



IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ON INTEREST TO MATHEMATICS OF INTELLECTUAL DISABILITIES STUDENTS FROM THE TEACHERS POINT OF VIEW*

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Моніка Суловська, Аліца Ванчова, Університет Яна Коменського, м. Братислава, Словаччина
Специфіка впливу інформаційних і комунікативних технологій на зацікавленість математикою студентів з розумовою відсталістю з точки зору вчителів

У статті представлено проміжні результати поточного стану математичної освіти з точки зору вчителів спеціальних закладів, які викладають для розумово відсталих студентів у спеціальних школах у Словаччині. Результати для аналізу були отримані за допомогою анкетування з метою виявлення очікувань, думок і вимог учителів для більш ефективного викладання математики в умовах спеціальної школи.

Ключові слова: легка розумова відсталість, спеціальна школа, інформаційні та комунікативні технології.

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Impact of information and communication technology on interest to mathematics of intellectual disabilities students from the teachers point of view

The work represents partial results of the current state of mathematics education from the point of view of special teachers teaching mentally retarded students the mentioned subject in specialised elementary schools in Slovakia. The basis for the analysis was obtained by form of questionnaire, of which goal was to detect expectations, opinions and requirements of teachers on more effective teaching of mathematics.

Keywords: student with mild mental retardation, specialised elementary school, specialised teacher, mathematics, information and communication technologies, questionnaire.

Theoretical Background.

Recently in the field of mathematics education of students with mild mental retardation we face with several changes resulting from the passing of a new educational conception. One of the goals of modern education is to gain competences in the field of utilising information and communication technologies (hereinafter referred to as ICT).

Currently there is a great number of definitions for information and communication technologies (digital technologies) introduced in works by its authors (Turek 1997, Turčáni 2000, Nagy 2000, Čelínák 2006, Kalaš 2000, 2006, 2011, Petlák 2000, 2004, 2008, Szököl, Sándor 2008, Baranovič 2008, Zounek, Šedřová 2009, Brestenská 2009, Barber, Cooper 2012 etc.),

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although we cannot consider any of them as generally valid or accepted. The reason is the swift, we can say, everyday development of these technologies, introduction of new concepts, methods, applications and other means relating ICT. We do not intend to present the definitions of ICT (or DT). We think it is more important to emphasise what this concept comprises, what is its content, since many people limit themselves in understanding it only to the perception of material means that results incorrect interpretation of the entire understanding of ICT in education.

Tarcsiová (2007) on the basis of the experience of several authors suggests that it is important to realize that the concept of ICT can be viewed from different angles, namely:

- as a technology that serves for processing of information and that is a software and organisational arrangement,
- as methods, processes and ways of collecting, storing, processing, checking of information in the required form and quality,
- as technical and software products that ensure, and/or support the provision of the above-mentioned activities,
- as a system of methods, programmes, processes, activities that carry out maximum utilisation of nearby and remote sources through communication in computer networks with the goal to find the optimal solution of defined problems or to reach its conclusions or to meet its requirements.

Therefore, under the concept of ICT is not the technology itself, but rather the interaction of several factors.

It follows from the conclusion of the State School Inspection (2011a, 2011b, 2011c) that the modernisation of teaching of non-informatic subjects (including also mathematics) linked with active use of ICT means is still not an ordinary and obvious reality even at specialised elementary schools. Recently the process of implementing ICT into the teaching process is taking place in a non-effective way, without clearly specified goals. The current level of ICT use is different at different schools. A lot of teachers today still face the question not only how to use the ICT, but mainly how to make the process of teaching more effective through their usage.

In the conclusions of foreign, but also of our studies (oriented on intact population), ICT demonstrably increase motivation and interest of students on learning (Slavík, Novák 1997, E-learning Nordic 2006, Baranovič 2008, Padberg 2010, Eurydice 2011, Masaryk 2011, Bakia, Murphy, Anderson, Trinidad 2011).

In respect of the words of Komenský (1956) who claimed that if the process of teaching is not pleasant for the student, then the student shall not learn anything, the ICT for the student of the today (so-called Z generation) are the most pleasant means of teaching.

Similarly Turek (1996) in his publication states that the educational system has not received such material means of teaching to which the students would have such natural, active and positive relationship than to the ICT.

How is it with the teachers? To look at the issue with the eyes of their students is for many teachers impossible. The «natural» relationship of teachers toward ICT and their inner motivation could be also disputable. What is the impact of positive relationship of a teacher in respect of the ICT on the interest of students in respect of the subject? The goal of this paper is not to describe the particularities of recent teaching of mathematics in detail and comprehensively, but to summarise shortly some of the aspects relating effective teaching of the mentioned subject.

Research Goals

The goal of the research was to discover the relationship of popularity of mathematics at the teacher and of the impact on interest in respect of this subject at the student. To compare the results to find out whether there are substantial differences between the answers of



teachers in the examined teaching practice. At the same time we tried to discover didactic issues relating recent education of mathematics at students with mild level of mental retardation.

Research Methodology

For research method for the goal specified by us we chose the questionnaire method. The measuring tool was the on-line questionnaire created by us on the basis of Gavor methodology (2010) that detects the impact of information and communication technologies on interest of students in respect of mathematics from the teachers' point of view. The questionnaire consisted of 26 questions from which 17 were close questions, 4 were semi-close questions and 5 were open questions. The questionnaire's items were arranged into 6 fields: factual data, a teacher's relationship to teaching mathematics, a student's relationship to teaching mathematics, student's relationship to using ICT in mathematics, a teacher's relationship to ICT, recent situation in the field of teaching mathematics at specialised elementary school.

We processed the information gained on the basis of the questionnaire into frequency tables and charts. We used methods of descriptive statistics and methods of statistical induction. These were the methods of analysing pivot tables and independence tests χ^2 for pivot (contingency) table. As we wanted to use *Pearson test of goodness of fit* – χ^2 we also calculated the expected (theoretic) frequency that would take place in case of identical distribution. The Pearson test of goodness of fit is based on the relationship:

$$\chi^2 = \sum_{i=1}^k \frac{(X_i - np_i)^2}{np_i}$$

where the value X_i is an empirical frequency, p_i is theoretic frequency, k is the number of every box in the table consisting of frequency.

By comparing frequency for the single answers we discovered that distribution in the single boxes is non-homogenous. The original usage of *the test of goodness of fit* – χ^2 on the pivot table assumed that the frequencies in the single boxes of the table are not very small and the number of all answers is sufficiently big. In literature there are conditions (Weber 1967, Anděl 1998, Lamsler – Růžička 1969, Eaton 1978), under which it is possible approximate χ^2 by continuous distribution. Today the most frequently are used the conditions defined by Koehler and Larntz (1980) that require the number of all answers to be $n \geq 10$, the number of categories to be at least 3 and the expected (theoretic) frequency to be at least 0,25. In our work we used the mentioned test, on statistical significance level $\alpha = 0,05$. If the value of $\chi^2 > \chi^2_{critical}$ then there are statistically significant differences between the single samples, we refuse hypothesis H_0 on fit of equalities.

Definition of the Research Sample

In the research – that was carried out in March 2013 – were addressed teachers of mathematics (teaching in A variant) from randomly chosen specialised elementary schools in Slovakia.

The questionnaire was filled out totally by 95 teachers from every district of Slovakia, from which 18 were men and 77 were women. The length of teaching practice of respondents was the most often in the interval of 11-20 years. The location of respondents on the basis of the school's seat (district) where they teach is in *table 1*.

Table 1

Distribution of Respondents as per regions (n = 95)

Region	BA	TT	TN	ZA	NR	BB	KE	PO
Absolute amount	7	19	7	14	11	14	16	7

Research Results

The results of the research provided a number of information that we are going to analyse and illustrate in a graphical way and describe, as well, for the purposes of the paper.



87 % of teachers stated that their students were interested in the study subject mathematics. In respect of this information we link a question relating the teaching of mathematics with ICT support. We expected that the interest of students toward mathematics via ICT would be higher. This assumption was not confirmed, 82 % of respondents think that ICT supported teaching increases the interest of students in respect of this subject. 59 % of respondents realizes that the use of ICT during the classes can students with mental retardation markedly contribute to faster understanding of the subject.

Upon the analysis of open questions of respondents the information and communication technologies (hereinafter referred to ICT) «are distinctive motivation factors... make teaching more attractive and colourful... students can concentrate longer... the use of ICT evoke higher activity of students, enable better visual skills, imagination, mediation from real life... possibility of multiple repetitions, immediate feedback, correction of mistakes... students learn to work independently, they develop not only mathematical, but also computers skills, they communicate more.»

In the next statistical research (table 2, chart 1) we found out that the length of teaching practice (eventually age) of the teacher has no impact on the interest of the student toward mathematics. We accept the hypothesis H0 on statistical significance level $\alpha = 0,05$, there are no substantial differences between the presented samples.

Table 2

Interest of Pupils on Mathematics with ICT support (pivot table)

teacher/pupil	no	I don't know	yes	totals
0-10 years	2 (2,06)	5 (2,95)	21 (22,99)	28
11-20 years	3 (1,92)	2 (2,74)	21 (21,35)	26
21-30 years	1 (1,84)	1 (2,63)	23 (20,53)	25
31-40 years	1 (1,18)	2 (1,68)	13 (13,14)	16
totals	7	10	78	95

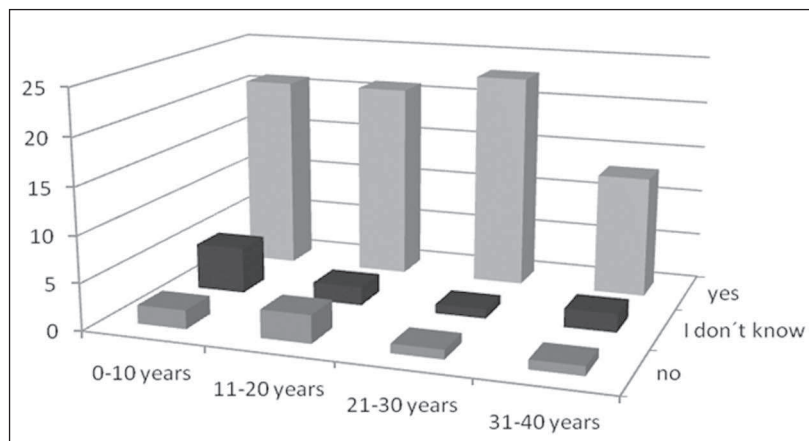


Chart 1. Impact of ICT on Interest of Pupils on Mathematics from the Point of View of Teacher's Practice

In literature (Turek, 2010) we read that teachers with positive attitude to teaching – from psychological point of view – as well as people satisfied with their professions, should be happier, more productive and should have better influence on forming students. Such teach-



ing of students motivates who create a positive attitude not only to the teacher, but also to the subject and to the teaching.

In our further research we refuse (table 3, chart 2) hypothesis H0 on statistical significance level $\alpha = 0,05$, among the specified samples are statistically considerable differences that means that popularity of the subject at the teacher has impact on the interest on the subject at the student.

Table 3

Relationship of Popularity of the Subject at the teacher on interest of the Subject at the Student (pivot/contingency table)

teacher/pupil	very interested in	interested in	not interested in	I dont know	totals
always look forward	1 (0,55)	12 (10,81)	0 (0,82)	0 (0,82)	13
often look forward	3 (2,57)	54 (50,73)	2 (3,85)	2 (3,85)	61
sometimes look forward	0 (0,88)	13 (17,43)	4 (1,33)	4 (1,33)	21
totals	4	79	6	6	95

It was an interesting discovery that only 50 % of teachers involved in the research would choose mathematics if they would be forced to choose, the other half of them would choose another language. The possibility of another subject was chosen most often by teachers with teaching practice of 0 – 10 years. Teachers with 31 and more years of experience, are more affined with their profile subject. More detailed results are present in chart 3.

The ICT in mathematics is used by 90 % of teachers, from which during some classes by 66 % teachers, during most of the classes by 17 % of teachers, the answer during every class was given by 4 teachers and two teachers use ICT during classes only under the pressure of the school management. It is conforming that 94 % of respondents use the internet for the teaching preparation. We did not deal with the question of what form? Whether only by downloading applications, work sheets, or even at the preparation and creation of own basis materials for teaching mathematics.

Although teachers declare even the negative sides of the ICT and those are as follows: «loss of time during transfer to the PC class-room... time-consuming preparation for such classes... health problems... in case of improper software interruption of the students' attention...». Although more respondents added additionally that «good preparation at home is reflected during the classes... relevant and purposeful use of ICT is a great contribution to the class». The ICT is thus perceived by most of them as a positive issue, *but not a necessity*. Some of the respondents declared that «*excessive attention is paid to the use of the ICT, somehow personal contact of human communication, of being together is missing, that is for students with mental retardation more important than their skills in ICT.*»

The specialised elementary schools have been using CDs during classes of mathematics that are primarily designed for intact students. They try to modify the content of such CD for students with mental retardation. Among the most frequently used ones according to our research results are the following: *Circus of Tom, the Clown, Alik – Joyous Mathematics, Little Bear Learns how to Count, Baltik, Children's Corner 1 – 5, TS Fairy-tailish Mathematics.*

Some of the respondents agreed that try to compensate the insufficiency of educating CDs for students with mental retardation by creating their own interactive materials.

For the practice of specialised teachers it is very important that the majority of teachers use ICT during their classes and it is assumed that they shall continue in it, because the need of ICT in case of specialised teaching shall be increasing. Here are the answers of some of the respondents: «*we have very good experience with the use of interactive board... our co-workers have a number of manually created interactive teaching materials... I have no problems*»

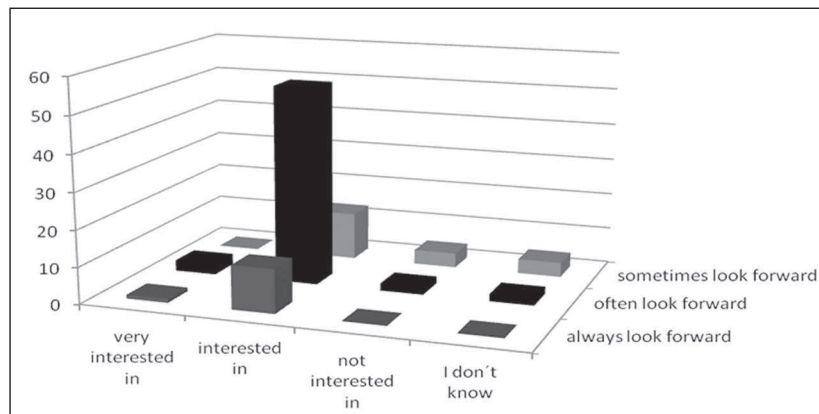


Chart 2. Relationship of Popularity of the Subject between the Teachers and the Students

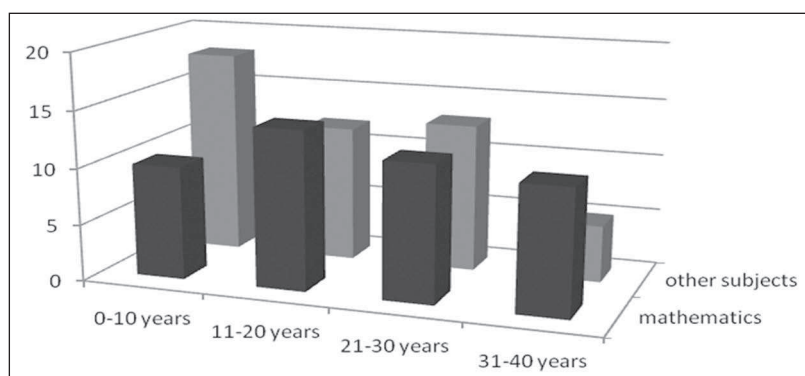


Chart 3. Options for choosing study subjects

with the use of ICT during the classes, even I enjoy it... I am lucky to teach at school that is equipped with ICT... The ICT are an inseparable part of the teaching process at our school... I cannot even imagine teaching without ICT... toward teaching supported by ICT I have a positive experience... I really like creating interactive games for the children... our school uses interactive boards in all class-rooms every day... We like using ICT at our school... I use ICT very often and I like it... The ICT is a very positive issue in teaching... it is great that the ICT have made its way to schools...».

In the research we were even looking for the answer to the question what are the teachers missing in the textbooks of mathematics. The majority admitted that «the textbooks look visually nice, although they are over-designed and the students cannot orient in them ... the text-books fail to correspond with the recent currency... correct solutions at the end of the text-book are missing... references to study programs and web pages are missing... examples/tasks for conclusion and reasoning are missing (riddles, simple puzzles)... more examples from practice and from recent life are needed... more playful and application exercises are needed... the text-books are monotonous... need of greater variability of examples... we have no text-books for Hungarian nationality students... I have the feeling that text-books were not written by teachers, but by a person who never taught and saw students with mental retardation... from the time we have the interactive board, I barely use the text-book...» From



the above-mentioned it can be concluded that not only the need for high-quality text-books is increasing, but it is also evident that the near future is welcome to interactive text-book even at specialised schools.

It is evident from the results of our research that a number of specialised elementary schools supplement the number of classes of mathematics given by the State Education Programme (4 classes/week) in their School Education Programme by one class/week from practical reasons, i.e. although time subsidy was decreased by one class/week, but the State Education Programme left the content of teaching in entire extent. Some schools compensated the loss of one class by creating a separate subject called Exercises from Mathematics.

Didactic games are inseparable part of the teaching process of mentally retarded students. Their advantage is that they can be used not only in all types of teaching classes, but in all stages of the class. This provides the teacher with an opportunity to react on keeping psycho-hygiene of teaching. One thing should be kept in mind that the goal of the didactic game is not to supplement the teaching of mathematics, it is only to give an addition, enrich and activate it.

The authors Kalhous and Obst (2002) state that the principle of the game is to keep the cleanness of the game, to play fair-play, to learn to accept failure and victory. One who learns if during the game, shall be able to cope with it in real life.

From the research results it is evident that the most favourite didactic games for the students in mathematics are as follows: *shopping game, mathematics in the kitchen, creation of tests for classmates, creating entertaining word games, mathematics in geography, mathematical quiz, looking for prices of foodstuffs in leaflets of department stores and calculating differences*. The respondents stated as very motivating and activating the following: mathematical puzzle, lotto, memory games, riddles, sudoku, simple mind-benders, labyrinths, colouring mathematics, singing songs with mathematical topic, work with calculator, computer games.

Some of the teachers stated insufficient use of the ICT at schools, others use interactive boards or computers every day. Many of them emphasised the need of incessant education in this field. It is comforting that interest on professional growth in the field of ICT was reported by 84 % of respondents.

Conclusions of the Research and Recommendations for the Practice of Specialised Teachers

On the basis of the carried out research it is possible to make specific conclusions, although they shall need to be verified within a more extensive research in order to obtain its more general effect.

Although, according to the reached results it is possible to state certain recommendations for the practice of specialised teachers:

- the need of life-long education in the field of methodology of the ICT use in mathematics

ICT skills necessary for the performance of the profession of a teacher is dynamically changing, thus constant professional growth is necessary. Although according to the research results, the majority of teachers think that high-quality preparation of teachers in the field of ICT is missing «*We have no effective training...not only mark that the activity has been done...perhaps there is effective training, although I have not attended any...*». The teachers lack not only high-quality training, but also text-books, the methodology of using ICT in the information education and in non-information subjects.

- to use the skills of students in the field of ICT at the development of mathematical competencies

- not to stick strictly to the specified text-books of mathematics

The new school act brought changes to the teaching in favour of the efficiency of knowledge in practice (Vančová 2010). It offers freedom and flexibility to teachers when choosing methods, forms and means for teaching to students the more effective way.

- to use sources of interactive education materials available on-line



In respect of the limitation of suitable software in the Slovak market, or their financial issues, we can see positive effect in the number of freely downloadable software in the internet, or applications and games that can be used on-line. The positive effect is that with their increasing number, their quality is also increasing and thus the possibility of a wider choice for students with mental retardation. In comparison with the teaching CDs, the mentioned internet software and applications have an advantage, i.e. that the students can practice the at home. In some cases the disadvantages include the English language, although the games are very intuitive and with a little help from the teacher the students are able to cope with it without any problems.

1. *mathematical games available:*

- SoftSchools.com <http://www.softschools.com/math/>
- MathPlayground.com <http://www.mathplayground.com/games.html>
- Coolmath-Games.com <http://www.coolmath-games.com/0-arithmeticgame/index.html>
- Harcourt <http://www.harcourtschool.com/index.html>
- ICT Games www.ictgames.com
- Jiří Soukup: Mathematics <http://www.naberanku.cz/vyuka/matematika/zaci/mat01.htm>
- Matika.sk (web-page of Comenius University in Bratislava, Faculty of Education) <http://www.matika.sk/index1.htm>
and several others.

2. Slovak education portals

- Modernizácia vzdelávania.sk (<https://www.modernizaciavzdelavania.sk/Default.aspx>)
- Planéta vedomostí, translated as The Planet of Knowledge (<http://planetavedomosti.iedu.sk/index.php/search/results/Matematika,1,0,1222;1317,0,25,1,tn,1.html>)
- Zborovna.sk (<http://www.zborovna.sk/>)
- FITucitela.sk (<http://www.fitucitela.sk/moodle/>)
- Naučteviac.sk (<http://www.naucateviac.sk>)
- Datakabinet-kabinet moderného učiteľa (<http://www.datakabinet.sk/sk/Home.html>)

3. *foreign education portals*

- Czech- <http://rvp.cz/>,
- Finland- <http://edu.fi/ammattikoulutus>,
- Poland- <http://www.bezkredy.pl/>,
- The Netherlands- <http://www.kennisnet.nl/>,
- Belgium – <http://www.klascement.net/> atd.

Innovative trends suggest constant increase of requirements not only of the teachers, but also of the schools that can in a great extent influence what shall be accessible and normally used in the education activity. Nevertheless, the ICT is not a heal-all, but its distinctive motivating and supporting effect is scientifically proven. Their effective usage in education does not depend only on teachers, but – as we discovered by the research – also on approach and support of the school management.

We identify with the opinion of Petlák (2007), according to which schools today cannot exist without using modern material and technical means. Although, we do emphasize that its use would serve for the increase of the quality (efficiency) of teaching.

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