented a *Cognitive Theory of Multimedia Learning* comparisons and computations were made based on the results given by the college students from the tests and experiments they participated in resulting in a table of Seven Principles of Multimedia Learning.	There are seven principles for the use of animation in multimedia instruction; The *Cognitive Theory of Multimedia Learning* is more consistent than the *Information Delivery Theory*.
Lowe (2004)	Animation and Learning: Value for Money?	To show the effectiveness of animation's potential to play a role in	Two assumptions about the role of animation in education: (affective function & cognitive function);	Animation needs to be aesthetically made and supported if it

		cognitive function.	There are two distinct types of animation problem: (overwhelming & underwhelming); Stated that today's educational animations are called "behaviorally realistic" depictions.	is to achieve educational potential; A systematic approach and progress beyond current adherence and behavioural realism should be observed.
Hasler et al., (2007)	Learner Control, Cognitive Load and Instructiona l Animation	Examines the influence of two different forms of learner-controlled pacing during a temporary, audio visual animation on instructional efficiency.	Cognitive Load theory (CLT) gives a model for instructional design depending on human cognitive architecture; The effectiveness of instructional activities are determined from cognitive architecture; Pertaining to problems linked with high unnecessary load because of processing transient information, learners manage the pace and segmentation of presentation (instruction) into meaningful segments; Researchers ended-up with positive effects for learner-controlled pacing and segmentation while others found the other way around.	The outcomes gained provided an experimental aid for the soundness and success of application of the principles derived from (CLT) in the context of multimedia learning.

Organization

The rest of this book chapter is organized as follows. In Section II we briefly review the chronological order of the history of animation. In Section III we discuss the fundamental principles of computer animation. In Section IV we discuss the usage of computer animation in education. In Section V we talk about the future of computer animation. In Section VI we conclude our paper and suggest future work entitled *Theoretical Aspects of Creating Educational Computer Animation based on the Psychological Characteristics of the Human Temperament*.

II. History of Animation

Looking at the past and the present, animation has evolved over time. It started with pieces of paper and rope in 1828 and is today 3D animation videos. In this section, we will list the chronological order of the development of animation and animation devices which have evolved and improved over the past two centuries. We have also included the most famous animation characters in the history of animation.

- **Thaumatrope**

A thaumatrope (invented by Paul Roget in 1828) is a simple mechanical toy which creates the illusion of movement. Thaumatrope means “wonder turner” derived from the Greek words: θαῦμα “wonder” and τρόπος “turn”. Roget was the first person in history to create such a device which produces the illusion of movement. In order to enjoy this animation, one would only need one small round piece of paper with pictures on it and thin ropes fixed at both ends of the shape (Figure 1). Below shows what a thaumatrope (Figure 1) is and how the illusion of movement is produced (Figure 2).

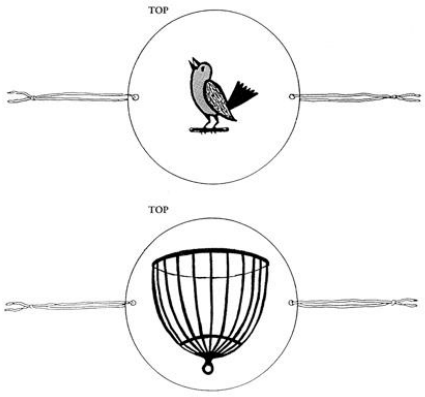

Figure 1. Thaumatrope.

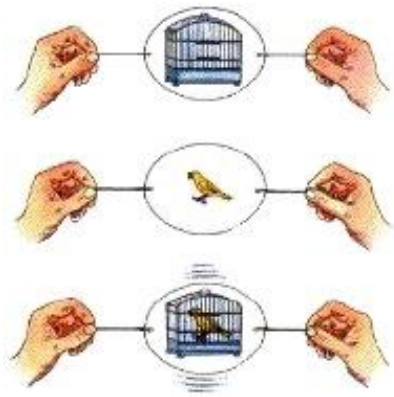

Figure 2. Illusion of movement.

- **Phenakistoscope**

After the invention of the thaumatrope, the phenakistoscope followed made possible by J.A. Ferdinand Plateau in 1832. This device uses the persistence of vision principle to create an illusion of movement. Phenakistoscope originated from the Greek φενακίζειν (phenakizein), meaning "to trick or cheat"; as it tricks the eye by making the figures in the pictures appear to move. It is composed of six similar images in different positions taken in order to relay the movement. A very simple example is a running reindeer and jumping frogs (Figure 3).

Figure 3. Examples of moving images using a phenakistoscope.

- **Zoetrope**

In 1843, William Horner, a British mathematician invented the zoetrope. A zoetrope produces an illusion of movement from a rapid succession of static pictures. Derived from the Greek words ζωή*zoe*, "life" and τρόπος *tropos*, "turn" this forms a “wheel of life”.

Figure 4. Different versions of the zoetrope.

- **Praxinoscope**

Almost the same as a zoetrope, the only difference was the integration of a mirror to the device which makes the viewer more comfortable as they watch the movement of the objects. It was designed by Emile Reynaud in 1877 and was known as the “action viewer”.

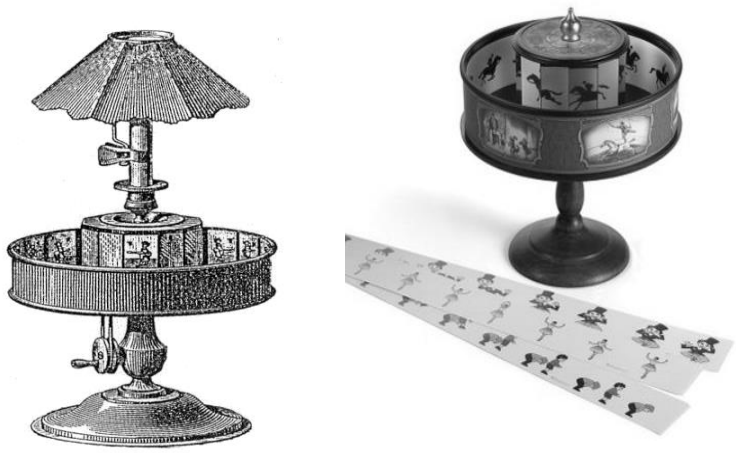

Figure 5. Praxinoscope in black and white, and a version in colour.

- **Kinestoscope**

An early motion picture exhibition device was invented in 1888 by Thomas Edison together with his colleague Eadweard Muybridge. The kinestoscope was designed for films to be viewed through the window of a cabinet (Figure 6). Kinestoscope means the "view of movement" from the Greek words *κίνησις* "movement" and *σκοπός* "movement".

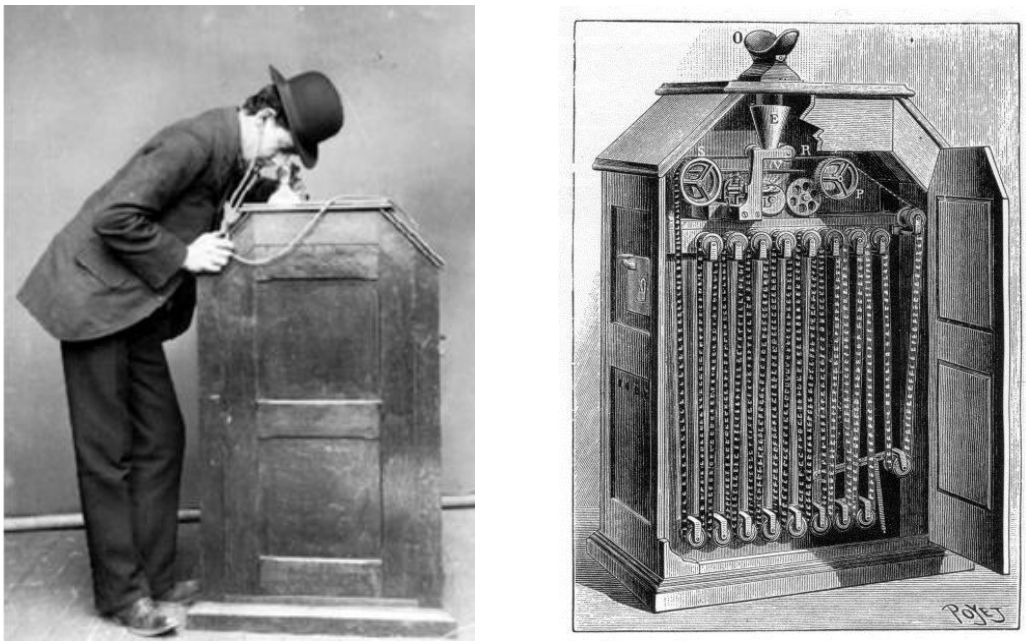

Figure 6. Man views the motion picture exhibit in a kinestoscope.

- **Multiplane Camera and Storyboard**

Walt Disney and his colleagues had a problem with creating realistic animation and how to conserve time while creating it. Then they came up with a great solution which can be considered another innovation in the field of animation - the multiplane camera (Figure 7). The multiplane camera is a piece of equipment designed to make cartoons more realistic and enjoyable. It uses stacked panes of glass each with different elements of the animation (Figure 8). With this, it allowed for the reuse of backgrounds, foregrounds, or any elements not in motion. The multiplane camera was developed by a Walt Disney Productions team headed by William Garity in the early 1930s. It was also known as the "super cartoon camera".

The storyboard was yet another successful creation in animation technology. It is used to recheck the story and utilizes pencil sketches to review motion.

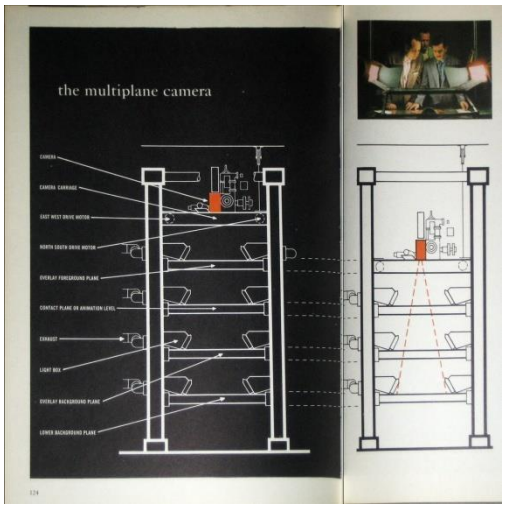

Figure 7. Multiplane camera.

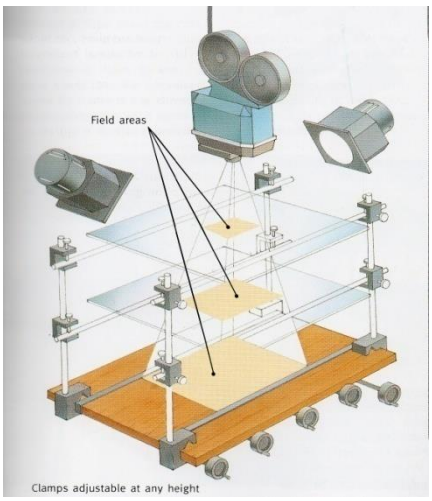

Figure 8. Multiplane camera II.

Next we will discuss the first ever animated films together with some of the most famous and successful animation characters. Outstanding works in stop motion and clay motion are also elucidated, followed by a discussion of computer graphics and computer animation, i.e., 3D animation.

- **Humorous Phases of Funny Faces**

After the invention of the above-mentioned devices, J. Stuart Blackton made the first animated film in 1906. The film was entitled *Humorous Phases of Funny Faces*, and with this he became known as the father of animation. He was

using a blackboard as his workplace together with chalk and an eraser as his main tools. He was able to record the animation using the "draw-stop-film-erase" method.

- **The Birth of Cartoon Characters**

The creation of the first ever animated film also inspired many animators to create their own animations. For instance, Winsor McCay drew *Gertie, the trained dinosaur* (Figure 9). It was an animated film astonishingly consisting of 10,000 drawings. The animation was shown as a film in theatres as well as at a multimedia event on stage with McCay interacting with the animated Gertie. Next in line was *Felix the Cat* (Figure 10). During the early 1920s, he became the most famous animated character. Then who could forget *Mickey Mouse?* (Figure 12). Mickey Mouse was created on November 18, 1928 and with his creation came the first successful sound animated film. *Mickey Mouse* was originally known as *Steamboat Willie* (Figure 11). He became an international star and made way for the launch of Disney Studios. Lastly, *Looney Tunes* was introduced in 1930 by Hugh Harman and Rudolp Ising run by the Warner Bros. Company. Bugs Bunny, Daffy Duck, Tweety Bird and Silvester are just a few of the main characters in this cartoon.

Figure 9. Gertie the trained dinosaur.

Figure 10. Felix the Cat.

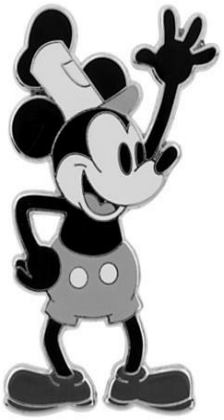

Figure 11. Steamboat Willie.

Figure 12. Mickey Mouse.

- **Stop Motion and Claymation**

Stop motion animation is used to animate things that are smaller than life size. Willis Harold O'Brian pioneered motion picture special effects, which were perfected in stop motion. He became famous after his successful work on *King Kong* (Figure 13), claiming the title Dean of Stop-action Animation. Ray Harryhausen followed in the footsteps of O'Brian and became one of the most outstanding stop motion film makers through his films *Mighty Joe Young* and *The Lost World* (Figure 14).

On the other hand, claymation also became a trend. Technically, it is the art of moulding clay figures and making them move, dance, talk, sing and whatever you can think of. Frames are run together to produce the animation. *Chicken Run* and *Wallace & Grommit* are the two most successful claymations created by Aarmand Studios of the United Kingdom.

Figure 13. *King Kong*

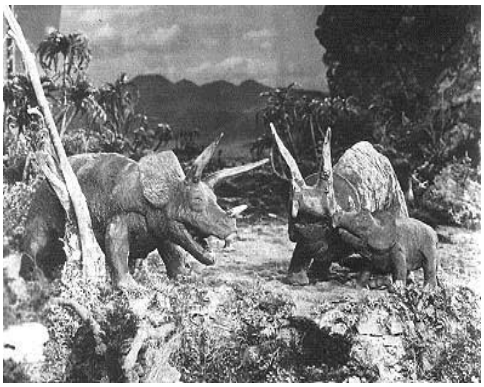

Figure 14. *Lost World*

- **Computer Animation**

When it comes to new forms of animation, firstly let us define traditional animation - a system of animating in which the illusion of movement is presented by photographing a sequence of individual drawings on consecutive frames of film. On the other hand, computer animation is a form of pictorial presentation which refers to simulated motion pictures showing movement of drawn objects.

- **Computer Graphics and 3D Animation**

This is where graphics are created using computers and the illustration of image data by a computer particularly with the help of respective graphic hardware and software such as Superpaint. It is used to replace physical models and then create realistic intermixed elements with the live action. 3D animation is today's animation. By using some sophisticated software and looking at the *Principles of Traditional Animation Applied to 3D Animation* concept, animators are able to produce outstanding and aesthetic animations such as, *Toy Story*, *Madagascar*, *Megamind*, etc.

III. Fundamental Principles of Computer Animation

In this section, we will discuss the famous work of Pixar's John Lasseter, *Principles of Traditional Animation Applied to 3D Computer Animation*. To begin with, let us first define traditional animation: basically this is 2D animation techniques such as inbetweening (Kochanek et al., 1984; Reeves 1981), keyframe animation (Burtayk et al., 1971), multiplane background (Kevoy, 1977), scan/paint (Kevoy, 1977) and storyboarding (Gracer et al., 1970).

While 3D computer animation uses 3D models instead of 2D drawings (Lasseter, 1987). In addition to that, 3D animations were script-based with few spline-interpolated keyframe systems (Catmull, 1972). The arrival of these reliable, user-friendly, keyframe animation systems was made possible by some large companies (Lasseter, 1987) such as Abel Image Research, Alias Research Inc., and Wavefront Technologies Inc.

Nevertheless, even with such high-tech systems, most of the animations produced were all bad. One could ask, what was the problem? Their (the animators) unfamiliarity with the fundamental principles used for hand-drawn character animation for over 50 years seemed to be the reason for this.

In the late 1920s and 1930s animation was developed from an innovation to a fine art form by the Walt Disney Studios. They set up drawing classes at the Chouinara Art Institute in Los Angeles spearheaded by Don Graham. Here the

students/animators learned the standardized formula of old cartoons which lead to the discovery of ways of drawing moving figures and humans (Lasseter, 1987). With this came a keen investigation of action made through the advancement of animation and its principles (Thomas et al., 1981).

There are about 11 fundamental principles of traditional animation namely: squash and stretch, timing, anticipation, staging, follow through and overlapping action, straight ahead action and pose-to-pose action, show in and out, arcs, exaggeration, secondary action and appeal.

a) Squash and Stretch

Technically, this pertains to the inflexibility and mass of an object by distorting its form during an action. The squashed position represents the form either flattened out by an external pressure or constricted by its own power. The stretched position constantly shows the same form in a much extended condition (Thomas et al., 1981). The most important thing to remember here is “no matter how squashed or stretched out a particular object gets, its volume remains constant” (Figure 15).

Drawing a bouncing ball is a standard animation test for the new learners in this area. The work is to complete a ball using a simple circle, and then have it fall, hit the ground and bounce back into the air (Thomas et al., 1981). There are times when some objects need not deform while doing squash and stretch. For example, a hinged figure like Luxo Jr. (Pixar, 1986), squashes by bending over on itself, and stretches by extending out completely (Figure 16). The squash and stretch principle is one of the most important principles to consider among these principles.

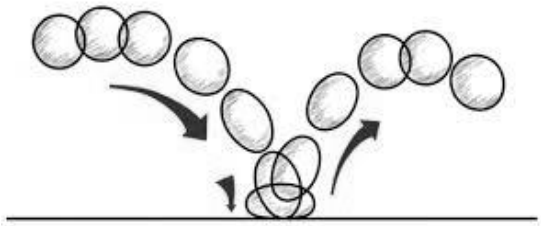

Figure 15. Squash and stretch unchanged volume.

Figure 16. Luxo Jr.

b) Timing

Timing is the gapping of actions to describe the weight and size of figures and the personality of characters. It marks to the viewers how well the idea behind the action is thought out. Accurate timing is critical to making ideas clear. The anticipation of an action, the action itself, and the feedback to the action are essentials, and adequate time is needed to prepare the audience for this. The audience will be confused if too much time is spent on any of this, and equally if not enough time is spent, the motion may be finished before the audience becomes aware of it, consequently wasting the idea (Whitaker et al., 1986).

c) Anticipation

The preparation for the action, the action proper, and the termination of the action are the main parts of anticipation. It is also a tool to gain the audience's attention, to prepare them for the next movement and to guide them to guess it before it actually happens. Anticipation is usually used to clarify what the next action is going to be. For example, when a character tries to grab an object, firstly he extends his arms as he looks at the object and makes facial expressions to indicate that he is going to do something with that particular object. The anticipatory moves might not reveal why he is doing something, however, the "what is he going to do next?" question is critical (Thomas et al., 1981).
More examples of anticipation include:

- A heavy object is present and a particular character is trying to pick it up. Bending right down before picking up the object, aids the momentum of the character to lift heavy things - this is known as exaggerated anticipation.
- Imagine a fat character stuck in the seated position. For the character to stand up, he would need to bend his upper body forward, with his hand on the armrests of the chair for support, before pushing his arms and using the momentum of his body (White et al., 1986).

d) Staging

This refers to the arrangement of an idea entirely and clearly, and it originates from 2D hand-drawn animation. For better understanding, action is staged. For easy recognition, personality is staged. To affect the mood of the audience, expressions and moods are staged (Thomas et al., 1981). In presenting

animation, actions should take place one at a time. If there is lot of movement at the same time, the audience will get lost and will not know where to focus, thus the learning is affected negatively. Each and every action and idea should be staged in the strongest and the simplest way before moving on to the next phase.

e) Follow Through and Overlapping Action

Since anticipation is the preparation of an action, termination of an action is defined as follow through. Actions do not often come to a sudden and full stop, but are usually carried past their ending point. For example, after releasing a thrown ball, the hand continues past the real point of release.

Regarding the movement of any particular objects, the actions of the parts are not synchronized; there should be an initiation for the movement, e.g., the engine of a train is also known as the lead. Let us consider walking where the action starts with the hips. As the walking starts, the hips swings forward, which then sets the legs into motion. The hip is the lead, next the legs follow then the torso, the shoulders, arms, wrists and finally the fingers all come into play.

f) Straight Ahead Action and Pose-to-pose Action

There are two main approaches to hand-drawn animation namely: straight ahead action and pose-to-pose action. The main difference between these two is the readiness. Straight ahead action starts from nothing and hopes to continue as ideas pop-out from the mind. On the other hand, pose-to-pose action makes sure that everything is ready, that the characters are drawn and prepared, and that it is just a matter of connecting them in size and action with one another, and then the inbetweens are drawn.

g) Slow In and Out

The gapping of the inbetween drawings between the extreme poses describes the slow in and out. In mathematics, this is defined as the second- and third-order continuity of motion. The “slowing out” of one pose then the “slowing in” to the next basically describes the logic behind slow in an out. In essence it pertains to the timing of the inbetweens (Figure 17).

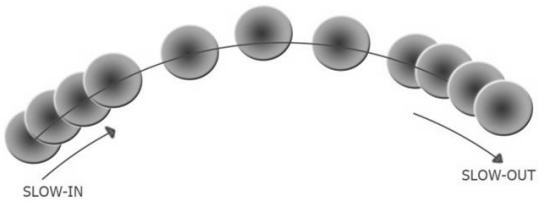

Figure 17. Slow in and slow out.

In addition, the animator should point out the position of the inbetweens with a "timing chart" as shown below (Figure 18). With this, animation becomes more alive and spirited.

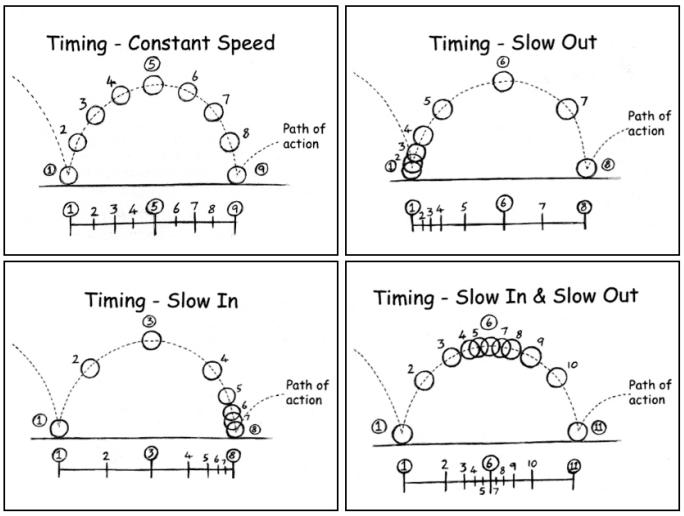

Figure 18. Timing chart.

h) Arcs

An arc describes the visual path of action from one previous extreme to another. It is also the most economical routes by which an object, shape or form can be in motion from one place to another. In order to make the animation smoother and less stiff the use of arcs is highly advisable as opposed to just using a straight line. In some cases, even an arc can turn into a straight path, for instance, the free fall in physics. The use of arc in a free fall animation would be illogical.

Generally, the path of action from one extreme to another is maintained by a similar spline in 3D keyframe computer animation systems and that which controls the timing of the inbetween values.

i) Exaggeration

The distortion of the shape of an object or making an action look more violent or unrealistic does not necessarily mean exaggeration. It is the animator's job to go to the heart of anything or any idea and develop its real meaning, comprehending the cause for it, so that the viewers will also understand it. For instance, a sad character could be sadder, or if he is bright, make him dazzling.

j) Secondary Action

Secondary action is basically the action that comes directly from another action. Secondary actions are essentials in building interest and including a realistic complexity to the animation. From the name itself, secondary action is always inferior to the primary action. If it conflicts, becomes more interesting, or dominates in any way, it is either the wrong choice or is staged improperly (Thomas et al., 1981). To give you a simple example, if the character's movement of the body is the main idea, the facial expression becomes the secondary action (Thomas et al., 1981).

k) Appeal

Appeal is mainly composed of the quality of charm, pleasing design, plainness, communication and magnetism. Appeal is what the person or the audience likes to see. A figure or object that has appeal will easily catch the audience's eye and holds it while the audience appreciates the object. An inadequate drawing or design lacks appeal. Any complicated design with clumsy shapes and strange moves is hard to understand and likewise lacks appeal.

After all these principles *personality* comes into the picture. Personality refers to the wise application of all the principles of animation. Notice that when the character animation is successful the audience is entertained. This is because the accomplishment of character animation depends in the personality of the characters regardless of whether it is drawn by hand or computer. The story also becomes more essential and evident to the audience if good personality is shown. Moreover, in personality there is no one type of character created. Take a boy playing a ball and his dad into account, their physical characters are very different so too are the emotions. The boy is very lively and active while the father is just calm.

IV. Using Computer Animation in Education

Nowadays, we live in a digital era: it is inescapable. The advancement of technology and the drastic changes in the surroundings affects our needs and desires, be it psychologically, socially or emotionally.

Similarly, the need for change in education as time has passed has strongly accelerated. These days, the old chalk and talk methods in front of a blackboard, or even the more updated whiteboard, marker and projector, are simply not enough for effective teaching and learning. As Abbas (2012) comments, "students tire of this teacher-centered model…..and complain that the…..class is very boring and monotonous and they want something new and different". Though the old methods may still be present, increasingly there is a demand for a more competitive tool which will supply the needs of the students more effectively. This involves "changes in both the instructional strategy and also the teaching and learning environment" (Vonganusith & Pagram, 2008).

Computer animation, specifically educational computer animation, can be considered as one of the main tools available for teachers to use to promote effective learning nowadays. In this part, we will enumerate the usage of computer animation in education:

1. To help the learners to visualize something which can't be seen easily in the real world (Ainsworth, 2008).
    a) e.g. the movement of atoms in a gas (Russell et al., 2000) shown in Figure 21.
    b) the shifting movements of the continents (Sangin et al., 2006) shown in Figure 22.
2. To illustrate events that are not inherently visual (Ainsworth, 2008). Animation clarifies relationships through visual means (Weiss, 2002).
    a) e.g. computer algorithms (Kehoe, Stasko, & Taylor, 2001).
    b) e.g. stages in a mathematical solution (Scheiter, Gerjets, & Catrambone, 2006).
3. To serve a decorative or cosmetic function (Levin, Anglin & Carney, 1987; Weiss, 2002).
    a) e.g. special animated effects sometimes can dazzle and impress students in the opening of a lesson (Weiss, 2002).
4. To gain attention (Rieber, 1990a).
    a) e.g. interesting special effects for transitions between instructional frames, screen washes, moving symbols or characters, and animated prompts (Weiss, 2002).

5. To provide feedback.
    a) e.g. a dancing bear, a unicycle-riding clown, or fireworks used as feedback can motivate learners to strive for correct answers (Weiss, 2002), though according to Surber and Leeder (1998) overuse of colourful graphics does not enhance motivation.
6. To use it as part of the presentation strategy (Weiss, 2002). This is particularly helpful when presenting highly abstract or dynamic processes (DiSessa, 1982; Kaiser, Proffett, & Anderson, 1985; Rieber, 1990a, 1991).
    a) e.g. animation might be particularly useful in helping students understand the flow of blood through the body (Weiss, 2002).
    b) e.g. the inner life of the cell.
7. To assist the users with animated agents (Johnson , Rickel & Lester, 2000), where lifelike characters are animated to include gesture and movement (Ainsworth, 2008) shown in Figure 23.
8. To assist with language teaching and learning (Bikchentaeva & Ziatdinov, 2012). The use of computer animation in language development can be justified according to several theoretical paradigms: constructivism, which places emphasis on a learner's active engagement with the learning process in order to construct meaning out of the available input (for instance, Williams & Burden, 1997); cognitive psychology, which acknowledges a learner's active attempts to understand, acquire, store and use knowledge (for instance, Skehan' 1998); the Affective Filter Hypothesis (Krashen & Terrell, 1983) which recognizes the importance of emotional factors such as motivation, interest and anxiety in effective learning; the Noticing Hypothesis, which suggests that learning takes place most effectively when the material to be learnt attracts and holds the learner's attention (Schmidt, 1995); learning style, which suggests that individuals have different preferred ways of learning and that they learn best when their particular style is accommodated (for instance, Reid, 1987); and learning strategies, according to which different activities are more or less effective for the promotion of learning in different students (for instance, Griffiths, 2013; Oxford, 2011).

Computer animation can be used in all areas of language cognition and skills development, e.g. expanding vocabulary. Computer animation could be particularly useful when teaching verbs (for instance, run. jump. kick, climb, fall, etc.) where the action dimension can be especially difficult to convey using conventional static teaching methods.

    a) e.g. explaining grammar. Computer animation techniques can be specially effective, for instance, with drilling new grammar until it becomes

automatic, a process which can be extremely monotonous and demotivating using traditional pedagogical techniques.

b) e.g. modeling pronunciation. According to Massaro (2003, p.172) "combined with principles from linguistics, psychology and pedagogy, (computer animation) technology has the potential to help individuals…..learning a new language".

c) e.g. providing listening input. It is not always easy to obtain an adequate supply of material to develop listening skills, but computer animation programmes have the potential to provide an unlimited source of such material.

d) e.g. stimulating speaking practice. By means of interactive programmes, it is possible to develop students' speaking skills in an interesting, non-threatening environment

e) e.g. presenting interesting reading material. An unlimited source of reading texts, matched to the students' interests and ability levels, can be provided by means of animated computer programmes.

f) e.g. motivating students to write. Receptive skills (listening, reading) can be used to stimulate productive skills (speaking, writing) by means of the attention generated from computer animation.

The use of computer animation in education has broadened and continues to grow at a rapid pace. Because of the speed of change, we need to train teachers who are capable of dealing with technology. Also, as Abbas (2012) explains, teachers need to learn how to adopt new roles, such as those of facilitator and guide, integrator, researcher, designer and collaborator. Since the new pedagogical paradigms involve more than mere transmission of knowledge, which was once considered the norm, teachers may need training in how to develop the professional expertise which using computer animation in education requires.

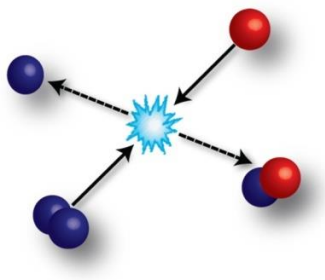

Figure 19. Movement of atom gas.

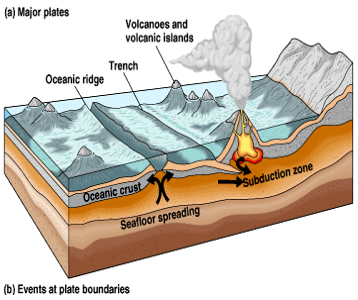

Figure 20. Illustration on plate movement

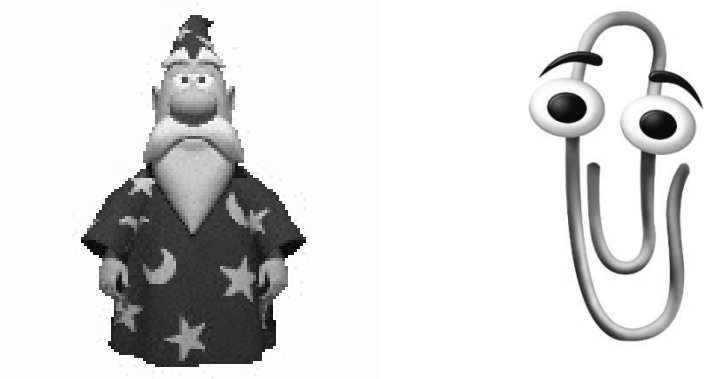

Figure 21. Microsoft's famous animated agents Merlin(L) and Clipit(R).

V. Future of Computer Animation

In order to effectively use animation it is useful to understand how people learn from pictorial and verbal media (Mayer and Moreno, 2002). In order to promote the cognitive processes required for meaningful learning such as selecting, organizing and integrating, multimedia presentations should be designed in ways to promote just that (Mayer and Moreno, 2002).

In the next millennium, pictorial forms of teaching are likely to expand as a complement to verbal forms of teaching (Pailliotet and Mosenthal, 2000). As stated by Mayer and Moreno (2002), "animation is a potentially powerful tool for multimedia designers, but its use should be based on cognitive theory and empirical research… The future of instructional animations is bright to the extent that its use is guided by cognitive theory and research."

VI. Conclusions and Future Direction

Animation, which is basically a form of pictorial presentation, has become the most prominent feature of technology-based learning environments. Animation refers to simulated motion pictures showing movement of drawn objects. Educational animation is one of the most elegant tools for presenting materials for learners. Its significance in helping learners to understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. It may be very useful for learning about some topics in the natural sciences, where educational modelling and preparing materials convenient for learning can reduce the time required in class and increase the efficiency of the educational process. On the other hand, English language and literature can benefit

from the possibility of creating animated multimedia books. By utilizing animation, students develop skill competencies in visual communication, storytelling, observation and sensory aspects, problem-solving and innovative aspects, e.g., concentration, as well as cognition, ethics and aesthetics.

Our future work aims to establish an inter-disciplinary field of research looking into greater educational effectiveness. With today's high educational demands, traditional educational methods have shown deficiencies in keeping up with the drastic changes observed in the digital era. Without taking into account many significant factors, educational animation materials may turn out to be insufficient for learners or fail to meet their needs. However, the applications of animation and ergonomics to education have been given inadequate attention, and students' different temperaments (sanguine, choleric, melancholic, and phlegmatic, etc.) have not been taken into account. We suggest there is an interesting relationship here.

We shall propose essential factors in creating educational animations. The fundamentals of design are divided into design principles (alignment, balance, emphasis, unity, proximity, rhythm) and design elements (colour, line, shape, space, texture, value). Using these fundamentals and forming sequences of images to create an illusion of aesthetic movement, i.e., movement of objects along aesthetic paths drawn by so-called fair curves (class A Bézier curves, pseudospirals, superspirals, quadratic Bézier curves with monotonic curvature function, Pythagorean hodograph spirals), we intend to create educational materials considering different types of student temperament and preferences. To give an ideal model of educational animations, in this study we use design and animation software such as CorelDraw Graphics Suite X6 and ToonBoom. CorelDraw Graphics Suite X6 is broad software for graphic design, page layout and picture editing. ToonBoom is the leading international developer of digital content and animation software solutions, providing the most cohesive and state-of-the-art toolsets available today. It serves educators at all levels searching for ways to integrate an art-based curriculum into their existing classroom environments. Educational materials designed using the above software increase literacy rates and facilitate the achievement of overall learning objectives.

We believe that this study is likely to have wide benefits in the field of education. Designing educational materials with the aid of the mentioned software, while considering the types of temperament of students, is a really promising avenue to improve the learning process. Teachers will be able to feel more confident in the presentation of their lessons, in addition, they will become more competitive and professional.

VII. Acknowledgement

This work is supported by the Scientific Research Fund of Fatih University under the project number P55011301_Y (3141).

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12 PEDAGOGICAL TRAINING FROM THE PRE-SERVICE TEACHERS' POINT OF VIEW AT THE UNIVERSITY OF DEBRECEN – A PILOT RESEARCH

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Abstract

This study is aimed to present the results of a questionnaire-based research filled in by first year students of the teacher-training master program of the University of Debrecen (Hungary) in September 2012 (1st questionnaire, n=58, N=70) and February 2013 (2nd questionnaire, n=25, N=69). The questionnaires contained open-questions. This study presents the opinion of candidates about the pedagogical training and their view, knowledge and future image on their teaching. We aimed to gain information about fears and hidden doubt of the candidates. Our research, like previous studies, indicated that the candidates' teacher image is in harmony with the image of an ordinary, traditional teacher and this is based on candidates' past school experiences. For this reason, we have to lean on these experiences and gained information in order to form attitude in an effective way in the future.

Keywords: teacher training, teacher image, questionnaire-based research, constructive pedagogy

Introduction

Since 2006 teacher training has been divided into two segments due to the Bologna Process. In September 2013 the system of teacher training is about to change and become undivided again for future applicants/candidates.

In a system that is being changed so often it is really important for the training institutions to get immediate reflections on their way and content of teaching. This study is based on a pilot research that aims to provide practical information. However, this kind of research has many broader lines but we think that the information they contain can be very useful. The main limit of this research was the "practical aim" itself. Because we were trying to gain information about specified courses (that is the reason for using open-questions) we had to skip those questions that could be useful for theory but it would have taken too much time and even the candidates' attention could have even been diverted away from the

most important questions. On the other hand, the number of studies related to students' opinion on teacher-training is limited as well. Thirdly, the system of the training has been frequently changed and therefore we can compare data with previous research only in a limited way.

In spite of the difficulties mentioned above, the major results of this study are the following:

- Answers given by students provide a close look at their opinion on pedagogical courses and their attitude towards teaching and pupils. The relatively small number of subjects made us think in a general way in some of the cases.
- These results provide the opportunity for further researches.
- The Bologna-system of teacher-training will be withdrawn soon. This research documents some of its features and opinion of students on it.
- Those contents that students preferred in their answers are really important because in the new system, the amount of pedagogical-psychological courses will be reduced to half.

Aims of the research

In February, 2012 and February, 2013 a questionnaire-based research was managed and controlled by Magdolna Chrappán and Zoltán Nagy among the first year students of the teacher-training master programme. These teacher candidates had recent memories about their BA subjects and they are also familiar with the structure of the MA as well. The first questionnaire was filled by students of the "Didactics I.," the second one was filled by students of "Didactics II." subject. In the first semester we reached nearly 83% of the students with the paper-based format (n=58, N=70), in the second semester we reached less students (n=25, N=69) with an online-based form of the questionnaire. The questionnaires contained open-questions, working with data gained from the answers was made mostly according to the method of semantic content-analysis (Krippendorff, 1995: 35).

The major aims of the research were the following:

- measure how satisfied the students are, get their opinions on the 10-credit pedagogical-psychological module;
- students' demand on the pedagogical courses "Didactics I" and "Didactics II"
- students' opinion on the "Didactics I" lecture;
- students' expectations on teaching and their images according to teaching;

- how students are familiar with the recent changes of the educational system;
- students' hidden uncertainty, fears (there were no concrete questions on these issues but we could gain information from the answers);
- Do students demand communication and vernacular training? (However, the participants of the research do not have any courses on their mother tongue, but their opinions are important because in the new system of teacher training, future teacher candidates will have to fulfill a "Native module" as well.)

The major questions of this research touch two apparently separated fields: one kind of the questions examine the students' satisfaction with the pedagogical courses, the second kind of questions gain information on their principles and expectations of teaching. In spite of this we did not separate these two fields in the study. The main reason for this is that we think the candidates' answers should be examined from a unified and holistic point of view. Our point of departure is based on the idea that suggests that the "entering" concepts of candidates should be strengthened in the training and the concept of teacher training should be in harmony with students' opinion.

The previous studies, although limited in number, showed that the pedagogic courses were not that popular among candidates. Kocsis found, in one of his studies dealing with teacher-training, that candidates think that the pedagogic training in comparison with the special subject training is weaker (2003: 68.). Wubbels (2008) thinks that most students find knowledge gained in teacher-training being sometimes useless.

A possible reason for this that the candidate's previous experience is not in harmony with the knowledge s/he gained in teacher-training. According to constructive pedagogy the knowledge taken by the candidate differs from the (new) knowledge s/he gains (in this case: teaching image) that the conceptual change fails to come. So the experience the candidate takes from his/her previous school years is different from the experience s/he gets within the walls of the training institution and because "the process of learning is being formed by the interaction between new experiences and inner system of interpretation but with the leading role of the latter one" (Nahalka, 2003: 122), so the previous knowledge "wins." In consequence of this we can suggest that candidates start teaching following "traditional" concepts and not those ones they gained in the training institution.

What is the "traditional" teacher image like? Dudás (2007) studied the points of view of candidates with a variety of methods. He concluded that "the teacher image of candidates is effected by a pedagogical culture that limited in

presenting the new material" (106). The study mentioned before and Köcséné's researches show that candidates over-value a teacher's personality and inner qualities and think that improving these qualities is essential for their further development, however "they simplify the teaching profession" this way (Dudás, 2007: 72). According to the research based on the study of conceptual maps "a good teacher has knowledge of his/her subject, evaluates in an objective and fair way and s/he is patient" (Dudás, 2007: 72). These points were strengthened in our research as well.

Several studies deal with roles of teachers and related changes. Kovács (2011) studied the teaching identity in reflections of social roles, Varga (2009) summarized the changes of roles of educators. Not only candidates highlight the importance of the qualities of a teacher but this is a common topic of researches as well (Figula, 2009; Szivák, 2003). The role of the teachers were studied in a wider context by Szabó (2009a) who studied this case from schoolmasters' point of view. Vámos (2003) studied this from the children's and the parents' point of view. Németh & Chrappán (2013) made a comparative study of pre-service teachers and school-teachers, with a special stress on the rating of the qualities of a teacher.

Forming the image of a teacher is stressed by modern educational studies that suggest that this process is very complex and time-consuming and should not be separated because of previously mentioned or taken knowledge. The synchronizing of the contents of pedagogical and psychological knowledge is needed. This is very important in a divided (Bologna-type) system which was strongly criticized before introduction (see Ladányi, 2008: 176–182) because instead of the previous concurrent model, it follows the consecutive model of teacher-training which suggest a "one or two-years-long training after the training related to the special subject, condensed theoretical and practical human studies" (Szabó, 2009b: 172). The candidates in the teacher-training MA, not counting the 10 credits pedagogical-psychological subjects in the BA, do not have courses which can change their concepts. For this reason, the undergraduate training does not help students. Instead, it provides more time for them to deepen their knowledge and previous concepts which trainers want to shape. The training they get is related to their special subjects and also frontal and material-based.

Students opinion on the BA pedagogical-psychological module

In the Bologna system which contained the bachelor and the master programmes, BA students are supposed to fulfill a so-called "pedagogical-psychological module" which contains five courses, 2 credits each, 10 credits in

total. Fulfilling these courses is the requirement of applying to the master programme. Among these, there are courses related to psychology, such as "Theoretical Basics of Psychology" (lecture) and "The Personality Development of the Teacher Candidate" (seminar). The following courses are related to pedagogy:

- "The Social Foundations of Education" (lecture), which aims to deal with forms, social background and current issues (such as drug consumption) of institutionalized education;
- "Philosophers on Education" (lecture) that examines major points and milestones of the history of education from ancient times to the 20th century;
- "Introduction to Education" (seminar). The content of this course depends on the instructor, but the basic aim of it is to introduce students into the "inside world" of a school and provide some details on its structural and operative features, participants of school life and the inner logic of pedagogical procedures.

In this research we asked the new MA students in the autumn semester (September, 2012) about how they were satisfied with their BA pedagogical courses and how successful those courses were. ("Are you satisfied with your BA pedagogical courses? Interest, usability, did it raise your interest about the teaching profession, manners of instructors, could you fulfill the course easily, was bibliography sufficient and available, learnability, etc.") So, the question was related the pedagogical subjects because the university treats the pedagogical-psychological module as a unified segment. Only 12 students out of 58 made a difference between the subjects related to pedagogy and the ones related to psychology:

"In the BA we just had to fulfill two pedagogical courses, and these were very complex in content, there were high requirements in the examinations, but I think we needed these requirements."

The students' answers concerning their satisfaction with the undergraduate (BA) courses can be divided into three categories (see Table 1).

	satisfied	partly satisfied	not satisfied	total
number of students	17	35	4	56

Table 1. Satisfaction rate of students related to their BA courses

Reading the answers of two students it turned out that they did not attend any of the lessons so they could not answer the questions dealing with the satisfaction rate. 30.36% of the subjects (17 students) were totally satisfied with the courses, 62.5% of them (35 students) were just partly satisfied with the pedagogical training. 2/3 of subjects made a difference between lectures and seminars and they complained about the content of the lectures that the material cannot be used in practice. 4 students were dissatisfied with the training. One of them found the practical training too short, another student found the courses too boring, the third found one of the teachers too "powerful" while the fourth was a student of the pedagogy minor programme and s/he had to fulfill the courses before. 11 subjects found the 10-credit module insufficient. Students can experience the disadvantage of the consecutive model (Szabó, 2009b: 172): *"The pedagogical and psychological courses are worth 10 credits together within the 180-credit BA programme. I think candidates of the teaching programme should learn more than this."* There was a subject who said that the amount of the courses related to the special subject field should be increased and the number of pedagogical-psychological courses should be decreased.

In the second semester (spring term, 2013) we asked the following question: "Do you think your previous (BA/BSc) pedagogy courses helped you to fulfill your courses in the MA programme? If yes, how?" Similarly to the first semester, the answers can be divided into three categories as well (Table 2).

	very useful	partly useful	not useful	total
no. of students	4	12	9	25

Table 2. The satisfaction rate of students with pedagogical courses of BA in the 2nd semester.

Having a look on the results of both the first and second semesters we can see that the majority of students are satisfied with the compulsory pedagogical subjects and found them useful as well. The difference is that in the first semester students found the number of the seminars too small *("I think, developing the syllabus of the 10-credit courses in the BA was not a success and I find the priority of the practical training more useful.")*, while in the second semester they referred to the differences within the syllabus *("They did not help a lot because in this training we learn new things"; "To tell the truth, I do not find many connections between the subjects of the BSc and MSc programmes. I liked the BSc courses as*

well, I heard interesting things related to child protection and the job of an officer of youth protection for example, but I think, the courses of the master programme can be fulfilled well without the knowledge gained in the BA as well.").

In the first semester the question related to the students' satisfaction was complex, contained more elements. Some of the students (13) wrote about how their interest toward the teaching profession was influenced by undergraduate courses. Three subjects mentioned that these subjects had an effect on their teaching profile: *"My interest in the teaching profession was strengthened by my well-skilled educators. Most of them are role models for me because of their manner and the way they teach."* The fact that 10 subjects out of 13 wrote that their view and calling on their careers were not influenced during the undergraduate training is not a negative one because choosing a profession is preceded by a long process. Being a teacher is that profession toward which the interest can be raised in childhood as well (Gombocz-Trencsényi, 2007: 86). *"My interest in teaching started earlier and not while I was a BA student. This just called my attention toward other special topics."* 90% of subjects were satisfied with the manner of those educators of the University of Debrecen who teach pedagogical courses in the BA programme. The dissatisfied students mainly referred to the unorganized syllabus. 2/3 of subjects could reach bibliography of the courses too.

In the first semester "Introduction to Education" and "Theoretical Basic of Psychology" subjects of the BA programme were found the most useful ones by students:

"The Theoretical Basic of Psychology lecture was very interesting, the instructor was friendly and tried to raise attention by several interesting exercises. As for me, 'Introduction to Education' was very interesting because of the positive manner of the instructor. This subject was really important, we heard many personal experiences from the tutor."

"Philosophers on Education" seemed to be the less useful and "The Social Foundations of Education" was the most contradictory one because almost the same number of students found it useful or useless:

"I found 'The Foundations of Education' lecture interesting and useful because in the lectures I could learn about child protection and the job of an officer of youth protection."

vs. *"'The Foundations of Educations' subject is crumbled and not transparent."*

The feasibility of the courses is in connection with their utility according to students' answers. This made the "Philosophers on Education" lecture the most difficult one to fulfill.

Students' expectations toward Didactics I–II. lectures

In 2012 we asked subjects of this research about their expectations of the possible results and effects of the pedagogical courses of the MA programme they might get, maybe, especially in the Didactics I. lecture. Of course, the answers of the students were different but the following opinions were the most frequent ones:

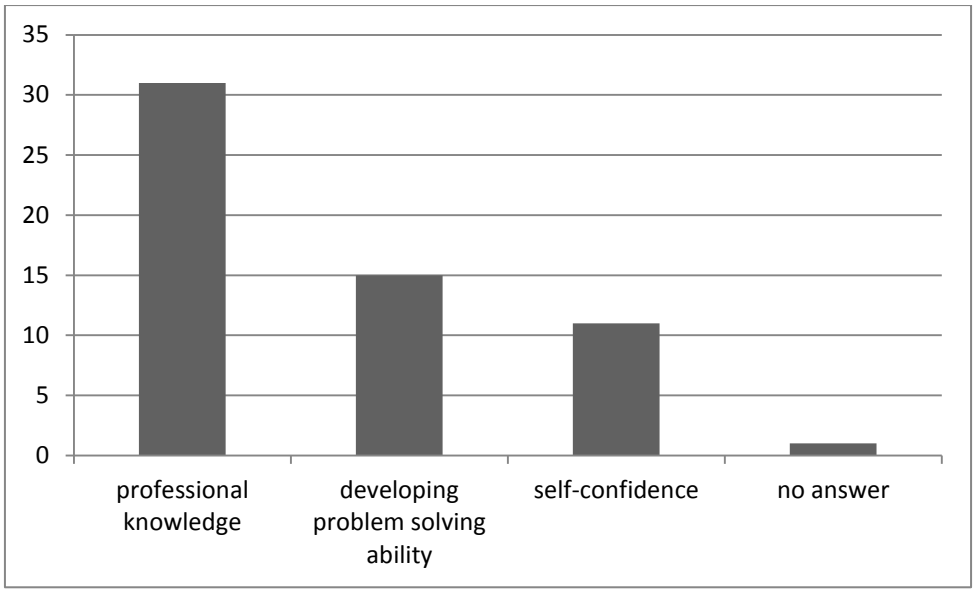

Figure 1. Students' expectations related to Didactics I lecture

A student gave this answer to the question: *"How to teach? If there are twenty "heads" in front of me with lack of comprehension?"* Related to the development of problem solving abilities students referred to kinds of situational activities which will help them one day to deal with their teaching or form teaching tasks. Beside self-confidence they highlighted patience and attention. A teacher candidate expects a result that points to something beyond the world of education: *"If I am not going to be a teacher, I will still use what I learn here."* Students of the Faculty of Music gave a negative evaluation on the pedagogical courses and the reason might be the lack of this kind of courses during their undergraduate studies and the fact that they had more than one classes at the same time which probably caused some difficulties and inconvenience for them. Of course, there was a counter-argument as well, highlighting the importance of the pedagogical courses:

"Being a student of the Faculty of Music I am really interested in those pedagogical processes that will help me to organize and give individual lessons and get on well with my pupils. As for me, it is really important that my pupils do not attend my lessons just because they love music itself but to relax and forget the difficulties of everyday life."

In the second semester there was a question in connection with the students' expectations: "What kind of results or effects do you expect from MA courses, especially from Didactics II. lecture?" Several students wrote that *"the tutor's manner made a very positive effect on them," "the situational activities or the story-telling parts were good"* and a lot of students liked that *"the material of the courses was not that 'dry' or difficult."* The following opinions provided by the students demonstrate well the image students had about the courses: *"It took me closer to reality than any other pedagogical courses," "I was afraid of the fact that the course material would be difficult but with the examples given the whole lesson was not that 'book-like'."* The expectations of students are shown in Figure 2:

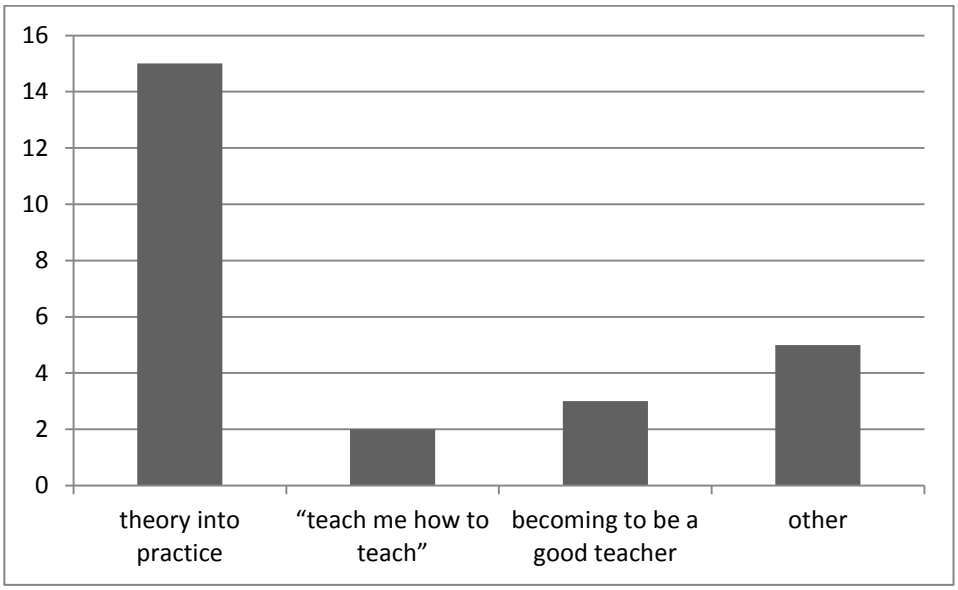

Figure 2. Students' expectations related to Didactics II. lecture.

As it is clearly stated in the diagram the majority of the subjects highlighted the importance of practical knowledge opposed to demands.

Students' opinion on "Didactics I" lecture

The major topics of the lecture were the following:

- The general context of the teaching profession, problems of a beginner teacher
- Understanding pedagogical processes, the position of teaching-learning within school activity. The beginning of teaching-learning process, constructing and organizing.
- General learning-organizing activities, motivating students, feedback, differentiating.
- Working forms of learning-organization: frontal, group-work, individual work; cooperative techniques
- Methodologies, strategies during lesson activity.
- The question of content: choice of material to be taught, syllabus, curriculum (national curriculum, curriculum frameworks)
- Local curriculum and its features
- Topic-based design and organizing lessons/school work.

In the second semester one of the examined questions was the success of the "Didactics I" lecture: "Did you have expectations toward this lecture? If yes, what kind and were they met?" For this question, we gave four kinds of answers (Table 3).

	it was more useful than I expected	It was the same as I expected	it was not that useful as I expected	I had no expectations, but it was useful	total
no. of students	4	6	2	13	25

Table 3. Students' expectations toward Didactics I lecture in the 2nd semester.

In Table 3 we can see that 92% of subjects (23 students) wrote that the lecture Didactics I. was useful in some way. Majority of students (13 students) had no expectations or could not remember any:

"I had no special expectations. It was good that the tutor told us her personal experiences several times."

"I didn't know what I was going to learn so I had no concrete expectations, but at the end I found it good. I was afraid a bit of the material, I thought it was going to be 'dry' and not very easy to learn but the fact that we could hear a lot of personal examples and not only those from a book made the whole lecture enjoyable."

"I had no expectations but I really liked the lectures, because of the manner of the tutor as well. The lecture was more 'life-like' than the previous ones we had."

It is not surprising that the candidates permanently highlighed their demands for the practical training in the case of neither the 10-credit-BA module nor the Didactics lecture. Based on the theoretical concepts mentioned above we suppose that the candidates separate the theoretical and the practical training and prefer the latter, we say that the real "breaking line" is not this. Highlighting the importance of practical training arose from – according to constructivism – the very fact that they cannot process the new (theoretical and practical) knowledge. Students think that the knowledge they get in the university is mostly theoretical and they use their previously taken teaching image as the practical one. This means that, candidates want to gain that kind of knowledge in pedagogical-psychological courses that is in harmony with their earlier school-life experience. This is the reason why they think that some of the concepts that pedagogy or educational sciences identify as an important is "theoretical" from the candidates' point of view, such as working on the reflective teaching habit (Brookfield, 2008). The demands of candidates illustrated in Figures 1 and 2 suit the concept of "traditional teacher image."

Teacher image of the candidates

In order to map the teacher image of the candidates we had a closer look on the following answers:

1st questionnaire (September, 2012):

1. Which parts or activities of the teaching profession are you more interested in?
2. In your opinion what are the most important tasks and aims of teachers at school?
3. Which characteristics or abilities should you improve to become a good teacher?

2nd questionnaire (February, 2013):

- Which parts or activities of the teaching profession are you more interested in?

- Did your opinion on the teaching profession changed? If yes, how?
- What are “the worst” mistakes that teachers can make in their profession? How do you think these mistakes can be prevented or corrected?
- In your opinion what are the most important tasks and aims of teachers in school?
- Which characteristics (qualities) or abilities should you improve to become a good teacher?

25 students (43%) out of those who were asked and sent back the questionnaires are interested especially in gaining and passing knowledge within the teaching profession. Beside this, subjects’ attraction to form-teaching is also high-rated (8 students, 13%), some candidates are less interested in motivating their pupils (5 students), some are interested in the relationship between teachers and pupils (4 subjects), some in make the pupils like the subject that s/he teaches (4 subjects) and some in out-of-school activities (3 subjects). Three developing categories are also listed beside these, but that has different meanings according to the candidates. Among the answers we can find ones in connection with developing personality, ideology, cultural, general and communicational abilities. If we collect and put these ideas into the category named “development/developing”, that represents 13% of the answers and we can say that for the candidates it is as attractive as being a form-teacher.

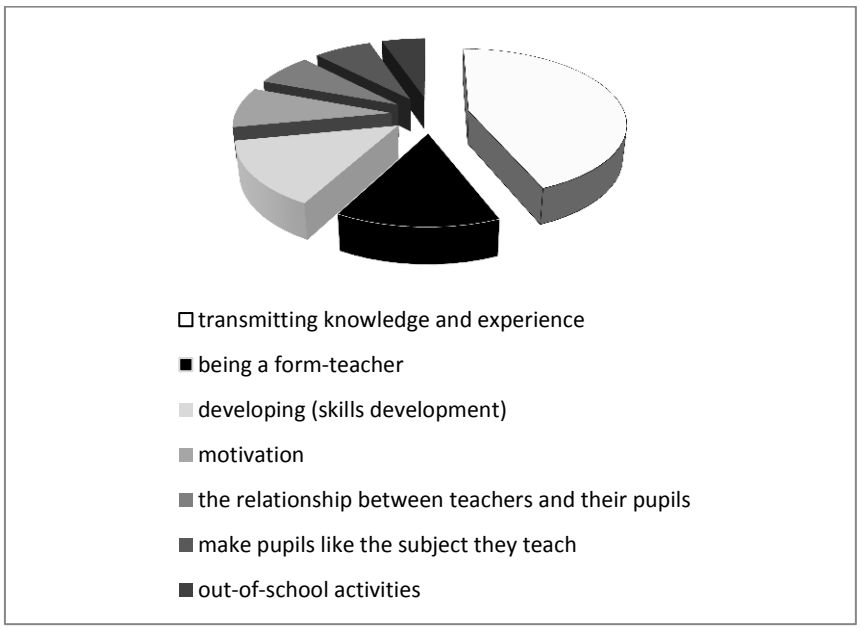

Figure 3. “Which parts of the teaching profession are you mostly interested in?”

Candidates also suggest some other ideas in their answers that cannot be put into the listed categories.

"It is important to highlight that pupils do not know where they live. I think as a teacher I would go on excursions/trips with them to call their attention."

"Educating pupils means the development of his/her personality, ideology, soul in a good way and a kind of a help for him/her in his/her natural improvement, to help them learn and keep their 'ancient knowledge.'"

"It always made me happy if I could teach him/her something new. I enjoyed helping them, their interest made me happy."

We raised this question at the end of the second semester again. Among the subjects (n=25) 7 are interested in teaching, 5 are interested in educating, 3 subjects in motivation, 3 in talent management. 1 person is interested in being a form teacher, in methodological research, in forming ideology and in making the pupils like the learning process itself. There were several answers that indicated an attraction to the relationship between teachers and pupils, like working with children, developing personal contacts/relations, knowing the children, getting on well with them and dealing with out-of-school activities.

The answers related to the most important teaching tasks were pretty much the same in the first part of the research. 25 students (43%) feel that the most important task is to transmit knowledge. The same number of subjects is the most interested in this field too. The next important aim on the list is the exemplary behavior, education and educating for life, motivation and mediation of values. Education and educating for life do not mean the same for the candidates.

task	transmitting the material	exemplary behavior	education	educating for life	motivation	mediation of values
proportion	25 (43%)	14 (24%)	14 (24%)	12 (21%)	10 (17%)	7 (13%)

Table 4. The most important tasks of a teacher according to candidates. (1st questionnaire)

Beside these, the candidates mentioned in their responses several tasks, although the proportion of them is not that prominent, yet indicates well the things they found essential.

task	amount
socialization	7
make pupils like the subject	6
teach material pupils can later use/teaching useful knowledge	6
talent management	4
giving/providing help	5
developing real self-concept	3
shaping basic social behavior forms	4
educating for independence	3
offer alternatives for interest	3
keep in touch with pupils and parents	6
achieving respect	3
sense of duty, vocation	3
empathy, conflict-management, fairness, creating the best atmosphere, take part in school-life	2–2

Table 5. Further (most) important tasks of a teacher. (1st questionnaire)

For those who filled in the second questionnaire, the most important task of a teacher is the mediation of the material and knowledge (18 subjects); however, most of them think that it should be clear, enjoyable and practical. The second most important task is educating again (8 subjects) and preparing pupils for life (6 subjects). Motivating and providing a role model is among the most important tasks according to 5-5 subjects. Providing alternatives and help in order to make the pupil reach his/her goal is important for 4 subjects:

"Help pupils to reach their aims, help those who do not have aims, give them direction."

"Show the best way to the pupils. Show them some opportunities, ways/paths that they can go along and help them at the starting point."

Beside these, following tasks are mentioned:

task	no. of subjects
socialization	2
make the pupils like the material	3
improve thinking	2
collaboration of pupils, tolerance, empathy, consistency, authenticity, keep the rules and regulations, build up confidential relations	1–1

Table 6. The most important aims of the teaching profession. (2nd questionnaire)

There was a person who stated: *"I think the aim might be preparing them to survive."*

Dudás – based on his study – claims that, "the deep knowledge related to their subject was the most important for students, beside this they think of the teacher as an owner of several valuable qualities and abilities. Those elements which relate to organizing and assisting the learning process and are also connected to the methodology of learning and teaching are missing in teacher-training" (2007: 106). All of these are strengthened in this study. The answers of subjects show that they have a strong image of the teacher who "bears" knowledge. The answers relating to the process of organizing learning and teaching are pretty "superficial" (for example, developing thinking). Not only the candidates stress the importance of transferring knowledge and educating (Szivák, 2003: 91-92). These are in a strong connection with the expectations of their future workplaces. Szabó (2009a) claims that even headmasters think that educating is the most important (ethics and harmonic personality) while transferring knowledge ranked fourth on the scale.

The subjects were asked both in the first and second semester about their weak points they needed to improve.

area needed to be improved	no. of subjects
patience	19 (32%)
communication skills	16 (27%)
professional knowledge	10 (17%)
self-confidence	10 (17%)
presentation skills	8 (13%)
relationship with pupils	6 (10%)
empathy, creativity, attention	4 (6%)
punctuality, schedule, flexibility	3–3 (8–8%)

Table 7. Areas needed to be improved by candidates. (1st questionnaire)

Beside these qualities some candidates feel that they have to deal with their "stage fright," acquire professional tricks and methodology, ability to motivate pupils and manage conflicts. There were some unusual answers as well:

"I should become more copyable, simple, and more acceptable."

"I have to accept that some students/pupils are untalented."

In the second questionnaire answers given to the same question reflect that candidates gained some experience in classes with micro-teachings and in schools they visited several times. New qualities are listed here such as legible handwriting, acquiring methodology, dividing attention and using pupils' heads (try to think in the same way). We can find the same qualities that were listed by candidates in the first questionnaire as well.

area to be improved	no. of subjects
patience	8
self-confidence	6
communication skills	5
professional knowledge	4

Table 8. Areas needed to be improved by candidates. (2nd questionnaire)

Having a look at the last two tables it is clear that the first four areas that need to be improved are the same in the first and the second questionnaires. These are patience, self-confidence, communication skills and improving methodological skills.

Németh & Chrappán (2013) used a range containing 20 items to measure the educators' quality preferences (they asked practicing teachers to make an order of qualities on a scale 1–7). This study was a bit different (they asked the qualities of a good teacher, we asked the fields of self-development); however, it is important that patience ranked in the first place (178). Köcséné (2007) also asked candidates to list the fields they need to improve to be good educators. She made six categories out of which five (patience, communication, professional knowledge, self-confidence, relationship with pupils) fits our research in content. In the future, it should be also examined why is patience so stressed among candidates as well as educators: (1) comes from self-reflective attitude, (2) teaching is thought to be a profession that needs a lot of patience, (3) or this is just a so natural quality of a teacher that "should be" mentioned.

In the second questionnaire there were two questions that we did not raise in the first one. We were looking for the answer about what are those "big mistakes" that teachers might make while they are in their profession and how could they correct them according to the candidates. We listed their answers in the following table:

mistakes	no. of subjects
burn out, apathy	5
lack of vocation	4
no changes in methodology	1
change in attitude	2
stick to old values	1
lack of up-to-date professional knowledge	2
inflexibility	1
“if s/he gives up”	1
desire for power, “poking students”	1
“teacher-centered” (teacher in the middle)	1
crank who can think of nothing but his/her subject (Fachidiot, have tunnel vision)	1
unfairness	2
lack of benevolence	2
make students hate the subject and school itself	1
“forgets that s/he was also a student once”	2
alienates students from him/herself	1
“force their opinion on students”	2
do not teach what you cannot keep”	1

Table 9. Mistakes of teachers

The lines in grey refer to the teacher’s personality and professional knowledge. 17 subjects (68%) thought that these mistakes/problems are the worst ones. Out of these, the most common mentioned mistakes were burn out and lack of vocation.

The lines indicated with a white shade list those factors that influence the relationship between teachers and pupils. 14 subjects wrote mistakes that could be listed in this category. A little number of subjects answered the second part of the question but there were some advices how to correct or solve these problems/mistakes.

“I think, avoiding mistakes is only possible if we think over everything and take every possible consequence into consideration. ‘Treating’ is more difficult but I’m sure that if I become a teacher and will make a mistake, I will always apologize for it.”

“We should be impulsed to love our profession again.”

“We should listen to pupils’ opinion.”

"Raise the question to ourselves: what would I do/would I have done if I were/had been him/her? I think, this makes judging pupils' acts easier."

Since we asked candidates in the first and second semesters of their MA studies we were curious about how their opinion on the teaching profession was changed. They had lectures where tutors asked them to inform about the current educational system and the changes to be made on it. They could also see several types of teachers, pupils and situations while they were visiting schools. 12 subjects did not change their mind. 4 subjects did not provide valuable answers. 6 subjects changed their mind on the teaching profession.

"There is a lot of negative things if you are a teacher but you could experience a lot of positive ones as well. We have to concentrate on these ones. This can only make our job successful."

"I started to feel that this job is very responsible. We always have to observe and being up-to-date."

There were answers for both questionnaires that we could not take into consideration because candidates pulled several questions together and did not provide answers we could evaluate.

Knowledge of students

In the first semester we asked a less personal question: "What do you know about the current changes in the educational system and school work? What are the most important things you have heard/read about the changes of educational system?"

The most commonly mentioned changes by candidates are listed in the table below (if a candidate mentioned more than one change, we counted it separately).

restore undivided teacher-training	17 mentioning
introducing "everyday" P.E. lessons	13 mentioning
the owner of schools is not the local government any more	13 mentioning
scholarship provided by the state, student contract	9 mentioning
curriculum-related changes	8 mentioning
compulsory ethics or religious education lessons	5 mentioning
school uniform/school gown	5 mentioning
did not mention any examples	14 subjects

Table 10. The most commonly mentioned changes by candidates

We can examine the candidates' answers from another point of view: knowledge related to university or other school types. This duality is interesting because the subjects of this research are university students but they are going to teach in primary and secondary education.

changes mentioned only in connection with higher education	changes mentioned both related to higher and public education	changes mentioned only in connection with public education
9 subjects	13 subjects	20 subjects

Table 11. Students knowledge about the different types of schools

Within these there were answers suggesting wider knowledge of subjects about these changes.

"In higher education, the undivided teacher-training will be restored. It means that teachers will be trained in a 4+1 and a 5+1 system depending on whether they want to teach in primary or secondary schools in the future."

"In connection with higher education it is the restoring of the undivided system in teacher training and introducing student contracts, etc. Related to public education it is the introducing of everyday P.E. Lessons, ethics and religious education. It is an important chage that a lot of schools are becoming church supported and not government supported."

We can feel that the candidates are kind of uncertain about the news. As an example for this, almost every candidate has heard something about everyday P.E. lessons but there was only one student who had specific information about it (*"From the grades of 1, 5 and 9 everyday P.E. lessons will be compulsory."*). It is also common that candidates have only partial information about the changes or they just could not use the right words/terms to explain them (for example: *"in most schools the church will be the supporter instead of the local government"*).

Their uncertain knowledge is reflected in the *way* they gave answers as well. A big number of students started giving their answers with "excuses" or stated that they are not that well-informed *("Nowadays I do not really have time to read/watch the news but I have heard that there will be changes," "We are informed in a way but not well-informed. Of course when I will plan to start working, I will gain information." "I do not follow the news and changes because when I finish my university studies they will change everything again and introduce new laws and regulations.")*. After one or two introductions similar to the previous ones, a big number of candidates gave some concrete examples as well; these are listed below.

s/he stated that s/he is not well informed	but provided specific information	15 subjects	TOTAL 28 subjects
	and did not provide any information	10 subjects	
did not excuse but did not provide information as well		3 subjects	

Table 12. Students' knowledge of the changes.

Finally, we must mention that even this was the most impersonal question, there were subjects whose answers were full of emotions.

"The recent change I have heard about is the student contract which concerns me as well. I must tell that I am distressed that the government wants to keep us within the country's boarders this way. I have always been a patriot and few years ago I felt that I can live in this country forever but the situation is getting worse. First, they should create the conditions that make the youth stay in its homeland."

"The next thing that made me angry is related to the application. Instead of decreasing the state scholarship places in universities they should increase the amount of points to get higher education and maybe this way is not only stupid, but work-shy people from rich families could enter higher education on behalf of those from poorer families."

Several subjects were personally concerned by the changes because their parents are teachers.

"My parents work in a village and they have been afraid of having their workplace closed for almost two years now in spite of the fact they won some money in a competition to develop and enlarge the school building. More and more parents take their kids to other institutions. Sometimes my parents have to work more for the same salary but they are happy because they can teach at least."

What is between the lines?

We can find regular shapes in the students' fears, especially in contrast with the fact that there were no specific questions on their uncertainties toward the teaching profession. These fears can be put into three categories:

(1) Candidates are afraid of being not able to manage real school conflicts/problems and the lack of instructions for dealing with these in their studies

(2) Negative attitude toward the teaching profession in Hungary

(3) Lack of competence, individual weak points

Some of these fears appear explicitly, some appear in a less unambiguous way but we can find these general fears in the answers of the majority of subjects. We examine these in the following section.

(1) Reading the answers given in the first semester we can say that every candidate hopes that s/he will receive a kind of a training which will help him to cope with different school situations.

"I would like to get some help in order to be able to deal with everyday school situations."

"Being able to cope with every kind of different school situations would be important."

"For me, the problem is that real life does not create those conditions that are needed to be able to use the methodological instruments."

Examining the answers from the second semester we have to state that, unfortunately, candidates do not feel like they get this knowledge from the university. Eight subjects are not satisfied with the amount of practical training, they think that the theoretical training is too much. The candidates think that this knowledge will not help them when they have to teach individually.

"We should get more practical training instead of theory 'pressed down our throats'."

"…we do not want to learn theory, we need practical knowledge as well."

"It is a general statement that each and every situation is different. This made me think that the teacher is always alone when s/he has to solve a situation or manage a conflict and her/his 'inner voice' is the only one which can help or give direction. However a 'beginner' teacher is not that experienced to make the right decisions in each and every situation."

(2) *"For this amount of money we are expected to think and be qualified and work without managing conflicts. Being a public employee for this low salary is humiliating. I think we may face the fact that in Hungary it is not worth being a happy and appreciated educator. After this a new 'world' should come where school life and work can be reformed and made a better place where we can "strengthen" pupils on their way of becoming adults."*

The candidate who used these words is not alone with his/her opinion that today, in Hungary, work of teachers is not appreciated enough. Reading these answers we can see that the candidates started to think and worry about their careers:

"Nowadays, we have to be happy if we can work (as teachers) as well."

"I have bad feelings about the conditions of educators."

While at the very beginning of their training the majority of candidates were concerned about the changes of higher education, after half a year passed, they started to be concerned about their personal teaching careers so we can say that the professional socialization of candidates began.

(3) Is there any student who thinks that this is not just a quality s/he wants to improve but a kind of a fear?

"In the first pedagogy lesson I started to feel that I am going to be a bad teacher because I could not react to the situations in a good way, always told nonsense things and I noticed that I could not stop talking like in high school… for a moment I started panicking."

"I am always doing several things at the same time which sometimes makes my work not that perfect."

"I am very impatient and I know that this is not a quality of a teacher but I am working on it."

"I should be more patient, sometimes I am very ebullient."

Students' demands of native training

From the fall semester of 2013 the undivided teacher-training was restored. A new element of the training is a native module that is compulsory for candidates. As it is stated in the 8/2013.(I. 30.) EMMI (Ministry of Human Resources) order "the *native material* is a criteria which consists of knowledge on the mother tongue (practical communication skills, rhetoric studies, speaking skills, spelling) and the knowledge that forms attitudes to a language."

The regulation does not mention any specific information or criteria (for example as the time of the training is concerned) above the four skills so that was the reason for the research managed by Edina Kovács and Zoltán Nagy (attitude study) using questionnaires to measure the related demands of teacher-trainees in connection with the courses on these four skills and their attitude toward their mother tongue and grammar lessons (n=166, N=660). (BA students who signed in for pedagogical courses were considered as teacher-trainees, and the students in the teacher-training MA were also asked to fill in the questionnaires.)

Since the study depended on a big sample there was no opportunity to ask open questions. This was the reason for asking open questions from MA students in the case of our research when we asked the students attending the Didactics II lecture to answer the following three questions:

1. "According to a regulation introduced by the government in the new (restored undivided) teacher-training system a new native-language related subject will be compulsory (dealing with rhetoric studies, spelling, practical communication

skills and speaking skills) for future students. Do you think that this subject is needed for students? Do you think it would be useful in your career as well?"

2. "List another field that should be improved in your opinion within the structure of this subject"
3. "How many semesters do you think are needed to make this course successful (if students have one class a week in a semester)?"

Furthermore, we asked the students to rate the four skills from 1 to 5 (1=not useful, 5=very useful). We gave them some short definitions on these skills. Students highly supported this type of training. Out of 25 subjects, 11 students rated all the skills as "very useful" and there were no students who rated the skills "not useful." The practical communication skills and rhetoric studies are the most popular ones (4.72 and 4.6), then these speaking skills and spelling (4.52 and 4.24). Answers given in connection with the length of the training vary from one semester to all semesters. There was a student who wrote that candidates are already "overloaded" so one semester would be enough.

Answers given for the first question refers that students think it is really important to take part in training related to native language. However, in some of the answers we could find very few specific information/argument for that: the training is useful because it is important for a teacher:

"Yes, we need a subject like this. I would find it useful. All the four skills are essential for a teacher."

"Absolutely. I think it is useful to make the teaching profession perfect."

"Yes, we really need that. Of course, I find it useful."

A big number of subjects could not answer the question because they did not have much information about the exact content of this subject:

"I do not have information about whether there were any courses similar to this one in the previous undivided system. As for me, these are just "plus" subjects. I do not think that we really need them."

"The question is what are teachers going to expect from students and what is the exact content of them. But I can imagine that students need a kind of training like this, the new generation is a bit different."

Those who supported the training referred to the low quality of teacher-trainees' verbal skills:

"A lot of students cannot say at least one sentence in an intelligent way in spite of that they want to be teachers"

"I think, these skills are very useful for teachers. Even students/pupils cannot express their ideas correctly in writing or speaking or in a way that is suitable in a situation. I think, it is urgent to introduce these subjects and make them compulsory."

"I can partly agree because there is a lot of students at the university who were just lucky when s/they were accepted. Some of them cannot even speak or write in an intelligent way. Of course, I am not that professional as well, I should also improve my spelling but I think, some courses on our native language would be helpful for most of the people here."

A lot of subjects said that a course can only be useful if it provides very practical information:

"For those who are studying the teacher-training programs, both communication and rhetoric studies can be useful if it is practical training. This course can be really useful if students should not learn only the grammatical rules, for example something about consonants but they can get more and more opportunities for expressing themselves orally."

"I learnt some rhetoric in other courses. But I find it a bit useful, for example if the course is a shortened seminar or an optional one."

However, the demand on learning speaking skills is smaller, there was a subject who highlighted the importance of that:

"I think, it would be useful because we should care about what and how to say to the student. You cannot learn from a teacher who cannot speak, strengthen, articulate, you will lose your intention to learn. I also noticed when I was speaking for too long that my voice 'went away…' I think in this course I can learn a technique how to keep it."

Two subjects found it shocking that future candidates will have to learn these things in the university:

"This is the first time I have heard about this and I am kind of shocked. Do they really want to teach how to communicate in universities? And how to spell in a correct way?And what about the primary and high school lessons? I think, if someone has problems with these things, he should not apply for teacher-training. Of course, I find it important that the above mentioned skills should be improved but in my opinion, these skills cannot be acquired within one semester."

"I have just one problem with this new element. I think, these should be acquired in primary or secondary school."

These opinions are not surprising because we got similar results in the case of the attitude study. We gave three statements and the students could rate them in a four-point scale:

- "Improving native competence is the task of the primary school primarily."
- "Improving native competence is the task of the secondary school primarily."
- "Improving native competence is the task of the higher education primarily."

In the figure below you can see that this is the task of the primary school primarily, according to the students we asked:

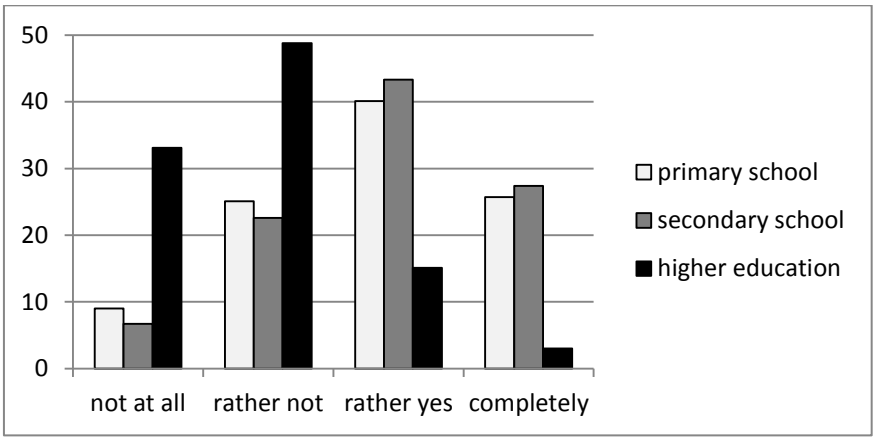

Figure 4. The importance of improving native language competence on different levels of education (%, n=166, source: "attitude study")

Answers that were given for the second question indicate other kinds of fields to be developed which are not really connected to native skills but the students found them important. According to three subjects, candidates should practice writing on school boards because some teachers' handwriting on boards is not legible enough. 4 subjects would add some "cultural skills" to the training as well (for example History, literary remains of Hungarian language). There were some specific skills mentioned by subjects as well: reading comprehension, improving presentation skills, writing skills, "vocabulary building," how to communicate with parents and non-verbal communication.

In all, we can say that the students strongly support training related to native language skills and they want to gain a kind of a practical knowledge that they can use every day. The importance of change in concept is stressed here as well, so the courses on native language training should be made available from the beginning of the training.

Conclusion

Our research proved that pre-service teachers interpret teaching as a traditional teaching-educating function. Besides, they may be open for pedagogical training and basically they are satisfied with the courses they attended and try to gain information about the changes of the educational system. As the teacher-

training becomes undivided again since September 2013, the pedagogical courses will be distributed in an equal amount throughout the years of the training. If we take into consideration that the "concepts become explicit at the beginning, both for students and trainers, this is important at the very beginning of the training" (Dudás, 2007: 111), this structure of training has more advantages than the divided one. However, the fact that the credit amount of pedagogical-psychological courses was decreased in a drastic way may cause difficulties later. It is an opportunity for trainers and tutors of pedagogy – in spite of the lack of time – to form candidates' concepts on teaching from the very beginning of the training.

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13 SPRACHLICHE ATTITÜDEN DER SLOWAKEN IN SÜDOSTUNGARN – EINFLUSS ZUM SCHULWESEN

Sándor János Tóth

Abstract

The paper deals with the language attitudes of the minority language usage of the Slovaks in Tótkomlós (Slovenský Komlóš), South-East Hungary. The sociolinguistic research of the Hungarian Academy of Sciences made a query about the self-evaluation and language usage behavior in the town of Tótkomlós (Slovenský Kolmóš). The paper will present the statistically evaluated outputs of the research.

Key words: Sociolinguistics, minority, language usage, bilingualism, attitudes

13.1 Das Ziel und die Methoden der Forschung

Die zusammenfassende Studie über die Sprachgebrauchsanalyse der Slowaken von Tótkomlós entstand aufgrund einer gemeinsamen Forschung der Abteilung für Gegenwartssprache des Sprachwissenschaftlichen Instituts der Ungarischen Akademie der Wissenschaften, des Lehrstuhls für Ungarische Sprache der Filosophischen Fakultät der Lórand-Eötvös-Universität und des Forschungsinstituts der Slowaken in Ungarn im Rahmen des Projektes Nr. NKFP 5/126/2001 *Bewahrungsmöglichkeiten von Minderheitensprachen*. Das Projekt wurde von Csilla Bartha und Anna Borbély geleitet und ausgearbeitet. Mitglieder des Forschungsteams in Tótkomlós waren: Erzsébet Uhrin, Tünde Tuska, Sándor János Tóth und Mária Zsilák, Mitarbeiter des Forschungsinstituts der Slowaken in Ungarn. Die Untersuchung erfolgte mit der Methode des empirischen Fragebogens, aber auch andere soziolinguistische Methoden spielten eine Rolle, wie etwa direkte Beobachtung, Dokumentensammlung usw. Die Forschungsergebnisse weisen in den Themenbereichen Sprachwahl, Codewechsel, Zweisprachigkeit, Dialektverhältnis, sprachliche Attitüden sowie Stereotypien interessante Zusammenhänge auf.

Die Hauptzielsetzungen des Projektes waren, Grundforschungen über die mögliche Modellisierung der Sprachtauschprozesse, die Möglichkeiten des Spracherhaltes und die Rolle der sprachlichen Prozesse durchzuführen, die die Minderheits- und Mehrheitsattitüden und -stereotypien beeinflussen, sowie fachliche Hilfsmaterialien zu erarbeiten, mit deren Hilfe die Forschungsergebnisse

in der Praxis, vor allen Dingen im Minderheitenunterricht und im Aufbau der Minderheitengemeinschaft zu nutzen sind.

Die allgemein zu beantwortenden Fragen bezüglich der Formen des Sprachtausches und Spracherhaltes:

a) Gibt es allgemeine Zeichen, aufgrund derer im vornherein anzugeben ist, ob in einer gegebenen Kontaktanordnung eine (Minderheiten-) Sprache erhalten bleibt oder ihre Funktion vollständig von einer anderen Sprache übernommen wird?
b) Kann in Fällen, in denen die „Symptome“ des Sprachtausches bereits klar registrierbar sind, irgendeine Prädiktion über die Intensität des Prozesses gemacht werden?
c) Welche gemeinsamen bzw. abweichenden Züge und welche Beeinflussungsfaktoren der sprachlichen und gesellschaftlichen Prozesse in den einzelnen Minderheitengemeinschaften Ungarns gibt es?

Bei diesem Teil unserer Untersuchung versuchen wir, ein Bild über

– die funktionale Arbeitsteilung der beteiligten Sprachen,
– die Verteilung der vom Gesprächspartner, von der Situation und vom Thema abhängigen Sprachwahlmuster unter Lebensalter- und Ausbildungsgruppen sowie Geschlechtern,
– die subjektive Selbsteinschätzung der Gewährsleute,
– die eigenen Attitüden sowie die gegenüber der Mehrheitssprache (Sprachvarianten) und den Sprechern,
– die angegebene Sprachkenntnis der Gewährsleute zu erhalten.

Das Rückgrat der Forschung stellte ein Fragebogen mit 142 Fragen dar, der an ausgewählten Forschungspunkten der deutsch-, kroatisch-, rumänisch-, slowakisch-, bea- und lovarsprachigen Gemeinschaften in Ungarn aufgenommen wurde. Hauptgesichtspunkt bei der Auswahl der Forschungspunkte war, daß in dem betreffenden Ort ein Zwischenzustand der Zweisprachigkeit herrschen soll, weshalb unser Forschungsinstitut Tótkomlós im Siedlungsnetz der Slowaken in Ungarn auswählte. Den Fragebogen füllte der Fragesteller aus, die Gewährsleute antworteten mündlich auf die gestellten Fragen. Die so entstandenen soziolinguistischen Interviews wurden auf Tonband aufgenommen. Ein wichtiges Hilfsmittel der direkten Beobachtung war das Notizbuch, in das die Fragesteller die sprachlichen Umstände notierten, die im Fragebogen nicht vorkamen, aber als wichtig beurteilt wurden. Die statistische Aufarbeitung der Angaben führte András Vargha durch, wonach sie von den Fragestellern analysiert und mit ihren eigenen Erfahrungen verglichen wurden.

Die Forschungsarbeit in Tótkomlós führte eine Forschungsgruppe von vier Sprachwissenschaftlern im Dezember 2003 und Januar 2004 durch. Bei der Organisation der Forschung und der Auswahl der Gewährsleute halfen die slowakische Minderheitenselbstverwaltung vor Ort und die Leiter der slowakischen Organisation. Wir nahmen an den slowakischen Veranstaltungen in der Forschungsperiode teil, die ebenfalls gute Gelegenheiten der persönlichen Datensammlung bezüglich des Sprachgebrauchs der Slowaken und der Zweisprachigkeit waren. Tótkomlós war 1746 von slowakischen evangelischen Siedlern gegründet worden, die am Anfang des 18. Jahrhunderts aus den nördlichen Komitaten des ehemalihen Königreich Ungarn – dem Gebiet der heutigen Slowakei – vor den wachsenden Leibeigenenlasten, der Übervölkerung und der Religionsverfolgung in die Große Ungarische Tiefebene geflohen waren. Die Bevölkerung von Tótkomlós stammt nicht aus einem einzigen Gebiet des slowakischen nördlichen Sprachgebietes, sondern bewegte sich aus den südlichen Gruppen der mittelslowakischen Dialekte nach Süden – fallweise mit Einschluß vorübergehender Interimsaufenthaltsorte – bis an ihren endgültigen Wohnort Komlós. Der heutige slowakische Dialekt von Tótkomlós hat – ebenso wie die schriftlichen Denkmäler – treu die sprachlich/dialektalen Kennzeichen dieser Herkunft aus unterschiedlichen Dialektgebieten bewahrt. Den Dialekt der Tótkomlóser Slowaken beinhaltet auch der Atlas der slowakischen Dialekte in Ungarn (Magyarországi szlovák nyelvjárások atlasza, Fügedi Erik, Gregor Ferenc, Király Péter 1993). Die funktionale Schichtung der Sprache der Tótkomlóser Slowaken und einige Typen der metaphorischen Ausdrucksweise in der Tótkomlóser slowakischen Sprache analysiert Žiláková in ihren Arbeiten (2004). Divičanová (1999, 2002) beschäftigt sich mit den ethnokulturellen Veränderungen in Tótkomlós, sie schildert die Sprach-Kultur-Gemeinschaft und ihr Beziehungssystem. Das Forschungsinstitut der Slowaken in Ungarn hat innerhalb seines soziolinguistischen Projektes *Slowakischer Sprachgebrauch im Kom. Békés* (Uhrinová–Žiláková 2005) in der Stadt ebenfalls eine Untersuchung des Sprachgebrauchs mittels Fragebogen durchgeführt.

13.2 Analyse der empirischen Angaben

13.2.1 Allgemeine Charakteristik der Befragten

Der Sprachgebrauchs-Fragebogen mit 142 Fragen wurde von 70 Gewährsleuten beantwortet. Die Mitglieder der Forschungsgruppe sprachen während der Feldarbeit slowakisch mit den Gewährsleuten. Die slowakischsprachige Kommunikation und der Fragebogen bereiteten der großen Mehrheit der Interviewten keine Probleme, nur einige Begriffe mußten ins Ungarische übersetzt bzw. Inter-

pretiert werden, z. B. *Staatsbürgertum*, *Nationalität*, *Muttersprache*, *Zweisprachigkeit*, deren Bedeutung vor allem die Älteren nicht kannten (vgl. Népszámlálás 2001). Die Vertreter der jüngeren Altersklasse beantworteten die Fragen in mehreren Fällen ungarisch, besaßen aber auch dann sichtlich die passive Sprachkenntnis. Ihre Namen verrieten sämtliche Gewährsleute, woraus geschlossen werden kann, daß man sich nicht mehr zu äußern scheut und daß die Tótkomlóser Slowaken das historische Trauma des Bevölkerungsaustauschs von 1946/47 aufgearbeitet haben. Ihren Namen gaben sie meist slowakisch an, womit sie auch die Zugehörigkeit zu ihrer Nationalität demonstrieren. Wahrscheinlich verwenden sie üblicherweise beide Varianten.

Von den Befragten waren 48,6 % (34) Frauen und 51,4 % (36) Männer, in Tótkomlós geboren waren 85,5 % (59), anderswo 13 % (9) und im Ausland 1,4 % (1), aber auch letztere lebten schon länger als zehn Jahre am Ort. 20–40jährig waren 22,9 % (16) der Gewährsleute, 41–60jährig waren 48,6 % (34) und 61–85jährig 28,6 %. Das Muster verzerrt bewußt, da die hinsichtlich Nationalitätenaktivität und Zukunft determinierendste Schicht der mittleren und jungen Altersklasse überrepräsentiert ist. In der natürlichen Population ist die ältere Altersklasse am zahlreichsten. Von den Intrviewten hatten 44,3 % (31) Grund-, 41,4 %% (29) Mittel- und 14,3 % (10) Hochschulabschluß. Die Mehrheit von ihnen arbeitet in Tótkomlós, 68,1 % (47), nicht tätig sind 23,2 % (16), tägliche Pendler sind 4,3 % (3), am Wochenende nach Hause kommen 2,9 % (2) und seltener als wöchentlich 1,4 % (1).

Die Tótkomlóser Slowaken sind evangelisch, von den Befragten 96,8 % (60), 3,2 % (2) sind Katholiken. Die Kirche besuchen wenige bzw. selten, hauptsächlich aus dem Grunde, daß sie keinen slowakisch sprechenden Seelsorger haben und nur selten Gottesdienste in slowakischer Sprache gehalten werden. *„Zrietka (c)hoďím do kostola, ľebo ňemáme slovenského farára, Erka len zrietka (c)hoďí.“*

Von den Befragten haben 88,2 % (60) slowakisch zuhause gelernt, 11,8 % (8) im Kindergarten und der Schule. Aus diesen Angaben läßt sich folgern, daß der lokale slowakische Dialekt die Muttersprache der Interviewten ist, da sie ihn sich teils oder vollkommen schon in der Kindheit aneigneten. Auch die ungarische Sprache lernten viele der Gewährsleute, 61,2 % (41), zuhause, im Kindergarten und der Schule 38,8 % (26). Aufgrund der Angaben ist anzunehmen, daß von den befragten 70 Personen ca. ein Drittel in einsprachiger slowakischer familiärer Umgebung aufgewachsen ist und zwei Drittel schon wahrscheinlich als Kleinkind mit der ungarischen Sprache in Kontakt kamen und seither in irgendeiner Weise zweisprachig sind.

Die Forscher, die sich mit dem Minderheitensprachgebrauch und der Zweisprachigkeit beschäftigen, können nicht die Problematik des Muttersprachenbegriffes vermeiden (s. Bartha 1999: 151–154; Uhrinová 2004: 20–21). Nach Auffassung von Tove Skutnabb-Kangas kann eine Person hinsichtlich Herkunft und Identifikation sogar mehrere Muttersprachen haben:

Die Muttersprache

- ist von der Herkunft her die als erste gelernte Sprache;
- ist hinsichtlich der Identifikation einerseits die Sprache, mit der sich der Betreffende identifiziert, andererseits die Sprache, mit der er als Muttersprachensprecher identifiziert werden kann;
- ist die dem Grad der Sprachkenntnis nach am besten gesprochene Sprache;
- ist der Funktion nach die am meisten gesprochene Sprache (s. Skutnabb-Kangas 1997: 13).

Diese Bestimmung ist für die Minderheiten sehr sympatisch, da sie sich differenziert dem Problem in seiner Komplexität annähert und die Muttersprachenfrage nicht bloß auf einen Gesichtspunkt reduziert.

Im Spiegel unserer Forschungsergebnisse ist die Muttersprache der Gewährsleute von Tótkomlós das Slowakische, da die meisten von ihnen es sich teilweise oder gänzlich in der Kindheit angeeignet haben. In ihrem Falle ist es also die zuerst gelernte, die Primärsprache. Die andere große Gruppe der Befragten hat das Slowakische während der sekundären Sozialisierung gelernt, hängt aber gefühlsmäßig stark an der slowakischen Kultur und Sprache. Sie identifizieren sich mit der Sprache ihrer Vorfahren, bzw. die Mehrheitsgesellschaft identifiziert sie als Menschen slowakischer Muttersprache. Aber auch auf die Slowaken in Ungarn trifft die Benennung *„ambivalente Muttersprache“* der Terminologie von István Lanstyák zu, dergemäß dieselbe Person den einzelnen Kriterien nach verschiedene Muttersprachen hat und für ihren Sprachgebrauch die Dominanz der Mehrheitssprache typisch ist (Lanstyák 2002). Nach Ansicht von A. Divičanová (1999) hängen die Slowaken in Ungarn in erster Linie gefühlsmäßig an ihrer Muttersprache, der Sprache ihrer Vorfahren. Der Muttersprachengebrauch der Slowaken ist also primär von Gefühlen geleitet und nicht von gesellschaftlicher Notwendigkeit motiviert. Utilitaristische praktische Gesichtspunkte, „Existenzzwang“, gesellschaftlich-ökonomische Herausforderungen und Außenkontakte haben die Herausbildung der Zweisprachigkeit gefördert.

Die Eltern sind bei 84,6 % (55) der Befragten slowakischer Nationalität, bei 15,4 % (10) ist es nur die Mutter bzw. der Vater. Von den Großeltern der Befragten sind bei 80 % (55) alle vier slowakischer Nationalität, drei bei 4,3 % (3), zwei bei 13 % (9). Bei 54,8 % (34) der Befragten ist auch der Ehepartner slowakischer

Nationalität, 29 % (18) berichteten von Doppelbindung, Ungarn sind die von 16,1 % (10). Die Angaben lassen den Schluß zu, daß für die Ehen in Tótkomlós auch heute noch die Endogamie und die intraethnischen Beziehungen typisch sind, wenn sich auch ihre verringernde Tendenz parallel mit dem Erscheinen der Doppelidentität nachweisen läßt. Die große Zahl von Eheschließungen innerhalb der Gruppe trägt auch dazu bei, daß jahrelang, bis in die jüngste Vergangenheit die slowakische Sprache weitertradiert wurde. Zu ihren Trägern wurden auch die Vertreter der jüngeren Generation, wenn auch für sie eher die passive Sprachkenntnis typisch ist.

An den slowakischen Veranstaltungen der Stadt nimmt die Mehrheit der Gewährsleute, 60 % (42), häufig teil, 30 % (21) selten und 10 % (7) nie. 90 % (27) der Befragten sind Mitglied einer slowakischen Organisation oder Gruppe. Viele besuchen regelmäßig die Programme der Slowakenorganisation von Tótkomlós, monatlich 32,3 % (21), bei ein bis drei Gelegenheiten 13,8 % (9), wöchentlich 10,8 % (7), mehrfach 1,5 % (1), niemals 41,5 % (27). Den Angaben gemäß beteiligt sich die Mehrheit, mehr als die Hälfte der Befragten regelmäßig an der Arbeit der slowakischen Organisation, mehr als ein Zehntel sind ausgesprochen aktiv zu nennen, aber bei fast der Hälfte der Befragten steht die Gewinnung, die Aktivisierung noch aus.

Auf die Frage *„Aufgrund wessen fühlen Sie sich als Slowake?“* antworteten 37,7 % (23) *„Weil das meine Muttersprache ist“*, dem folgten bei 29,5 % (18) die Eltern, bei nicht viel wenigeren, 24,6 % (15), die Gemeinschaft als soziolinguistische Variable, und 8,2 % (5) wählten die Antwort *„Weil ich in dieser Sprache spreche“*. Den Antworten ist zu entnehmen, daß bei der Bestimmung dere Identität in Tótkomlós noch immer der Sprachkenntnis, der Muttersprache die größte Rolle zukommt. Ein wichtiger identitätsbestimmender Faktor ist die Herkunft, der familiäre Beweggrund, aber als neues Element erscheint in ähnlichem Maße auch die Gemeinschaft, auf die wahrscheinlich schon die heutige Gemeinschaftsaktivität zurückzuführen ist.

36,4 % (24) der Gewährsleute schätzte die Gesamtzahl der Slowaken in Ungarn auf einige Hunderttausend, dann folgten 33,3 % (22) mit der Schätzung von einigen Zehntausend, danach 13,6 % (9) mit einigen Tausend und 12,1 % (8) mit *„ich weiß nicht“.* Die beiden extremen Antworten von einer Million oder mehr bzw. einigen Hundert wählten verschwindend wenige, 3 % (2) bzw. 1,5 % (1). Es zeigt sich also, daß einerseits die der Realität nahekommenden Schätzungen bei den Befragten typisch sind, andererseits aber auch die Übertreibung und Überschätzung aus Uninformiertheit oder als Ausdruck der Wünsche (aufgrund der Daten der Volkszählung von 2001 leben in der Stadt 6547, zur slowakischen

Nationalität bekennen sich 1159, Slowakisch geben 1175 als Muttersprache an. Mit den slowakischen kulturellen Werten und Traditionen fühlen sich 1370 verbunden).

Den Anteil der Slowaken gegenüber den Ungarn hat man in Tótkomlós schon realer angegeben, 45,7 % (32) nannten konkrete Zahlen, die den Volkszählungs- bzw. den Schätzungsangaben der lokalen slowakischen Organisationen nahekommen (nach den amtlichen Volkszählungsangaben sind 20,8 % der Stadtbewohner Slowaken, nach der Schätzung der Slowakenorganisationen 35–40 %).

Von den Gewährsleuten besuchten 94,1 % (64) die Slowakei, 5,9 % (4) nicht. Aus den Antworten auf die Frage *„Wann waren sie zum letzten Mal dort?“* läßt sich auch ohne genaue statistische Indizes die Folgerung ziehen, daß heutzutage regelmäßige, häufige slowakische Kontakte für die Slowaken von Tótkomlós charakteristisch sind. In die Slowakei reisen 37,9 % (25), zum Verwandtenbesuch. Sie freuen sich darüber, daß sie mit den während des Bevölkerungsaustausches von 1946/47 ausgesiedelten Verwandten nun wieder ohne Angst und politische Behinderungen Verbindung halten können. Einige machten die Bemerkung, daß sie nach der Aussiedlung jahrelang ihre Verwandten nicht sahen und auch die Korrespondenz langwierig, verspätet und zensuriert war. Die Analyse des bis heute nachwirkenden Traumas des Bevölkerungsaustausches und seiner Folgen ist jedoch nicht Aufgabe dieser Studie.

Ausflüge und Urlaubsreisen in die Slowakei unternehmen ebenfalls viele Slowaken aus Komlós, 27,3 % (18); zu anderen Zwecken, im allgemeinen zur Aufrechterhaltung amtlicher Beziehungen, 19,7 % (13); wegen der Aufgabe, irgendwelche Arbeit zu verrichten, 10,6 % (7). In Tótkomlós hat sich erwiesen, daß die Beziehungen zum Mutterland eine durch nichts zu ersetzende positive Wirkung sowohl auf das Identittsbewußtsein als auch auf die Sprachkenntnis haben. Den häufigen Aufenthalt in lebendiger, moderner slowakischsprachiger Umgebung halten wir für einen der wichtigsten spracherhaltenden Faktor, ähnlich den übrigen Möglichkeiten slowakischer Kontakte, wie etwa Gegenbesuche der Partner in Tótkomlós, die ebenfalls gute Gelegenheiten zur Kommunikation und Sprachübung sind.

In der Slowakei sprechen 68,8 % (44) der Gewährsleute slowakisch, viele haben festgestellt, daß die Komlóser Slowaken mit der Kenntnis ihres Dialektes vorzüglich in der Slowakei zurechtkommen. Beide Sprachen verwenden bei ihrem dortigen Aufenthalt 6,3 % (4) und ungarisch sprechen 25 % (16). Auf die Frage, warum sie das tun, beriefen sie sich außer auf mangelnde slowakische Sprachkenntnis auf die ungarischen Sprachkenntnisse der Verwandten und Ungarn in der Slowakei, also darauf, daß sie sich auch auf Ungarisch verständlich machen können.

13.2.2 Sprachwahl

In Tótkomlós sprechen (sprachen) 38,2/36,9 % (26/24) der Befragten mit Mutter/Vater immer slowakisch. Beide Sprachen verwenden in der Kommunikation mit Mutter/Vater 30,9/30,8 % (21/20), immer das Ungarische 17,6/18,5 % (12/12). Allgemein slowakisch sprechen mit den Eltern 11,8/9,2 % (8/6) und allgemein ungarisch 1,5/4,6 % (1/3). Die Angaben lassen die Feststellung zu, daß man mit den Vätern etwas mehr ungarisch spricht als mit den Müttern. Die Waage des slowakischen Sprachgebrauchs neigt sich etwas auf die Seite der Mutter, was wahrscheinlich der Tatsache zu verdanken ist, daß die Mütter der älteren Generation noch nicht im Arbeitsverhältnis standen und deshalb ihre Muttersprache weiter bewahrten bzw. im Familienkreis verwendeten. Beim Vergleich der Tótkomlóser Ergebnisse mit den ähnlichen Indizes aus dem Komitat (Uhrinová-Žiláková 2005) erweisen sich erstere als wesentlich besser, denn die Mehrheit der Befragten im Kom. Békés und in Békéscsaba spricht bereits allgemein ungarisch mit den Eltern, slowakisch nur manchmal (35 %).

Die Analyse der Indizes der Kommunikation mit den Großeltern zeigt ein starkes Ansteigen des slowakischen Sprachgebrauches, was eindeutig bezeugt, daß das Lebensalter als signifikante Variable der Sprachwahl betrachtet werden muß. Die ältere Generation spricht noch regelmäßig slowakisch, bzw. mit ihr wird noch regelmäßig slowakisch geprochen. Im Alltagskontakt mit den mütterlichen/väterlichen Großeltern verwenden (verwandten) 70 %/79,2 % (42) immer das Slowakische, 11,7 %/7,5 % (7/4) das Slowakische und das Ungarische etwa gleich häufig und 10 %/5,7 % (6/3) immer das Ungarische. Allgemein slowakisch sprechen 6,7 %/7,5 % (4/4) mit den Großeltern, im allgemeinen ungarisch 1,7 %/0 % (1/0).

Mit Geschwistern sprechen die meisten bereits immer ungarisch. *„Mojho brata daľi do maďarskej školeˇ, ľebo nazdaľi sa, že takto sa zaobíjďe ľahšie. Vie, rozumie po slovenski, aľe ťažko rozpráva“.* In der Kommunikation mit dem Ehepartner dominiert bei 41,5 % (27) der Befragten ebenfalls das Ungarische. In gleichem Maße verwenden das Slowakische und das Ungarische 21,5 % (14) als Kommunikationsmittel, immer das Slowakische 16,9 % (11), allgemein das Ungarische 15,4 % (10) und allgemein das Slowakische 4,6 % (3).

In der Sprachgebrauchskurve steigt die ungarische Sprache bei der Untersuchung der Kommunikation mit den Kindern weiter stark an. 50,8 % (30) der Gewährsleute sprechen mit ihren Kindern immer ungarisch, nur slowakisch niemand mehr, auch *„Allgemein slowakisch“* gaben nur 3,4 % (2) an. 37,3 % (22) wählen das Slowakische und das Ungarische gleich oft als Kommunikationsmittel,

allgemein ungarisch, manchmal aber auch slowakisch sprechen 8,5 % (5). Ein interessanter, konträrer Zusammenhang läßt sich beim Einfluß von Kindergarten/Schule auf den Sprachgebrauch feststellen. Denn 45,8 % (27) der Befragten kommunizierte auch schon vor dem Kindergarten/Schulbeginn der Kinder nur ungarisch mit ihnen, 35,4 % (15) aber nur slowakisch. Gleich oft slowakisch und ungarisch sprachen 22 % (13), im allgemeinen ungarisch, aber manchmal auch slowakisch 6,8 % (4). Seit die Kinder Kindergarten/Schule besuchen/besuchten, sinken die slowakischen Sprachgebrauchsindizes auf der einen Seite wesentlich, immer slowakisch sprechen nur noch 6,1 % (4) mit ihren Kindern. Auf der anderen Seite ist jedoch ein noch offensichtlicheres Absinken im ungarischen Sprachgebrauch mit den Kindern festzustellen. Die Antwort *„Immer ungarisch“* wurde nur noch von 13,6 % (9) gegeben. Die Zahl derer, die beide Sprachen gleich oft benutzen, stieg auf 34,8 % (23), und auch die der bei Dominanz des Ungarischen manchmal slowakisch Sprechenden auf 45,5 % (30). Die Antwort *„Allgemein slowakisch“* gab keiner der Antwortenden. Diese Angaben lassen darauf schließen, daß Kindergarten/Schule einerseits den ungarischen Sprachgebrauch verstärken, andererseits auch den innerfamiliären slowakischen Sprachgebrauch zu Hause positiv beeinflussen. *„Musíme sa čím viac slovenski rozprávať s ďeťmi, opravovať ich, ľebo (c)hodia do slovenskej školeˮ* äußert einer der Gewährsleute über diese Situation. Aufgrund der Erfahrungen in der Feldarbeit in Tótkomlós ist festzustellen, daß bei den Vertretern der älteren Generation auf Einfluß von Kindergarten/Schule eine Verdrängung des Muttersprachengebrauchs und der Raumgewinn des ungarischen Sprachgebrauchs eingetreten ist, wofür es unterschiedliche Gründe gibt.

In den slowakischen Schulen in Ungarn wurde allerdings nach dem Zustandekommen und dem Ausbau des slowakischen Schulsystems die von Ľudovít Štúr kodifizierte slowakische Literatursprache zur Unterrichtssprache. Die geltenden Lehrpläne berücksichtigten lange Zeit* die tatsächliche Muttersprache der Schüler, den Dialekt, überhaupt nicht. Auch die überwiegende Mehrheit der Lehrer unterstützte ihre Verwendung in der Schule, in den Stunden nicht. Ein spezifischer Zug der Lage des slowakischen Sprachgebrauchs in Ungarn ist des weiteren, daß bis 1948 nur die Grundlagen des Slowakischen und nur der Religionsunterricht auf Slowakisch bzw. in der biblischen tschechischen Sprache gelehrt wurde.

- Die Kenntnis der slowakischen Dialekte in Ungarn schreiben erstmals der 1997 in Kraft getretene NAT (Nationaler Basislehrplan) bzw. die Rechtsnorm *Grundprinzipien des Unterrichts der nationalen und ethnischen Minderheiten* verbindlich vor.

In der Kommunikation mit den Enkeln ist nur eine sehr bescheidene Veränderung zugunsten des slowakischen Sprachgebrauchs festzustellen. Nur slowakisch sprechen mit den Enkeln 4,3 % (3), gleich häufig slowakisch und ungarisch 11,5 % (8), im allgemeinen slowakisch 1,3 % (1), hauptsächlich ungarisch, aber manchmal auch slowakisch 5,8 % (4), nur ungarisch 11,5 % (8). 65,6 % (46) der Gewährsleute haben noch keinen Enkel. Diese geringfügige positive Veränderung ist wahrscheinlich der wachsenden Aktivität der slowakischen Nationalität und dem günstigen gesellschaftlich-politischen Umfeld zuzuschreiben.

„Môj sin a moja dcéra a aj vnučka veďia po slovenski, s ňimi običajne slovenski hovorím. Vnuk ňevie. Veľmi ma boľí, že vnuk ňevie po slovenski. a másik példa *Moje ďeti sa v škôľki naučiľi po slovenski. Jedna dcéra maturovala v slovenskom gimnáziu a druhá teraz (c)hoďí na jazikoví kurz. Vnučka na univerziťe si ťiež vibrala slovenskí jazik. Vnuk (c)hoďí do slovenskej školeˮ. Na moje otázke maďarski odpovedá. Spieva, tancuje, aľe hovoriť ňechce.“* Die überwiegende Mehrheit der jüngeren Generation gehört nach der soziolinguistischen Terminologie schon zur Gruppe der sog. remembers (s. Bartha 1999: 128), viele von ihnen eignen sich, wenn sie keine slowakische Schule besuch/t/en, die slowakische Sprache nicht vollkommen an, verstehen sie aber noch ein wenig. Sie sind in der Lage, gebundene lexikalische Einheiten zu verwenden und weiterzugeben, z. B. Namen von Speisen, wie *májaška, hurke, mozgóčka*, Grußformeln, Lieder, Redewendungen oder Reimsprüche. Beim Ausfüllen der Sprachgebrauchs-Fragebögen mußten ihnen mehrere Fragen ins Ungarische übersetzt werden.

Wenn die Gewährsleute ihrem slowakischen Lehrer begegnen, sprechen 55 % (33) slowakisch mit ihm. Mehrere fügten hinzu, daß sie dies auf jeden Fall mit den slowakischen Gastlehrern tun, die auch ihrer Meinung nach wichtige Faktoren des Spracherhaltes sind. Gleich häufig slowakisch und ungarisch sprechen 26,7 % (16) mit ihnen, im allgemeinen slowakisch 5 % (3), hauptsächlich ungarisch, aber manchmal auch slowakisch 1,7 % (1), nur ungarisch 11,7 % (7).

Auf die Frage *„In welcher Sprache sprechen Sie mit ihrem eigenen Pastor?“* antworteten 38, auf die Frage *„In welcher Sprache sprechen Sie mit den Mitgläubigen in der Kirche, mit den Gemeindegliedern vor oder nach der Zeremonie?“* 39. Von den Kirchenbesuchern sprechen 68,4 % (26) mit dem Pastor nur ungarisch, gleich häufig slowakisch und ungarisch 21,1 % (8), nur slowakisch 5,3 % (2), hauptsächlich slowakisch, aber manchmal auch ungarisch ebenfalls 5,3 % (2). Vor und nach der Zeremonie sprechen mit den Mitgläubigen bereits mehr slowakisch: nur slowakisch 35,9 % (14), im allgemeinen slowakisch, aber manchmal auch ungarisch 17,9 % (7), gleich häufig slowakisch und ungarisch 15,4 % (6),

hauptsächlich ungarisch, aber manchmal auch slowakisch 7,7 % (3), nur ungarisch 23,1 % (9).

43,3 % (26) der Befragten sprechen mit den Nachbarn gleich häufig slowakisch und ungarisch, nur ungarisch 36,7 % (22) – vor allem mit der Begründung, der Nachbar sei Ungar. Nur slowakisch kommunizieren 11,7 % (7), vor allem slowakisch, manchmal aber auch ungarisch 6,7 % (4), im allgemeinen ungarisch, aber zuweilen auch slowakisch antwortend 1,7 % (1).

Mit ihren Freunden und Bekannten sprechen 33,8 % (23) der Gewährsleute nur slowakisch, gleich häufig slowakisch und ungarisch 27,9 % (19), vor allem slowakisch, manchmal aber auch ungarisch 11,8 (8), im allgemeinen ungarisch, aber zuweilen auch slowakisch antwortend 7,4 % (5). Nur ungarisch kommunizieren 19,1 % (13).

Wenn aber auch Ungarn anwesend sind, kommunizieren in Gesellschaft 52,2 % (36) nur ungarisch, damit, wie sie begründen, auch diese verstehen, was gesprochen wird. Bei solchen Anlässen sprechen gleich häufig slowakisch und ungarisch 23,2 % (16), nur slowakisch 8,7 % (6), vor allem slowakisch, aber manchmal auch ungarisch ebenfalls 8,7 % (6), im allgemeinen ungarisch, manchmal aber auch slowakisch 7,2 % (5).

Mit im Rathaus tätigen Slowaken verhandeln nur ungarisch 39,7 % (27), nur slowakisch 29,4 % (20), gleich häufig slowakisch und ungarisch 19,1 % (13), im allgemeinen ungarisch, aber zuweilen auch slowakisch 5,9 % (4), vor allem slowakisch, manchmal aber auch ungarisch ebenfalls 5,9 % (4). Mehrere hielten es für notwendig zu betonen, daß im Rathaus wenige Slowaken beschäftigt seien und sie mit den Mitgliedern der slowakischen Minderheitenselbstverwaltung im allgemeinen slowakisch sprechen.

Am Arbeitsplatz kontaktieren 27,4 % (17) ihre slowakischen Kollgen gleich häufig in slowakischer und ungarischer Sprache, nur slowakisch 24,2 % (15), nur ungarisch ebenfalls 24,2 % (15), im allgemeinen slowakisch 12,9 % (8), im allgemeinen ungarisch, aber zuweilen auch slowakisch 11,3 % (7). Diese Angaben zeigen, daß es in Tótkomlós immer noch die slowakische Sprache am Arbeitsplatz gibt, aber mit Ausnahme der Unterrichtseinrichtungen ganz sicher nur in informellen Gesprächssituationen.

Obige Folgerung wird auch durch die im Laden benutzte slowakische Sprache gestützt, wo nämlich 34,4 % (22) der Befragten immer slowakisch sprechen. Beide Sprachen benutzen bei Einkäufen 12,5 % (8), allgemein slowakisch 3,1 % (2), allgemein ungarisch 7,8 % (5). Die größte Anzahl spricht aber dennoch in den Läden ungarisch: 42,2 % (27).

Keine Probleme bereitete der entscheidenden Mehrheit von 97,1 % (66) der Befragten, daß sie mit dem Arzt nicht slowakisch reden konnten, 2,9 % machte dies Probleme. Einer der Gewährsleute ergänzte: *Keď sme mali aj takého doktora, ktorí veďel aj po slovenski zhovárali sme sa aj po slovenski ňie o chorobe, ale o tom ako sa máme, čo robíme, čo sme variľi. Nájdu sa aj takí, ktorí veďia slovenski.* Diese Bemerkung spiegelt gut die Funktion und Arbeitsteilung von slowakischer und ungarischer Sprache wider.

Trifft man sich in der Stadt, so dominiert die slowakische Sprache: 40,6 % (28) sprechen immer slowakisch miteinander. *„Radujeme sa, že sa môžeme zhovárať slovenski“* (Wir freuen uns slowakisch sprechen zu können), sagte einer der Antwortenden. In gleichem Maße verwenden 26,1 (18) das Slowakische und das Ungarische als Kommunikationsmittel, im allgemeinen slowakisch, manchmal aber auch ungarisch sprechen 7,2 % (5), im allgemeinen ungarisch, zuweilen aber auch slowakisch 2,9 % (2), nur ungarisch 23,2 % (16).

An den Veranstaltungen der Slowakenorganisationen sprechen 48,9 % (22) immer slowakisch, vor allem slowakisch, manchmal aber auch ungarisch 24,4 % (11), gleich oft slowakisch und ungarisch 15,6 % (7), im allgemeinen ungarisch, manchmal aber auch slowakisch antwortend 4,4 % (2). Nur ungarisch kommunizieren bei diesen Anlässen 6,7 % (3). Auch aus diesen Antworten geht hervor, daß die regelmäßigen slowakischen Programme neben der Stärkung des Identitätsbewußtseins gute Anlässe für die Pflege der Muttersprache, für die slowakischsprachige Kommunikation und dadurch wichtige Faktoren des Spracherhalts sind.

Die folgenden Punkte des Fragebogens waren auf die Automatismen gerichtet. Die Intimsphäre ist ein wichtiger Schauplatz des Sprachgebrauchs, da dort – bei Berücksichtigung auch der Ergebnisse der Psycholinguistik – Automatismen wirken, die verraten, wie sehr die slowakische Sprache „im Innersten“, im Unterbewußten lebt. Auch nach Skutnabb-Kangas' Muttersprachenbestimmung spielen die Automatismen eine große Rolle. Aufgrund einer seiner Bestimmungen betrachtet er diejenige als Muttersprache, in der man zählt und denkt.

Zwar ist im Unterbewußtsein der Tótkomlóser Gewährsleute die slowakische Sprache noch vorhanden, doch ist die Dominanz der ungarischen Sprache vorherrschend. 44,6 % (25) der Befragten träumen in ungarischer Sprache, 30,4 % (17) in beiden Sprachen gleich häufig, immer slowakisch 10,7 % (6), im allgemeinen ungarisch, manchmal aber auch slowakisch ebenfalls 10,7 % (6), überwiegend slowakisch, manchmal aber auch ungarisch 3,6 % (2). *„Slovenski sa mi sníva o minulosťi o roďine“* sagte ein Gewährsmann.

Auf die Frage *„In welcher Sprache beten Sie für sich?“* antworteten 40,5 % (15): ungarisch. Immer slowakisch beten 35,1 % (13), in beiden Sprachen gleich häufig 18,9 % (7), im allgemeinen ungarisch, manchmal aber auch slowakisch 2,7 % (1), überwiegend slowakisch, manchmal aber auch ungarisch ebenfalls 2,7 % (1).

55,1 % (38) zählen Geld in ungarischer Sprache. Gleich häufig slowakisch und ungarisch zählen 29,0 % (20), immer slowakisch 8,7 % (6), im allgemeinen ungarisch, manchmal aber auch slowakisch 7,2 % (5). Die Mehrheit der Befragten lernte die vier Grundrechenarten Addieren, Substrahieren, Multiplizieren und Dividieren ungarisch in der Schule. Auch dieses Faktum beeinflußt den hohen Anteil des Gebrauches der ungarischen Sprache. 50,0 % (27) der Befragten fluchen in beiden Sprachen gleich häufig, ungarisch 37 % (20), im allgemeinen ungarisch, manchmal aber auch slowakisch 9,3 % (5), immer slowakisch 3,7 % (2).

Aufgrund der statistischen Analyse der Angaben sind vor allem das Lebensalter und die sprachliche bzw. Nationalitätenidentität als stark signifikante Variable zu betrachten. Eindeutig ist der Zusammenhang zwischen dem Lebensalter, der sprachlichen bzw. Nationalitätenidentität und dem Sprachgebrauch der Befragten. Die Älteren sprechen mehr slowakisch als die Jüngeren. Wer über ein stärkeres sprachliches und Nationalitätenidentitätsbewußtsein verfügt, kommuniziert häufiger und lieber in der Muttersprache. Dieses Ergebnis belegen auch andere Untersuchungen des slowakischen Forschungsinstitutes (ausführlicher s. z. B. bei Divičanová 1999, 2003; Zsilák 2004; Tuska 2008; Tóth 2005, 2007; Uhrinová 2005 usw.).

13.2.3 Sprachwissen

Die folgende Fragengruppe war auf die Selbstbewertung der Sprachkenntnis der Gewährsleute gerichtet: sie mußten ihre slowakischen Sprachfertigkeiten von 1 bis 5 bewerten. Die slowakischsprachigen Zeitungen verstehen 44,3 % (31) der Befragten leicht und qualifizierten ihr Textverständnis als 4, mehr oder weniger gut verstanden 24,3 % (17), sie qualifizierten ihr Textverständnis als 3, alles vollkommen verstanden 15,7 % (11), ihre Qualifizierung lautete 5. Schwer verstehen die slowakische Pressesprache 12,9 % (9), ihre Bewertung lautete 2, überhaupt nichts verstanden 2,9 % (2), die also ihr Textverständnis als 1 bewerteten. Mehrere bemerkten, daß ihnen die Sprache der einzigen slowakischsprachigen landesweiten Wochenzeitung zu schwer ist, vor allem wegen der vielen Fremdwörter.

Die ungarischsprachigen Zeitungen verstehen 90 % (63) der Untersuchungsteilnehmer vollkommen, so daß sie ihr Textverständnis mit 5 bewerteten, 10 % (7) verstehen sie leicht, bewerteten das Textveständnis also mit 4.

Den Tótkomlóser slowakischen Dialekt sprechen aufgrund ihrer Selbstbewertung 50 % (35) vollkommen und bewerteten ihre Sprechfähigkeit mit 5; 25,7 % (18) sprechen ihn leicht, bewerteten sie also mit 4, mehr oder weniger können ihn 17,1 % (12) und bewerteten sie mit 3, nur schwer sprechen ihn 5,7 % (4) und bewerteten sie also mit 2.

Ihre Kenntnis der slowakischen Literatursprache bewerteten 40,6 % (28) mit 3, verstehen sie also mehr oder weniger, leicht sprechen sie 24,6 % (17) und bewerten dies mit 4. Die Zensur 2 gaben sich 15,9 % (11), sprechen sie also nur schwer, und gar nicht können sie 10,1 % (7), gaben sich also die Zensur 1. Für vollkommen halten die eigene slowakische Literaturprachenkenntnis nur 8,7 % (6).

Die Mehrheit von 80 % (56) der Untersuchungsteilnehmer spricht vollkommen ungarisch und bewertet die Sprachfertigkeit mit 5, leicht sprechen es 18,6 % (13) und beurteilen dies mit 4, mehr oder weniger beherrschen es und mit 3 beurteilen dies 1,4 % (1).

Auch aufgrund der Selbsteinschätzung ist festzustellen, daß man heute in Tótkomlós die ungarische Sprache am besten beherrscht und die slowakische Standard-, die normative Literatursprache am wenigsten.

Von den in Tótkomlós an der Forschung Beteiligten sprechen 55,1 % (38) slowakisch und ungarisch gleich gern; sie sind in der Lage, in beiden Sprachen auf entsprechendem Niveau zu kommunizieren, für sie ist die Doppelbindung typisch. Lieber ungarisch sprechen 29,1 % (20) – wie sie begründeten, weil sie das Ungarische viel besser beherrschen. Lieber slowakisch sprechen 15,9 % (11), sie sind die Vertreter der älteren Generation.

58,6 % (41) der Gewährsleute sprechen meistens ungarisch, beide Sprachen gleich häufig verwenden 28,6 % (20), mehr slowakisch sprechen 12,9 % (9). 90 % (63) der Befragten lesen ungarisch, 10 % (7) lesen slowakisch und ungarisch gleich häufig. Die statistischen Angaben beweisen, daß das Geschlecht keinen signifikanten Einfluß auf die Sprachkenntnis hatn.

13.2.4 Veränderungen in der Muttersprache und Mehrheitssprachengebrauch

Auf die Frage *„Welche Sprache steht Ihnen am nächsten?“* gaben 55 % (38) beide Sprachen, 15 % (11) die slowakische und 29 % (20) die ungarische an. Das ist ein auf starke Doppelbindung hinweisendes Ergebnis. Das Prestige der Standard-, d. h. der in der Slowakei verwendeten Sprachvariante scheint auf den ersten Blick

größer zu sein, denn fast 70 % (47) halten diese Sprachvariante für schöner, was allerdings durch die Schwierigkeit der Literatursprache (Fragen 65 und 67) für 80 % (54) überschattet wird. In Tótkomlós wird ein in sehr archaischer Form erhalten gebliebener mittelslowakischer Dialekt gesprochen, der ursprünglich zu den der Literatursprache zugrunde liegenden Dialekten von Liptó und Túróc gehört, aber dem heutigen Standardslowakischen in Zeit und Raum fernsteht. Ein großer Teil der Leute in Tótkomlós hält den eigenen Dialekt für einen Wert, erkennt aber den Primat der Literatursprache an – die auch in der lokalen Schule unterrichtet wird. Den eigenen Dialekt und das Slowakische in der Slowakei hält man für ungefähr gleich nützlich: Die Antwort auf die Frage *„Welche Sprache ist nützlicher?“* hing zum großen Teil davon ab, ob der Antwortende in Lokalrelationen dachte oder allgemein. Im ersten Fall ist der Komlóser Dialekt der nützlichere (26 %, 17), denn wenn im Ort slowakisch gesprochen wird, ist in lockerer Kommunikationssituation auf jeden Fall dieser die nützlichere Sprache. Andererseits steht das Slowakische als Literatursprache und als in der Schule unterrichtete Sprache im Vordergrund (43 %, 28). 30 % der Gewährsleute (20) halten beide Sprachvarianten für gleich nützlich. Beim vierten Element der Fragenreihe über die Beurteilung des slowakischen Dialektes und der Literatursprache *„Welche Sprache lieben Sie mehr? Die in Komlós oder die in der Slowakei gebrauchte?“* kehrt sich das Verhältnis um: gegenüber dem zuerst – vermutlich aufgrund äußerer, rationaler Gesichtspunkte – für schöner gehaltenen Literaturslowakischen lieben 61 % den Lokaldialekt mehr, was auf eine starke gefühlsmäßige Bindung hinweist.

Bei der Analyse der mit der ungarischen Sprache zusammenhängenden Attitüden ist es sinnvoll, auf die Angaben im vorigen Kapitel zurückzuverweisen. Von den Antwortenden können 12–15 % jene sein, die die slowakische Sprache eindeutig für die ihnen näherstehende halten und sie auch am häufigsten benutzen. Die gefühlsmäßige Bindung und die Praxis des Alltagslebens spiegeln sich auch in den Antworten auf Fragen 69–72. Die slowakische Sprache empfinden auch jene als schöner, die alle beide oder das Ungarische für nützlicher halten. Fast die Hälfte der Befragten (48 %) konnte nicht eindeutig entscheiden, welche Sprache sie mehr lieben. Ob die slowakische oder die ungarische Sprache als schwerer empfunden wurde, hing davon ab, ob die Antwort aufgrund der eigenen Sprachkenntnis oder allgemeiner grammatischer Gesichtspunkte gegeben wurde. Die Antworten darauf waren ausgeglichen: Etwa 30 % (20) halten das Slowakische für schwerer, etwa ebenso viele das Ungarische und die übrigen beide für gleich schwer. Allgemein ist die Ansicht, die sich sehr signifikant aus den Antworten auf die Frage *„Machen sie sich durch die slowakische Sprache in der Welt leichter verständlich oder durch die*

ungarische?“ ergibt: Die slowakische Sprache ist im ausländischen Sprachgebrauch weit nützlicher als die ungarische (47 % vs. 8 %).

Die Zusammenhänge zwischen Alter und sprachlichen Attitüden wurden mit dem Korrelationsverfahren untersucht. Der älteren Generation steht die slowakische Sprache näher, sie ist noch in ihr aufgewachsen. Die in der Slowakei benutzte Sprachvariante ist für sie schwerer, weil sie keine Beziehung zu ihr hatten und haben. Einige haben auf ihren Slowakeireisen erlebt, daß sie aufgrund ihrer Aussprache für dortige Ungarn gehalten und dementsprechend aufgefordert wurden, nicht ungarisch zu sprechen. Auch das in der Schule unterrichtete Literaturslowakische halten die Ältesten für schwierig und berufen sich darauf, daß sie die slowakische Sprache ihre Enkel „nicht verstehen“. Des weiteren machten ihnen einige Ausdrücke des Fragebogens Schwierigkeiten. Die Älteren schätzen sehr signifikant das Slowakische mehr als das Ungarische und halten es auch für schöner, doch ist die Beurteilung der Nützlichkeit und Schwierigkeit vom Alter unabhängig, es sind rationalere Gesichtspunkte. Ebensowenig ist vom Alter der Antwortenden abhängig, daß sie in der Welt mit dem Slowakischen besser zurecht kommen als mit dem Ungarischen.

Der Einfluß des Geschlechtes auf die untersuchten sprachlichen Attitüden: Unter den Männern gibt es mehr, denen das Ungarische schwerer fällt als das Slowakische. Das verhält sich nicht deshalb so, weil sie besser slowakisch könnten und ihnen die Aneignung des Ungarischen schwer fiele, sondern weil sie das Ungarische für ein vom Indoeuropäischen scharf abweichendes grammatisches System halten. Viele antworteten so auf diese Frage, als müsse ein Slowake das Ungarische wie eine Fremdsprache lernen. Die Frauen lieben das Slowakische etwas mehr, aber die Mehrheit schätzt beide Sprachen gleich. Dieses Ergebnis wird nur scheinbar vom Geschlecht beeinflußt, der wirkliche Grund ist im Bereich des Alters und der Beschäftigung zu suchen (eine große Menge von Lehrerinnen unter den Befragten).

Die Männer sind hinsichtlich der Codemischung großzügiger, sie halten sie für natürlich, wogegen die vielen Pädagogen unter den Frauen diese Erscheinung zu vermeiden suchen. Die Männer gingen und gehen häufiger in andere Orte zur Arbeit, kommen also mehr mit dem Ungarischen in Kontakt. Diese beruflichen Unterschiede beeinflussen die abweichenden sprachlichen Attitüden der Geschlechter. Nach der Varianzanalyse (Vargha 72) beeinflußt das Alter die sprachlichen Attitüden viel stärker als das Geschlecht.

Die angegebene Häufigkeit des Sprachgebrauchs hängt an mehreren Punkten mit den sprachlichen Attitüden zusammen, was dadurch begründet ist, daß die häufigen Benutzer des Slowakischen über das Verhältnis zum Dialekt und zum

Ungarischen eine markantere Ansicht haben können. Es ist evident, daß jemandem, der das Slowakische häufiger benutzt, diese Sprache und vor allem der Tótkomlóser Dialekt näher stehen. Die Männer halten zudem das Slowakische für nützlicher als das Ungarische, vor allem hinsichtlich des Zurechtkommens in der Welt.

Die Sprachkenntnis beeinflußt die Attitüden in ähnlicher Weise wie der Sprachgebrauch. Je besser jemand slowakisch spricht, ob nun die Liteatursprache oder den Dialekt, um so näher steht ihm das Slowakische. Auch die Mehrheit derer, die das Literaturslowakische gut sprechen, halten die Sprache von Tótkomlós für schöner, für gleich nützlich und schwer. Diese Gruppe bezeichnet beim Vergleich des Ungarischen und Slowakischen letzteres als geschätzter und schöner, allerdings ist die Sprachkenntnis interessanterweise hinsichtlich Nützlichkeit und Schwierigkeit nicht signifikant. Ungarisch sprechen alle Befragten gut, sie heben die Nützlichkeit des Komlóser Dialektes und die Schwierigkeit der slowakischen Sprache hervor.

Der Mehrheit derer, die sich als der slowakischen Nationalität zugehörig bezeichneten, steht die slowakische Sprache näher, doch ist der Unterschied nicht signifikant. Der Häufigkeitstabelle gemäß ist Muttersprache bzw. Nationalität von ca. 70–70 % (46–48) slowakisch, bei 84 % (55) sind beide Eltern Slowaken. Aufgrund der Korrelationsuntersuchung beeinflußt die slowakische Muttersprache die sprachlichen Attitüden stärker als die deklarierte Nationalität. Die sich selbst als slowakisch muttersprachlich deklarierten, halten das Slowakische für schöner und lieben es mehr – vor allem die Frauen: auch hier erhöhen die vielen Pädagogen die Indizes, ebenso wie bei den sich als Slowaken Bezeichnenden, wogegen die Männer sich weniger für ihre Muttersprache begeistern. Die slowakische Herkunft der Eltern erhöht zwar etwas die Achtung des Slowakischen, da aber in Tótkomlós fast alle aus einer slowakischen Familie stammen, zeigt das keinen signifikanten Unterschied und kann nicht als zuverlässige Vergleichsbasis dienen.

Das Bild über die Ungarn des Ortes und seine Zusammenhänge mit den sprachlichen Attitüden wurde mittels der korrelativen Gegenüberstellung der Fragen *„Wie verhalten sich die Ungarn gegenüber den Slowaken?“* und *„Haben Sie das Empfinden, daß sich heutzutage das ungarisch-slowakische Verhältnis geändert hat?“* und der Fragen bezüglich der sprachlichen Attitüden gemessen. Über die Ungarn am Ort gaben 69 % (48) eine positive Antwort, 29 % (20) äußerten sich neutral, und die Zahl negativer Stereotypien war minimal. Ebenso gestaltet sich der Prozentsatz nach der Häufigkeitsverteilung ebenso wie in bezug auf die Slowaken in der Slowakei. Unter denen, die eine ausgesprochen gute Meinung von den Ungarn hatten, lieben viele die ungarische Sprache mehr als die slowakische.

Zu den Slowaken in der Slowakei haben 80 % (56) der in Tótkomlós Befragten ein gutes Verhältnis, 20 % (14) äußerten sich neutral, negative Stereotypien zeigt der Fragebogen nicht. Dieses gute Verhältnis spielt eine positive Rolle bei der Beurteilung der slowakischen Sprache: Das Prestige der Sprachvariante in der Slowakei ist höher als das des Komlóser Dialektes, und das Slowakische schätzen jene mehr als das Ungarische, die die Slowaken in der Slowakei lieben. In bezug auf die Stereotypien sind noch einige ergänzende Dinge zu nennen, die in den Notizheften enthalten sind. Die Bewohner von Tótkomlós erwiesen sich als sehr tolerant gegenüber jeder Art von Minderheit, einschließlich der Gehörlosen und Zigeuner. Sie wünschten, daß es überall so ordentliche Zigeuner gebe wie in Komlós. Früher (in den Jahrzehnten nach dem Bevölkerungsaustausch) war das ungarisch-slowakische Verhältnis gespannter, aber das haben Zeit und Generationswechsel geglättet. Während das Verhältnis zu den einzelnen Nationen aufgrund des Fragebogens vorzüglich genannt werden kann, zeigen die Tendenzen, die in Frage 115 eruiert wurden (*„Haben Sie das Empfinden, daß sich heutzutage das ungarisch-slowakische Verhältnis geändert hat?“*), ein gemischtes Bild: 58 % (39) antworteten mit Nein, 23 % (16) meinten, es habe sich geändert, während 17 % (12) äußerten, es habe sich verschlechtert. Dazu ist allerdings zu bemerken, daß einige Antwortgeber an die lokalen Verhältnisse dachten, andere dagegen an das von den Medien vermittelte politische Verhältnis, wodurch das Bild gemischt wirkt.

13.2.5 Sprachliche Attitüden im Zusammenhang mit Spracherhalt, Sprachwechsel und Sprachkenntnis

Von den Befragten haben 88,2 % (60) slowakisch zuhause gelernt, 11,8 % (8) im Kindergarten und der Schule. Aus diesen Angaben läßt sich folgern, daß der lokale slowakische Dialekt die Muttersprache der Interviewten ist, da sie ihn sich teils oder vollkommen schon in der Kindheit aneigneten.

In Bezug auf den Spracherhalt finden sich markante Ansichten: Die Mehrheit der Befragten besteht darauf, daß die Kinder slowakischer Herkunft das Slowakische lernen, die slowakische Sprache bewahren und, wenn sie ein Teil der slowakischen Kultur werden wollen, slowakisch können müssen. Doch wird die Methode abgelehnt, daß die Slowaken im Interesse der Bewahrung ihrer Sprache untereinander heiraten sollen; nur ein Drittel hat die Besorgnis, daß die Kinder gemischter Ehen nicht slowakisch können werden. Der Grund dafür mag sein, daß in Komlós schon die dritte und vierte Generation lebt, die aus gemischten Ehen stammt, und es keine schlechten Erfahrungen gibt. Die gemischte Ehe stellte auch damals keine Gefahr für den slowakischen Sprachgebrauch dar, als Tótkomlós noch

ein rein slowakischer Ort und die traditionelle Volkskultur lebendig war. Wenn damals ein junger Ungar in die Familie kam, lernte er slowakisch und assimilierte sich. Heute aber ist es nicht mehr so, doch bemerkt man wegen der alten Bräuche nicht die Möglichkeit und Gefahr der Assimilation. Zwei Drittel der Befragten meint, daß in Ungarn die Slowaken nicht verachtet werden und daß das Nationalitätengesetz die Lage der Minderheiten verbessert.

Den Sprachwechsel spüren alle in Tótkomlós markant: Die überwiegende Mehrheit der Antwortenden war der Meinung, daß die Jugend weniger slowakisch spricht als die Alten, die es zudem besser sprechen. Der Häufigkeitstabelle nach antworteten auf die Fragen *„Sprechen die jungen Leute in Komlós weniger slowakisch?“* und *„Sprechen die Alten in Komlós besser slowakisch?“* antworteten mehr als 91 % bzw. 98 % (64 bzw. 67) mit Ja. Auch die Älteren sind dieser Meinung. Es wurden auf die Frage 77 nur fünf Nein-Antworten gegeben, mit der Begründung, daß sich die Jugend in der Schule die slowakische Literatursprache aneignet und somit besser slowakisch spricht als die Alten. Nach eindeutiger und übereinstimmender Aussage der Befragten wurde früher mehr slowakisch gesprochen als jetzt.

Die Attitüden der Alten im Zusammenhang mit dem Spracherhalt sind pessimistischer: Sie lebten noch in der Zeit, als in Tótkomlós das Slowakische das natürliche Kommunikationsmittel des Alltags war, und daren gemessen zeige der heutige Sprachzustand eine Tendenz zum Niedergang. Die Jüngeren sehen die Bemühungen der Schule und der Minderheiten-Selbstverwaltung um den Erhalt der slowakischen Sprache bzw. sind an ihnen beteiligt, weshalb sie einen Verlust dieser Sprache in Tótkomlós weniger befürchten. Ob die Kirchgänger besser bzw. mehr slowakisch sprechen, wurde nicht so einhellig beantwortet. Von den regelmäßigen Kirchgängern nehmen die übrigen Gewährsleute an, daß sie zu 63 % (37) mehr und besser slowakisch sprechen als die Nichtkirchgänger, aber das ist vor allem dem Lebensalter zuzuschreiben. Einen slowakischen Pastor gibt es in Komlós nicht, evangelischer Gottesdienst in slowakischer Sprache findet nur an größeren Festen statt und wird von Gastpredigern gehalten. Daraus folgt, daß die spracherhaltende Funktion des kirchlichen Lebens gering ist.

Ein signifikantes Merkmal in der vergleichenden Tabelle der Attitüden im Zusammenhang mit dem Spracherhalt ist, daß nach Meinung der Männer die Kinder aus gemischten Ehen nicht slowakisch sprechen werden. Das steht im Widerspruch dazu, daß man keinen Ungarisierungseinfluß der gemischten Ehen befürchtete; dennoch hält man das gegenseitige Heiraten ungeachtet dessen für keine gute Lösung, daß mit einem Ende der slowakischen Sprache nur 22 % (15) in Komlós rechnen, während 78 % (53) optimistisch sind und den Erhalt der slowakischen

Sprache voraussagen. Die Männer sind bezüglich des Spracherhalts nach der zweidimensionalen Häufigkeitstabelle pessimistischer als der Durchschnitt.

Die Ansicht derer, die Schulen durchlaufen haben, bestätigt nach den Angaben der χ-Quadrat-Probe die obigen Angaben: Auch ihre Antwort auf die Frage, ob die Älteren mehr und besser slowakisch sprechen als die Jugendlichen, ist ein signifikantes Ja. Nicht signifikant ist der Zusammenhang zwischen der Schulbildung ud den Attitüden des Spracherhalts. Auf die Frage *„Wer spricht in Komlós am schönsten slowakisch?“* antworteten viele, daß es die Lehrer sind, was darauf schließen läßt, daß die Schulbildung also doch zu den positiven Beeinflussungsfaktoren des Spracherhalts zu rechnen ist.

Die Nationalität des Ehepartners hängt folgendermaßen mit den Attitüden über die Sprachkenntnis zusammen: Bei denen mit slowakischer Ehefrau ist der Prozentsatz derer höher, die glauben, daß die Frauen mehr bzw. besser slowakisch sprechen als die Männer. Die Nationalität des Ehepartners kann die Sprach-erhaltsattitüden aus der Sicht der gemischten Ehen beeinflussen, worauf oben schon eingegangen wurde.

Die Identität (Muttersprache und deklarierte Nationalität) beeinlußt die Attitüden über die Sprachkenntnis insofern, als jene, die ihre slowakische Mutter-sprache bzw. Nationalität deklariert haben, signifikant der Ansicht sind, daß die Alten besser und mehr slowakisch sprechen als die Jugendlichen. Das andere Element der Identität, die Nationalität der Eltern, modifiziert des Bild an anderer Stelle: Von denen mit slowakischen Eltern sind mehr der Ansicht, daß die Kirchgänger mehr/besser slowakisch sprechen.

Die Mehrheit derer, die sich selbst bewußt als Slowaken mit slowakischer Muttersprache deklarieren, gehört zu den Älteren. Das hat zum Ergebnis, daß ihre Attitüde über den Spracherhalt mehr vom Alter als von der Nationalität beeinflußt wird. Die sich nicht für Slowaken halten, aber slowakische Familien- und Sprachbindung besitzen, sind weniger pessimistisch hinsichtlich der Zukunft der slowakischen Sprache in Komlós als die „echten slowakischen“ Alten, die die Stufen der Assimilation erlebt haben.

13.2.6 Attitüden im Zusammenhang mit der Bildung und Schule

88 % der Gewährsleute von Tótkomlós äußerten, die ungarische Sprache sich zu Hause angeeignet zu haben, nur 12 % in der Schule. Das erlaubt die Folgerung, daß mit Ausnahme der ältesten Generation, die noch nicht die ungarische Sprachkenntnis von zu Hause mit in die Schule brachte, fast jeder zu Hause ungarisch lernte.

Der Schauplatz der Aneignung des Slowakischen verteilt sich im Verhältnis 60 % zu 40 % zwischen Elternhaus und Schule, aber mit nicht mehr so überzeugender Mehrheit zugunsten des ersteren wie im Falle des Ungarischen. Das bestätigt die Feststellung der Pädagogen, wonach die Schule die Rolle der Weitergabe der slowakischen Sprache von der Familie übernimmt und Slowakisch als Fremdsprache lehrt. Dies bezieht sich auf die Jüngeren, die zu 60 % aus dem Elternhaus mitgebrachte Sprachkenntnis ist für die Älteren typisch. Die meisten Leute in Tótkomlós sind also in zweisprachiger Umgebung aufgewachsen. Auf die Attitüden über die Zweisprachigkeit hat auch diese Frage keinen signifikanten Einfluß, sie bestätigt nur die Meinung, daß man vom Zweisprachigen keine Kenntnis beider Sprachen auf Muttersprachenniveau erwartet und als Voraussetzung der Zweisprachigkeit den regelmäßigen Sprachgebrauch zugrunde legt. Das Element der Identität, daß die Eltern Slowaken waren, hat die Zweisprachigkeitsattitüden beeinflußt: Diejenigen, deren Eltern Slowaken waren, erwarten eher die Kenntnis beider Sprachen auf Muttersprachenniveau – da sie ja aus einer solchen familiären Umgebung stammen.

Bezüglich der Bildung enthält der Fragebogen drei Fragen: *„Welche Schriftsteller* bzw. *Musik lieben Sie mehr?“* (slowakische oder ungarische) bzw. *„Welcher Hymnus steht ihrer Seele am nächsten?“* Im weiteren wird untersucht, in welcher Beziehung Lebensalter (aufgeteilt in drei Abschnitte), Geschlecht, sozioökonomischer Status (Schulbildung) und das Maß des Lernens in der Nationalitätenschule zu den obigen kulturellen Attitüden steht. Die empirischen Angaben werden mittels mathematischer statistischer Methoden ausgewertet (Vargha 2000).

Ein interessanter, konträrer Zusammenhang läßt sich beim Einfluß von Kindergarten/Schule auf den Sprachgebrauch feststellen. Denn 45,8 % (27) der Befragten kommunizierte auch schon vor dem Kindergarten/Schulbeginn der Kinder nur ungarisch mit ihnen, 35,4 % (15) aber nur slowakisch. Gleich oft slowakisch und ungarisch sprachen 22 % (13), im allgemeinen ungarisch, aber manchmal auch slowakisch 6,8 % (4). Seit die Kinder Kindergarten/Schule besuchen/besuchten, sinken die slowakischen Sprachgebrauchsindizes auf der einen Seite wesentlich, immer slowakisch sprechen nur noch 6,1 % (4) mit ihren Kindern.

Je älter eine Tótkomlóser slowakische Person ist, sie sich um so mehr den slowakischen Schriftstellern verbunden fühlt, die slowakische Musik liebt. Die Jüngeren fühlen sich ungarischer Musik, Schriftstellern und der ungarischen Hymne stärker verbunden. 69,6 % (48) der Befragten antworteten, *„Ich liebe die Schriftsteller beider Nationen gleich“*, 27,5 % (19) *„die ungarischen“* und 2,9 % (2)

„die slowakischen Schriftsteller". Auf die Frage *„Welche Musik lieben Sie mehr?"* nannte ebenfalls die Mehrheit, 64,3 % (45), beide gleich, 20 % (14) die der Minderheit und 15,7 % (11) die ungarische Musik. Die *„Bindung an die Hymne"* gestaltet sich folgendermaßen: 58,6 % (41) fühlen sich mehr mit der ungarischen Hymne, 35,7 % (25) mit beiden gleich und 5,7 % mit der slowakischen Hymne verbunden (zu diesem Thema s. Kiss Gy.).

Im obigen Zusammenhang scheint Anna Gyivicsáns Feststellung wichtig zu sein, Tótkomlós sei eine jener slowakischen Siedlungen im Süden der Großen Ungarischen Tiefebene, für die das Dreischichtenmodell typisch ist. Das bedeutet, daß die mit der slowakischen Sprache verbundenen kulturellen Elemente in der hohen, der kirchlichen und der Volkskultur vorhanden sind (Divičanová 1993). Die älteren Gewährsleute erinnern sich noch an den in Tótkomlós zwischen 1907 und 1946 tätigen Amateur-Theaterspielkreis. Viele waren auch selbst Mitglieder. 108 slowakische klassische und zeitgleiche Schauspiele wurden aufgeführt. Die Auswahl der Stücke, die Regiearbeit der Aufführungen und die Leseproben trugen viel zu einem regen slowakischen Kulturleben bei und spielten eine wichtige Rolle bei der Bewahrung der sprachlichen Traditionen.

Die Schulbildung dient dazu, die Frage zu klären, ob sich irgendeine Wirkung dieses Faktors auf die erwähnten kulturellen Attitüden feststellen läßt. Bei den Frauen hat die Schulbildung die Antworten überhaupt nicht beeinflußt, aber bei den Männern war bei der Frage nach ihrer Vorliebe für Schriftsteller festzustellen, daß die besser gebildeten Gewährsleute die slowakischen Schriftsteller angaben. Vermutlich ist dies darauf zurückzuführen, daß die mit niedrigerem Schulabschluß die slowakische Literatur nicht kennen.

Die Häufigkeit des slowakischen Sprachgebrauchs wird auch für die slowakische Schule verlangt: Viele fügten ihrer Antwort auf den Fragebogen noch die Bemerkung hinzu, in der Schule müßten die Kinder mehr slowakisch sprechen als das Minimum in der Unterrichtsstunde.(dazu s. Tóth 2005).

Auf die Frage *„Wer spricht in Komlós am schönsten slowakisch?"* antworteten viele, daß es die Lehrer sind, was darauf schließen läßt, daß die Schulbildung also doch zu den positiven Beeinflussungsfaktoren des Spracherhalts zu rechnen ist. Ein großer Teil der Leute in Tótkomlós hält den eigenen Dialekt für einen Wert, erkennt aber den Primat der Literatursprache an – die auch in der lokalen Schule unterrichtet wird.

Die Frage *„Wie viele Jahre haben Sie in der slowakischen Nationalitäten-schule gelernt?"* hat keinen gültigen statistischen Wert, so daß in den Analysen der Zusammenhang zwischen dem Unterricht in der Nationalitätenschule und den kulturellen Attitüden auch nicht statistisch ausgewertet ist. Das ist zu bedauern, da

auch meine eigenen Erfahrungen belegen, daß die Nationalitätenschulen sehr wohl eine Rolle sowohl beim Bekanntmachen der slowakischen Kultur als auch des Slowakenbildes der Tiefebene und eventuell seiner Liebgewinnung spielen.

Zusammenfassend ist zu sagen, daß es bei den Tótkomlóser Slowaken keine signifikante Beziehung von Geschlecht und Lebensalter zu den Vorurteilen bzw. Stereotypien gibt. Einzig die Schulbildung hat die Antworten beeinflußt, und zwar dominant im negativen Zusammenhang. Je höher die Schulbildung war, desto positiver war die Meinung über die Minderheiten der Umgebung. Meiner Ansicht nach ist diese Angabe nicht überraschend, da wir auch bei anderen sozialpsychologischen Untersuchungen oft die Erfahrung machen, daß die Besserausgebildeten im allgemeinen toleranter, nachsichtiger sind.

Zusammenhang zwischen Häufigkeit des Sprachgebrauchs und Stereotypien bzw. Vorurteilen: 58,6 % (41) der Befragten benutzen das Ungarische am meisten, 28,6 % (20) nutzen beide Sprachen geteilt, gleich häufig und 12,9 % (9) die Minderheitensprache, also das Slowakische, häufiger. Es ist festzustellen, daß die Benutzer der Minderheitensprache das Verhältnis der Ungarn zu den Slowaken positiver beurteilen als jene, die mehr ungarisch sprechen.

13.3 Zusammenfassung

Aufgrund der Forschungserfahrungen ist festzustellen, daß sich die slowakische Gemeinschaft von Tótkomlós entsprechend unserer vorausgehenden Hypothese inmitten des Sprachtausches – im Kontinuum des Spracherhaltes – in einer Zwischenphase vor der Zweisprachigkeit befindet. Nach der von Csilla Bartha (Bartha 1999: 123–129) vermittelten soziolinguistischen Fachliteratur über die Sprachtauschtypen befinden sich die Tótkomlóser Slowaken im Prozeß des stufenweisen Sprachtausches. Daneben konnten in dieser slowakischen Gemeinschaft aber auch gewisse spezifische Merkmale des von oben nach unten verlaufenden Sprachtausches und eine Reihe von im Interesse des slowakischen Spracherhaltes durchgeführten konkreten Maßnahmen beobachtet werden.

Die empirische Untersuchung stützte den slowakischen Sprachgebrauch und die Existenz des Slowakischen in Tótkomlós unter den Befragten in der Untersuchungsperiode mit konkreten Fakten. Die Dominanz der ungarischen Sprache auf allen Kommunikationsebenen ist unbestreitbar. Für das Slowakische ist die Rolle der Sekundärsprache bezeichnend, und zwar in unterschiedlichem Maß und Qualität auf den einzelnen Schauplätzen des Sprachgebrauches. In Tótkomlós ist die slowakische Sprache auch heute in allen drei Basisschichten der Kultur

vorhanden und in Gebrauch, jedoch stark differenziert in den einzelnen Kommunikationssphären. Für den Zustand der Tótkomlóser slowakischen Sprache ist wie für die in Békescsaba (s. Uhrinová 2005) die entgegengesezt doppeltgerichtete Bewegung der gleichzeitigen Entwicklung bzw. Rückentwicklung bezeichnend. Auch dieser Zustand, die Sprachsituation der Zweisprachigkeit, belegt Anna Borbélys Folgerung „Obgleich Sprachtausch und Spracherhalt entgegengesetzt gerichtete Prozesse sind, sind sie dennoch, wenn auch im Leben einer Gemeinschaft in unterschiedlichen Maße, gleichzeitig vorhanden." (Borbély 2001). Die stufenweise Verdrängung der slowakischen Sprache kann in Tótkomlós in der Privatsphäre und im kirchlichen Leben verfolgt werden. Und in der Hochkultur verbreitet sie sich immer weiter, erscheint in wieder neuen Bereichen, wie den Medien, der Kultur, der Verwaltung und dem öffentlichen Leben. Doch ist dabei zu bemerken, daß dieser Sprachgebrauch zuweilen formal, von symbolischem Wert ist und darin den formalen, rituellen Kontexten des Sprachtausches von oben nach unten ähnelt. Bei der vorliegenden Untersuchung hat sich bestätigt, daß sich die funktionelle Schichtung und Umschichtung der slowakischen Sprache in ein und derselben Periode stufenweise erweitert und verengt. In Kenntnis der Untersuchungsergebnisse kann einerseits die funktionelle Entwicklung, der Prozeß der Sprachvervollkommnung, die Erweiterung der Funktionen und des Gebrauches der Tótkomlóser slowakischen Sprache auf den verschiedenen Schauplätzen des Sprachgebrauchs konstatiert werden. Andererseits ist für sie eine Zweisprachigkeitsdynamik bezeichnend, die durch die von Generation zu Generation abnehmende muttersprachliche und die in umgekehrter Relation wachsende Kompetenz der Mehrheitssprache charakterisiert ist.

Mária Žiláková ist bei ihrer Untersuchung der Entsprechung der kommunikativen und kognitiven Funktionen der slowakischen Sprasche in Ungarn zu der Folgerung gelangt, daß sich diese grundlegenden sprachlichen Funktionen vor allem wegen der Dominanz der ungarischen Sprache nur beschränkt verwirklichen, verwirklichen können (s. Žiláková 2004b) – eine These, deren Wahrheit sich auch in Tótkomlós erwiesen hat. Der Einfluß des Ungarischen erstreckt sich auf alle Ebenen der Tótkomlóser slowakischen Sprache von der Lautlehre bis zur Textstruktur. Die Untersuchung hat bestätigt, daß sich bei der primären Sozialisierung noch viele die slowakische Sprache in Tótkomlós aneignen. 67,6 % (46) erklärten, ihre Muttersprache sei das Slowakische. Eine andere Gruppe der Befragten hat während der sekundären und zuweilen der tertiären Sozialisierung slowakisch gelernt. Bei denen, die als Muttersprache das Slowakische angaben, kann allerdings vor allem schon von gefühlsmäßiger Identifizierung gesprochen werden. Das bestätigen auch jene 19,1 % (13), die beide Sprachen als Mutter-

sprachen angaben. Die Angaben belegen, daß bei der überwiegenden Mehrzahl die slowakische Sprache – allerdings mit kleineren oder größeren Schwierigkeiten – die Aufgabe der sprachlichen Kommunikation in mehreren Bereichen des gesellschaftlichen und Privatlebens versieht. Dabei muß aber betont werden, daß dies eine Diasporazweisprachigkeit ist, eine Diglossie in Relation zum Slowakischen in der Slowakei und zum Ungarischen in Ungarn.

Die Forschungsergebnisse haben unsere Hypothese bestätigt, wonach die slowakische Sprache, wenn auch unterschiedlich in Maß und Qualität, in Tótkomlós in allen Kommunikationssphären vorhanden und in Gebrauch ist. Zwar ist an sämtlichen Schauplätzen des Sprachgebrauchs der Gebrauch des Ungarischen dominant, aber auch die Existenz der slowakischen Sprache ist aufgrund der Antworten deutlich nachzuweisen. Die konkreten Ergebnisse zeigen, daß es Schauplätze des Sprachgebrauches gibt, in denen der Sprachtausch beschleunigt vor sich geht. Das zeigte sich sehr nachdrücklich in zwei Fällen: in der Privatsphäre und im kirchlichen Leben. Die slowakische Sprache, genauer der Lokaldialekt, wird noch in der Familie gesprochen, von einer Generation zur anderen ist aber eine ständig abnehmende Slowakischsprachigkeit typisch.

Der wichtigste Spracherhalt/Sprachtauschfaktor ist für die Befragten der Unterricht. Sie erwarten die Aneignung der slowakischen Sprache und Kultur von der Schule, da die meisten Familien nicht mehr – oder nur zum Teil – in der Lage sind, ihren Kindern das sprachliche und kulturelle Erbe ihrer Vorfahren weiterzugeben, zu tradieren. Bei der Erhaltung der slowakischen Minderheit in Ungarn und der Verlangsamung der Assimilation spielen auch nach den Ergebnissen anderer Forschungsprojekte unseres Institutes die Pädagogen und Unterrichtseinrichtungen die entscheidende Rolle (s. Uhrinová 2005). Die Schule, das Schulnetz wurde zu einem Faktor, zur wichtigsten Determinante, die die Gegenwart und Zukunft der Slowaken entscheidend bestimmte. Hier erhält der aus der Minderheit stammende Schüler außer Kenntnissen ein Verhaltensmuster, das auch sein Erwachsenenleben beeinflußt, ein Muster seines Verhältnisses zur Kultur und Sprache seiner eigenen Minderheit – oder er erhält diese nicht. In Tótkomlós gibt es einen slowakischen Minderheitenkindergarten und eine zweisprachige Schule, in denen sich die Zahl der Kinder und Schüler erfreulich erhöht. Eine für den Spracherhalt wichtige Initiative der Schule ist auch der seit dem Schuljahr 1997/1998 bestehende Sprachkurs für frühere Schüler und Erwachsene. Das Interesse an der Schule und ihren Angeboten zeigt das wachsende Prestige der slowakischen Sprache und Kultur in Tótkomlós.

Den Einfluß der Schule verstärken und dem Erhalt der slowakischen Sprache und Kultur dienen die Institutionen, Organisationen, kulturellen Gruppen des Ortes, die weitere wichtige Faktoren des Spracherhaltes sind. Seit 1994 existiert ständig die slowakische Minderheitenselbstverwaltung. Aus dem Interview mit dem Vorsitzenden der Selbstverwaltung sollen hier einige Details zur Illustrierung der den Sprachgebrauch fördernden Maßnahmen und Pläne stehen: *„Snažíme sa organizovať viac slovenských programov, aby si tunajší Slováci uvedomili spolupatričnosť, svoje miesto. Pokúsime zapojiť mládež, spolupracujeme s Organizáciou slovenskej mládeže v Maďarsku. Plánujeme dvojjazyčné názvy ulíc, aspoň tu v centre. Do miestnej (mestskej) televízie, by sme chceli slovenského spolupracovníka. Do miestnych novín dve strany. Rozšíriť a obnoviť školu. Sprevádkovať Regionálny kultúrny centrum, založiť regionálny spolok.“*

Seit 1987 arbeitet die Organisation der Tótkomlóser Slowaken und in ihr der Slowakische Klub Pávakör (Pfauenkreis). Bei den Klubbeschäftigungen und vom Klub organisierten Veranstaltungen, bei den Proben wird im allgemeinen slowakisch gesprochen, aber wegen der ungarischen Mitglieder – Ehepartner, Verwandte und Freunde – wird alles auch ins Ungarische übersetzt. Die Leitung und Mitglieder des Slowakischen Klubs haben beschlossen, die slowakischen Schauspieltraditionen von Tótkomlós wiederzubeleben, und haben eine Theatergruppe gebildet. Die slowakische Sprache ist in den lokalen Medien anwesend, der Komlóser Kurier enthält regelmäßig auch eine slowakische Beilage, und das städtische Fernsehen strahlt ebenfalls regelmäßig Programme in slowakischer Sprache aus.

Zusammenfassend kann festgestellt werden, daß wir unter den den Sprachtausch verlangsamenden und den Spracherhalt fördernden Faktoren heute den machtmäßig/politisch/ideologischen Verhältnissen und innerhalb dieser der Sprachenpolitik/Sprachplanung (language planning) die größte Rolle zusprechen (Bartha 1999: 197–205). Neben den Rechtsnormen haben das Unterrichtssystem und sonstige Minderheiteninstitutionen bzw. -organisationen bestimmende Bedeutung. Die positive, unterstützende Einstellung der slowakischen Familien ist auch heute eine Grundvoraussetzung für den Erhalt der Nationalitätensprache und -kultur. Den Prozeß des Sprachtausches verlangsamen (möglicherweise) in großem Maße die vielfältigen fachlichen, Verwandtschafts- und Freundschaftsbeziehungen mit anderen slowakischen Orten in Ungarn und der Slowakei. Der slowakische Linguistikprofessor Miroslav Dudok in der Wojwodina nennt Familie, Schule, Organisationen, Kirche usw. – also die für den Erhalt der Nationalitäten determinanten Institutionen – pulsierende Vektoren der Minderheitenexistenz (Dudok 2004), die er auf der Ebene der Abstraktion auch als sprachliche Universalien charakterisiert.

Die ambivalente slowakische Sprachentwicklungstendenz in Ungarn, in Tótkomlós ist ein Beweis, daß man mit günstigen politischen Entscheidungen in Ungarn bzw. im Vater-, im Sprachland, mit einem minderheitenfreundlichen Umfeld und der aktiven Funktionsübernahme der Betroffenen auch die Entwicklung des Sprachgebrauchs der Nationalitäten fördern kann. Mit einer Ausweitung der gesellschaftlichen Funktionen und Aufgaben bildet die Sprache weitere Schichten, entsprechend der neuen Funktionen entstehen neue sprachliche Schichten. Unsere Forschungsgruppe konnte sich von einem natürlichen, parallelen Zusammenleben der beiden Kulturen und Sprachen überzeugen.

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14 SCIENCE EDUCATION – FORMAL VERSUS INFORMAL EDUCATION

Zuzana Václavíková

Abstract

Systematic science education within the territory of the Czech Republic is approximately 250 years old. During this time there were many different educational models that reflected the needs of society, reacted to technical development and adapted to current didactic trends. We are currently entering the period when it is difficult to combine demands of a large volume of needed information and knowledge with the time allocated for science subjects in the educational process. One of the possible solutions is to look for potential in combining the formal and informal education via appropriate cooperation between schools and institutions of informal education. This chapter includes examples of activities connecting both levels of education which can be rather simply implemented into the educational process.

Key words: science education, Kids and Science, LARP game, creative science.

History

Science education in a global sense is approximately 350 years old; nevertheless, the first 100 years of that education was not systematic. During this period lots of paradigms and different views were applied on what to learn and how to learn science with best results. Reforms reflected the needs of society and technical development as well as new scientific results.

Systematic education in the Czech Republic dates back to 1774 (Felbiger law); natural sciences then used to include mathematics, geometry, and natural history only. The content focused primarily on practical applications and information was passed on in a descriptive manner without the use of empirical methods of learning. Later on, in 1930s, along with the establishment of universal technical schools, natural science education was mainly devoted to students who were preparing themselves for the career of traders and craftsmen.

In 1849 the natural science education was strengthened within the secondary education by the Exner-Bönitz reform. Due to the technical development and rapid growth of theoretical knowledge in the field of natural sciences, the second half of the 19th century experienced a increased gap between the

development of natural science and the education in the same field. That led to new opinions on methods of education from the point of both content and methodology. In 1869 the Hasner act determined the compulsory eight-year schooling; educational curriculum involved information in physics, chemistry, mineralogy, geology and other natural science fields. Education, although strengthened from the quantitative point of view, stayed at its descriptive level with respect to practical use of information. Modern standpoint to education in the field of natural science appears only at the end of the 19th century and at the beginning of the 20th century due to the industrial revolution, new findings in the field of physics and chemistry and due to the movement of educational reformism, too. Discussion concerning the child-centered approach started and a basis for science curriculum was formed. As for the primary education, diverse approaches were differentiated – on one hand, an interdisciplinary approach which was oriented to the study of nature in the vicinity in a very simplified form; on the other hand, an approach which was oriented to the transfer of information from the field of natural science theory without a research approach, using mathematical apparatus and the development of abstract thinking. In the 1920s a pragmatic paradigm was applied; this paradigm brought a departure from teaching facts to teaching with respect to a practical use. After the Second World War a polytechnic paradigm appeared; it was regarded to as the “golden age" of science education in terms of both the range of subject matter and the position of natural science subjects in the overall education. Polytechnic paradigm discontinued the child-centered approach and replaced it by an approach with a strong appeal to content, professionalism, scientific theories and principles. This era was then followed by a humanistic paradigm and scientific paradigm in the natural science education. The humanistic paradigm resulted in a significant reduction in the science subjects content; education focused on skills in reading, mathematics and communication. On the contrary, the scientific paradigm continued in the polytechnic approach; it promoted a high level of abstraction and mathematization. In the 1980s both of these paradigms fell into a crisis and further development reflected the attempt to search for the very goals of the natural science education. (see 1.) In the course of its entire development various opinions were changing in terms of both the content and teaching methods and roles of a pupil and teacher in the teaching process. Recent rapid growth of scientific knowledge and incredibly fast development of technology carried the attempt for the fastest possible transport of information and its acquisition by pupils, first. Later on, bearing in mind the fact that the natural science subjects may never include really everything, there appeared the question of what is important and how to efficiently implement the

information into the teaching process. First level stays with the creation of a suitable model of probably a multidisciplinary character (see 1. or 4.); the second level concerns with finding the way for incorporating the new model to the lowest level – into the school education as such. No matter whether we admit it or not, the level of natural science education does not depend only on a set model and curriculum but also, to a large extent, on the quality level of teachers. To adapt to a new generation means to include new trends even into the education of future teachers. Goal of this paper is not to describe current condition on a global scale but to introduce ideas that can be incorporated into the education exactly in the level of teaching natural science subjects and to show the potential of informal education.

New student: digital generation

Standing on the threshold of a new digital generation, we struggle with adapting the teaching methods to “digital students” who have completely different interests than students used to have long ago. It is obvious that a thorough understanding of scientific theories is inevitable for a student's further development in the field of natural science and, thus, for obtaining a certain level of knowledge; more - seemingly different - areas often intermingle. This is applied not only in the intuitive level but also with an adequate mathematical apparatus. Disadvantage of the modern development is a total lack of the need to make use of one's own knowledge and skills in everyday life. The thing which used to be a sufficient inspiration in the past for gaining a student’s interest in a particular field needs to be replaced by artificial elements today. Once subjugated by the serial production, we do not produce anything manually at home, do not breed livestock, do not plant flowers. We purchase majority of things which we need for our living in the form of finished products. Almost nothing is repaired because that is more expensive than acquiring a new product. Young generation perceives devices and technology around us as a “black box” which can be controlled by a single button. It is needless to know what is inside and how the device works. It is not designed for “home improvements” any more. In case of its malfunction it is more economical to throw the device away and purchase a new one than to try to understand the principle of its design, to identify the trouble and to make the effort to repair it. The same approach is applied by the service sector where a repair includes replacing the non-functioning items for new ones, without searching for the cause of the problem. Detection of a non-functioning part is usually carried out on a basis of a digital control with a clear outcome in the form of specific information.

Urbanization is the thing that separates us from the true nature and we perceive only its city's "substitute". We replace real experiences by virtual experiences. Schools offer an infinite number of prefabricated devices in classes; actually, they require no creativity and, unfortunately, often even no knowledge either. Although one of the main competences which we require from our students is the work with information, they are not forced to obtain them by observing the world around them, they do not need to write the information down, they do not need to classify the information as most of that is performed by appropriate software instead of them. Generally, we do not devote sufficient space to the confrontation of the obtained information with reality because the confidence in the saying "what is written, it is given" is strongly entrenched. In the course of the modern computer era we teach both our students and us to lose a headless confidence in what we read. We learn to look for the truth by reflecting the reality in our perception. Although the education is often understood as the activity spent on school grounds within the schooling, it is necessary to realize that we receive a large amount of knowledge, skills and experience in everyday life. Modern technology has brought us immensely higher quality of life on one side; on the other side, it has deprived us of many opportunities to explore the real world around us and to receive knowledge using our own experiences. Equally to the changing personality of a student, it is also necessary to create a new personality of a teacher and new educational environment.

Uniformity versus individuality

The historical context leads us to the conclusion that in future it will be impossible to make the education uniform regardless to the diversity, individual abilities and skills of particular students. However, it is impossible to give precedence to the individual approach over other groups of students. Even the issue of determining a "talent" is perceived absolutely distinctly in different countries. Systematic classification into the groups of above-the-average students, or below-the-average students does not work, and neither does the concept of a full integration of individuals into distinct groups. Although the time possibilities within the formal education are very limited, it is necessary to seek activities which make use of the talent and abilities of each of the students to its full extent and in the field which is dominant for them. This could be achieved by mutual interconnection of natural science fields and by seeking multidisciplinary topics, as well as by their intermingling with other fields – social science, humanities, etc. The team work of students that provides space for each of them and enables them to

develop individual interests and needs must be encouraged. It is essential to react to current facts where the way from a new idea to its practical usage represents a long process which only rarely involves just a single person today. Then the result usually includes cooperation of several teams from the introduction of a new discovery, via finding its utilization in practice and its technical design up to appropriate marketing in the commercial sector. Students also need to be prepared in this spirit. They need to be taught not to perceive their classroom as a potential competitive environment but as a space where an appropriate use of individual abilities can lead to better results.

As it may not be assumed that it would be useful to significantly reduce the content of natural science subjects in future and neither may be assumed that the number of lessons would be significantly enhanced, it is high time to make use of the potential of the informal education via a properly set cooperation between schools and institutions of informal education.

Potential of informal education

Concerning the field of natural science, institutions of informal education include particularly Science learning centers and Discovery centers. Science learning centers and Discovery centers are institutions focusing on popularization of natural and technical sciences. In the Czech Republic, as well as in many other European countries, they are established primarily by the European Union funds. Their goal is to bring the science closer, in a playful way, to stimulate the interest in these fields, to offer experiences and opportunities to explore natural laws and processes through interactive displays. It is the interactiveness that should ensure experiences strong enough with the educational impact; however, the issue of the interactiveness has often been discussed at present. Formally, the concept of an interactive display device or an interactive activity determines an object or an activity which evokes the involvement of multiple senses and intensifies perceptions and experiences of users (either a student or a visitor of the center). It addresses users in emotional, physical and intellectual levels. The interactivity degree should reflect the power of experience which is offered to the user. Many people conceive an interactive display device as a subject which can be moved with, can be analyzed, assembled, or activated in any other way. Nevertheless, the content of the word “interactive” is not as easy as it seems. If one considers it more deeply, it is even possible to speak about something interactive when speaking about a picture that is static as it evokes sensory perception sometimes at even a higher level than many display devices that are moving; but they are not really of

the user's interest. Even modern multimedia technologies can lead to an incorrect understanding of the essence of interactivity. A product is sometimes referred to as interactive only for the reason that it can be operated by simply touching it. However, if it does not require any degree of creativity or implementation of students' knowledge, such product can be considered worthless in education. The interactivity can sometimes be intensified by an appropriate support activity – if a student knows how to work with the device, what to take notice of, how to penetrate the essence of it, then the device or an activity may acquire an entirely new dimension. To design a good interactive device or to propose an interactive activity or an interactive educational material is very difficult. It is necessary to find a balance between an adequate "openness" of an interactive element, ensuring safety, minimizing the time demands and maximizing the educational effect at the same time. Thanks to today's technologies we have many new tools enabling us to achieve the above goals; nevertheless, we have to keep in mind the fact that the virtual communication differs from the real social contact and so do the virtual experiences that are much different from the real experiences. Particularly, in terms of the multimedia applications, we must pay attention whether the activity really requires the involvement of students' senses, whether it makes them think, and whether it provides worthwhile experiences that underline the educational goal in the field which the animation, digital game, or other multimedia activity is determined to. The offer of today's teaching materials reflects, to a certain extent, problems of the gap between authors on one hand and educators on the other hand. Designers who design display devices, activities and teaching materials, cannot often see deeper – into the real educational process; they are not familiar with the real knowledge of students and they often lack sufficient didactic knowledge. On the contrary, teachers do know what would usefully complement the educational process, but they lack abilities, skills and finances to carry out such activities. Solution can be seen in a mutual cooperation between them and in a peaceful interconnection of the formal and informal education. This is the right way for getting the students' interest and showing them how to make use of their acquired knowledge.

Ecsite as a connecting point

Cooperation between schools, universities as institutions providing education to future teachers and Science centers is nothing new in Europe and it has been working successfully for already more than two decades. They are associated by the Ecsite organization. The Ecsite is the European network of science

centers and museums, linking science communication professionals in more than 400 institutions in 50 countries. This organization was founded 20 years ago and connects member institutions through projects and activities and facilitates the exchange of ideas and best practice on current issues.

Members include science centers, discovery centers and museums, science festivals, natural history museums, zoos, aquariums, universities, research organizations and companies communicating and engaging the public in science through accessible, interactive exhibits and programs.

One of the many events organized by the Ecsite is the Annual conference. It annually attracts more than thousand participants from all over the world. During the conference, current issues concerning the science education are discussed in over 70 sections; participants share their experience in the field of cooperation with schools and they present new ideas. Science centers are rather new in the Czech Republic and schools only learn to use them. Nevertheless, thanks to the interconnection via the Ecsite, their offer really reflects current world trends in natural science education. (See www.ecsite.eu)

Activities and programs

Many different methods and activities which try to popularize natural sciences and to encourage educational goals of natural science subjects in this sense are currently being applied. Some of those that are carried out, for instance the World of Technology Ostrava in cooperation with educators of all types of schools in the Moravian-Silesian Region, are going to be described below. Being a part of the informal education, these activities can afford to respect all the above mentioned rules:

- it offers an individual approach to each student with a strong emphasis on collaboration,
- it brings a real experience in the interactive form,
- it makes the student implement his knowledge, skills and abilities from different, not just natural science, fields,
- it retains playfulness and its entertaining way.

Your idea - Kids and Science

It is a unique license of the Netherlands Kids and Science Foundation focusing on the development of technical knowledge of primary school students. The so called “Inventor class” is a week program determined for the whole class

with exact time planning and fixed goals – to make inventors out of the students in 7 days and to introduce them with the entire process starting from having an idea, via a prototype production up to an appropriate marketing campaign (see www.kidsandscience.org). The program is managed by specially trained animators who are familiar with the methodology to carry out the whole week. The week starts with the mutual introduction and with setting the rules which need to be strictly observed. The animators introduce students with some famous inventions from everyday life that incurred randomly or by mistake or accident as for instance the commonly used “Post-it” notes, velcro fastening and some others.

For instance the Post-it notes, which are easily found in every household and every office today all over the world, present an example of the fact that a dead end street of the development opens the way to a treasure. We are grateful to Spencer Silver for the existence of such notes; he worked as a developer of adhesives in a laboratory for the 3M company in 1968. However, the adhesive which he developed was useless as it almost did not stick. Several years later his colleague used that adhesive flop to make bookmarks into the hymn books for a church choir. He needed a bookmark which would not slip down and would be easy to be moved somewhere else. He made pieces of paper coated by the Silver's adhesive on one side and the product experienced an unexpected success. The purpose of introducing such accidental inventions is to show students that sometimes just a fairly simple idea might lead to a successful invention. They can even become inventors themselves. On the first day, animators also present some commercially successful inventions of other students who have already taken part in this program. Motivational topic of the first phase is “look around you, think of what works and what does not work as you would like it to, suggest what could be improved”. The task that the students take home with them is to look around at home or in their surroundings and find one thing which would deserve to be improved somehow, which does not work as they would like it to work. It means that students must explore their surroundings, think over usefulness of individual objects and search for causes of problems. Next day, they present the chosen object to classmates in the form of a single poster and the class chooses 10 ideas out of all which they are going to support. They form three-member groups and prepare a plan developing the idea and a design for the prototype production. In this phase, the animators cooperate with the teacher in dividing students into the groups. The teams should be as balanced and equitable as possible. However, it is impossible to divide students by command because the team work would not be performed spontaneously. The innovation is starting. During the rest of the week, the teams are involved in the prototype production as such. This production can be

carried out in school workshops if there are any at the school or a classroom can be temporarily adjusted for this purpose. It is important to let the students work independently, just to supervise their safety at work. During the production phase, the animators flexibly provide professional experts if the students need to consult some parts. They also ensure the purchase of all aids and material required. Under the guidance of animators students are motivated to think the product over not only from the point of its construction/production but also from the point of its future users, its design, product durability, energy and material demands of the production and usage, safety. And last but not least, they must also discuss appropriate marketing strategy. The program ends by an Idea Market meeting with the representatives of both companies and academic sphere. The evaluation includes the best idea, best presentation, interesting use of material, etc. In case of really original ideas the animators then provide consultancy in the field of intellectual property.

The World of Technology Ostrava bought the license at the beginning of the year 2012 and since then the program has involved about 700 students from various schools in the Moravian-Silesian Region. Ideas of students varied a lot, from very simple ones and easy to be carried out up to abstract visions of the future. We can mention the example of an idea with solar panels on airplanes which could reduce the costs of air transport. In this case, only a model was made in the production phase not the prototype itself.

Figure 1 Idea with solar panels and their authors

There has also been rather an innovative idea – implementation of GPS navigation into an electric wheelchair. Authors of this idea found it useful for better orientation in a city/town but also for searching for a suitable barrier-free path to

move from one place to another. Students, while developing their own projects, could also picture how many other partial factors need to be solved – for example to add the identification of barrier-free access into the GPS maps, etc. Another interesting idea was also a Swinging chair inspired by a common activity – swinging in a chair. Do you often swing in a chair and sometimes fall down? These problems are over - the chair is added, at the bottom, with two small additional legs which function as a stop. It is fascinating to observe how subjective the perception of the world by a student is and how strongly a student can be influenced by his/her environment, society and interests of his/her closest environment. A student who has no disabled person in his/her surrounding would hardly come up with the idea to improve a wheelchair.

Figure 2 Design of swinging chair with the authors

It is necessary to emphasize the fact that many ideas require addressing some specialists in a certain field, ensuring consultancy with professionals which is something that a school is not able to provide. On the other hand, institutions of informal education have sufficient personnel and financial background in this area as well as contacts to the commercial sector. Therefore, the cooperation with them is almost inevitable. In the "Inventor class" program the biggest emphasis is placed on bringing the idea to its end. Without the full support of the idea and without providing a helping hand in its development, its educational meaning as such would disappear.

The Kids and Science presents international know-how encouraging independent technical creativity of children based on pillars Explore-Research-Innovate. In terms of topics, activities are not limited at all – ideas from various fields can be presented; it provides space for the cooperation among students; it also lets other students shine – the ones that are less proficient in knowledge but

they are, for example, manually skilled. Ideas do not end in the imaginary level but the teams must realize their ideas during the week; they must bring their idea to the end, to cope with various problems which they can run into during the production phase. There is a need for a strong cooperation within a team and, due to the week time limit, students experience a spontaneously rising concentration to find an appropriate way for solving problems that arise. A significant aspect is also the fact that students work on their own ideas which they chose themselves with respect to their interests; they work correspondingly to their knowledge level and in the environment which they know very well and is interesting and attractive for them. Weekly programs are mostly offered by specialized institutions of informal education and the program is always run in the premises of a school.

LARP as an educational tool

The LARP abbreviation comes from the English language and means Live Action Role Play and it is a form of a play where the participants represent fictitious parts (with precisely defined characters) of a prepared story and they create and perform the story by their acting. It is important for the play to be performed in an authentic environment with respect to the plot itself; actors have costumes, scenery and predetermined rules. LARP is intended for players –actors - and there is no audience. This form of a play originated independently at several places: in Northern America, Europe and Australia at the end of the last century; nevertheless, its use has not been really widespread in the educational process. In fact, it is the LARP which offers a unique opportunity for students to create something independently in an entertaining way, to solve situations and estimate the consequences of decisions, to implement their knowledge and learn to seek information.

LARP as a mean of education forms a separate group in classification of plays; it cannot be assigned to thematic or even dramatized play. If the LARP is to have an educational effect, it may not be created universally but always with respect to the age group of participants. However, this does not exclude the LARP plays that interconnect more diverse age groups but their suggestion as well as the realization is more demanding. Younger children are often satisfied with an easier LARP play without higher costs regarding the material or space equally as with a thematic play. Many tools and scenery can be prepared from commonly available inexpensive materials. Characters should be simple, specific and mostly positive to be well-reproducible by students with respect to the developmental stage of cognitive functions. If we want to prepare a LARP play for bigger students, it is

essential to prepare a story of a high quality, costumes and appropriate environment so that the students can be well-integrated into the plot of the story. Bigger students are also able to empathize with more abstract characters. They are able to adjust their decisions during the play according to characteristic features of the part which they present in the play. The LARP play Odyssea Holy, prepared by the World of Technology Ostrava can be mentioned as an example. It is intended for students aged 15 – 18 and focuses on inorganic chemistry. Actors represent a spaceship crew that, in the future, transports chemical elements between planets. During their journey, the spaceship encounters problems that are to be solved. This LARP play takes place in a unique industrial zone The Lower Area of Vítkovice in the center of Ostrava.

Figure 3 The Lower Area of Vítkovice

Even though the major educational theme is generally provided, knowledge from other fields will be needed during the play as well – knowledge of physics (movement in space, spaceship construction), mathematics (deciphering the codes), geography (key points are to be found using the GPS navigation and e-maps), etc. The LARP play is guided by animators who form part of the story, too. In order to meet the educational goals, a perfect preparation of both the story itself and material and technical facilities during the LARP is inevitable. The deeper the story is processed and the more authentic the environment is, the more the participants are immersed into the story.

LARP is also ideal in the point that knowledge from diverse topics can often be implemented into the story, and the story can be derived from the environment that we have at our disposal for carrying out the play. Owing to the fact that the

only thing that is determined is the nature of characters, not their reactions or specific storylines; the play always develops in a different way. Yet, participating in such a play has a sense for a student just once. After a person already knows the plot of the story, he/she may not be sufficiently immersed into the story any more. It is the reason why it is ideal to make use of the cooperation with institutions of informal education that currently have sufficient financial resources to fund an expensive preparation of a good LARP play. In case a play is prepared with respect to the thematic content of the school curriculum, such a play can be offered to more schools in the region and its usability is then more meaningful.

Creative science

One of the positives that the modern age has brought is, among others, a sufficient number of prefabricated teaching aids that can be used by teachers in their classes both to demonstrate experiments and during the laboratory work when students carry out experiments on their own.

On one side, such products save your time and make your preparation for classes simpler; however, on the other side, they do not really reflect current picture of everyday life any more and suppress students' creativity. Many of the aids are so “perfect” that they do not require knowledge of a particular subject-matter and deeper understanding of the topic at all. Construction kits can be assembled randomly up to the moment when “they achieve it”. The teacher does not have time for the explanation of the functionality of individual elements, and therefore, the experiments are carried out according to a “cookery book” from pre-labeled ingredients and elements. Then the students miss the essence of a phenomenon and they also miss the information about what they make it from and what they are, actually, making. Classes often include assembling of some devices that are not really useful for students; students do not usually find them interesting regarding their age and gender differences. A new trend called “creative science” tries to eliminate such negatives. This trend focuses on a creative production of various devices, physical or mathematical “toys”, biological experiments, or chemical experiments from commonly available materials which can be tried either at home or at school. Creative science projects are based on the following requirements:

- no material or time demandingness,
- each project will explain one phenomenon with the support of interdisciplinary links,

- each project will introduce just a basic idea but it will leave some results open, which means that students will have to learn through observation - it will make them think independently during the process and make them estimate the result. It could also make them examine the fact why a device or a phenomenon does not work as it should work,
- the entire creation process will be supplemented with a worksheet which will be gradually filled in by a student and the student himself/herself will create the final form and will add his own observations and also information that he/she has traced,
- project result will be a real product, or a real experiment, reflecting all practical imperfections, so, a student should learn "to improvise in the field of science".

The goal is to enable students to create independently and to leave an open space for their own creativity. Projects are prepared in the form so that they meaningfully intermingle natural science fields with other subjects such as technical education, work activities, art classes. The projects encourage natural childlike playfulness and enable cooperation among teams at school and also with adults – either as teachers or parents.

The World of Technology Ostrava cooperating with educators of primary and secondary schools has formed a creative science series consisting of natural science subjects. Each series focuses primarily on a specific learning topic which becomes the theme of 5 teaching lessons involving production of various devices or realization of experiments. Secondarily, there appears the interconnection with other topics from both the same subject and other science fields at teaching lessons. Partial teaching lesson contains a methodological text for the teacher describing the progress of a lesson into details, students' prior knowledge needed, the time and material required, and the possibility of including it into the teaching process. Further on, it contains step-by-step instructions for a device production or experiment realization and a worksheet for a student. Thereon the student will find new information regarding the given issue and tasks that will guide him to observations of important phenomena. He/She will write down his/her observations and evaluate the production progress. Series are prepared for a specific age group of students. As an example we can mention the series We Play with Electricity adequate for secondary school students. It contains 5 teaching lessons: Making a Battery from a Lemon, Making a Ventilator, Making an Alarm into My Room, Making a Lighting Greeting Card and Making a Shining Map of Starry Sky. Teaching lessons require only elementary knowledge of electrical circuits. Students

will become familiar with semi-conductors or a small engine during the production. Topics are chosen so that students can produce things which they find attractive and useful with respect to their age. They can make some of the things as a gift for their younger brother or sister, or as a cool gadget for themselves. Teaching lessons can be combined in accordance with the gender – boys will find production of a door alarm more interesting whereas the girls will prefer a lighting greeting card for St. Valentine's Day.

Production of a shining card replaces a standard assemble of a simple electrical circuit with a source of voltage and an appliance in the form of a LED diode. The diode is used for two reasons – it enables work with low voltage and, at the same time, we can introduce students with a semiconductor element. The student does not need to know a diode before and the working instructions will guide him/her to connecting the LED diode in both directions. Thus, he/she can easily find out that after one connection the diode is lit, after the second one it is not. The worksheet tells him/her what a semiconductor in an electric circuit is, which can be used when learning about semiconductors. The standard shape of a greeting can also be modified into a geometrically different shape – to incorporate geometrical objects and create spatial greeting or leave it completely up to the authors – students. A metal paper clip is used as a conductor and it works as a simple switch at the same time. Thus, in terms of the material the product becomes very easy and the student realizes that it is not necessary to use prefabricated elements but he/she can search for substitutes in his/her environment and can improvise independently. Girls will appreciate the opportunity to design it in a creative way, add interesting visual effects and provide the product with its own identity.

Figure 4 Ventilator and lighting greeting card

Out of the projects in mathematics, we can mention the series Playing with Coding designed for primary school students. Series includes five teaching lessons: Making a Coding Grid, Sending Messages by Telegraph, Secrets of Digital World, Substitution Cipher and Coding Wheel, Binary Codes. The Binary Codes lesson is also suitable for younger students; it explains the principle of the code with two states in the elementary way. In addition to various games even the Braille writing system is used as a practical example of the binary code.

The Braille writing system, intended for the visually impaired to read by touch, was developed by Louis Braille by modifying French military system enabling reading in the dark. These days signs in this writing system can be found almost in all public places, and therefore, students can be rather familiar with it. However, they do not know any details about it. Characters of the Braille writing are formed by a grid sized 2x3 dots. Each position is either elevated (occupied) and represents the ON state, or it is not elevated (unoccupied) and represents the OFF state. An empty character (no position is occupied) is used as a blank space. For shaping the Braille writing commonly available containers for 6 pieces of eggs are used as this is where one can find the required shape of one character.

Positions are occupied using blown out eggs. Figure 5 shows shaping the letter Z using the Braille writing. The ideal occasion for implementing such a teaching lesson is in the time of Easter holidays – students could decorate their classroom in a completely unconventional way by the signs made of eggs using the Braille code (Happy Easter, etc.). In this case, eggs in boxes can be decorated in the Easter way as well. This topic can be interconnected to social science and the importance of the writing to the visually impaired can be explained. Students are introduced with the alphabet in the Braille code and they can try to "decipher" signs which they find in their environment. Concerning older students, teaching lessons can implement knowledge in combinatorics (How many different characters are we able to generate? Is that sufficient? How to carry out other characters if there are no possibilities? What are prefixes?).

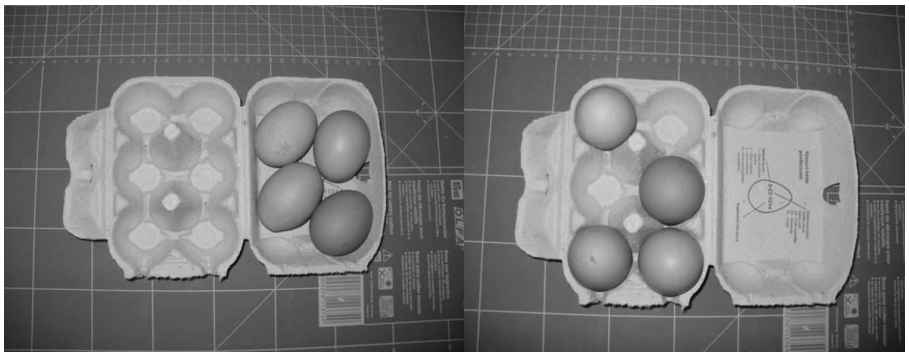

Figure 5 Braille writing system using the eggs box

With all creative science projects the emphasis is placed on the maximum degree possible of both recycling and utilization of things which the students can find around them – for instance a small engine can be recycled from an old toy car, battery can be used from an unneeded watch, an empty deodorant container can be used as a stand for ventilator, old eggs boxes can be used for coding. Students are also given space in order to improve the product design so that the product is not only functional but also attractive for its design. Each project leaves a wide space for creativity so that more active students may modify their product according to their own ideas.

Creative science projects can be used during ordinary classes, too, it means during the days when teaching is more relaxed (end of the school year, on the Children's Day) or when appropriately interconnected with another subject (drawing, technical work). Creative science, equally as a majority of similar projects, is connected with a parallel free training of teachers.

Conclusion

In future, whichever direction the development of natural science education is going to head to, there will be a focus on an effort for the narrowest approach towards a real scientific knowledge of these fields. One of the interconnectors between these two "different worlds" could become the institutions of informal education because they unify the personnel of scientists and educators. With a good cooperation they are able to offer a high quality support to the educational process in the form of activities for students and trainings of educators.

Information provided in the first part of this chapter regarding the historical development of paradigms was drawn primarily from (1) where one could find more detailed information about the development of science education paradigms particularly within the territory of the Czech Republic as well as an outline of a possible further development.

Activities introduced above represent the result of the preparatory phase for the opening of the Science learning center World of Technology Ostrava. This preparatory phase includes establishing of a close cooperation with educators of all schools types in the Moravian-Silesian Region (from nursery schools up to universities) and it reflects experience of similar institutions which have already undergone such process.

Opening of the World of Technology Ostrava is planned for the end of the year of 2014; it is assumed that the support program for schools and the general

public will be successfully started then. These days majority of materials for teaching activities are available for free to all registered educators, including the free training. The program is offered for free to all schools through a reservation system. Cooperation of schools and institutions of informal education does not solve general problems of the future of the science education in a wider context. Nevertheless, it is able to bring an improvement of the educational process - although at the lowest but still even more important level – directly in the teaching process.

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