

Multimedia as a Didactic Tool for Teachers in Elementary Education in Croatia

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Abstract— This paper presents the current situation regarding multimedia education in primary schools in Croatia. It specifically concentrates on teachers in primary schools and their mission in informatics and multimedia literacy education. The new technology and multimedia environment put forward new requirements to teachers: they are expected to become lifelong learners, but also to be informational, multimedia and IT literate. The motivation and satisfaction of elementary school teachers in Croatia related to multimedia literacy education is analyzed and revealed in this paper. Also, our comparative statistical analysis showed that there is a significant correlation between results students achieve in the multimedia literacy test and the teacher's use of multimedia teaching materials in the classroom.

Keywords—Croatia, multimedia education, multimedia literacy, multimedia materials, primary school, teachers

I. INTRODUCTION

The modern educational process can hardly be imagined without the use of instructional media, which make an important and indispensable part of modern reality. The media are evolving rapidly and open up many new horizons in education and upbringing.

The bases for the development of the 20th century education were textual media that are still used in schools on a daily basis (e.g. textbooks and manuals, workbooks and sheets, school exams, etc.).

However, the presentation of educational content in the form of text or oral presentation greatly demotivates today's students from learning and creates difficulties in attracting students to learn and keeping their attention.

But, if the school's curriculum combines multiple instructional media (text, sound, video and images), it is possible to attract students' attention and deepen their learning experience, as well as to create opportunities to form associations between different representations of educational content.

Therefore, it is a priority of each educational institution to introduce and use a variety of instructional media in the

classroom as a tool for learning, enrichment of the classes and student's advancement.

The recent research on use [1] of multimedia instructional tools, as well as the research on impact of multimedia materials [2] emphasizes the importance of this topic. For example, the use and advantages of interactive whiteboards have been examined in elementary schools all over the world, such as in United Kingdom [3], Taiwan [4] and Czech Republic [5].

Also, the effect of interactive e-books on learners has been studied, exploring new reading patterns to provide recommendations for the interaction of teaching and learning in this new era [6].

Apart from the impact of multimedia on the students and educational process, recent studies also investigate the level of IT competency of teachers in schools [7] and the use of ICT by teachers at primary schools according to age, duration of pedagogical practice and their education in the ICT area [8].

Finally, influence of multimedia to education is intensively studied in the last two decades. Since learner's cognitive resources interact with aspects of the external environment, the design of the educational process needs to embed the use of complex media [9].

In Croatia, didactic rules for the selection of instructional media in elementary school were already given by Matijević [10]. He emphasized that in the early years of schooling the advantage should be given to learning in the real world. He also points out that the multimedia CD-ROM or the Internet as a source of knowledge should serve as a supplement to learning, but should never become the primary or main teaching medium.

Children in the early years of schooling do not need to avoid the use of computers, whether browsing software on CD-ROM or searching the Internet, but one should also not expect the equipment of all school classrooms with computers or encouragement of prolonged sitting in front of the computer during the school day.

Finally, according to Matijević [10], it is more useful to think about new educational solutions for children who will live at the beginning of the third millennium, rather than pushing the Internet and multimedia in the framework of the existing rigid curriculum, which already in advance limits the communication capabilities.

Media competencies are an important part of the modern school curriculum. It does not affect the change in the educational role of schools, but it implies a new paradigm. The use of new media opens up new opportunities that may be

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creatively introduced into different teaching units and topics of all courses in primary and secondary schools.

II. MULTIMEDIA FOR PRIMARY SCHOOL STUDENTS

Educational institutions may be the most appropriate place for the use of multimedia. Graphics and animation are the most important for the youngest age, while sound can often replace or supplement the text (e.g. in reading exercises).

However, slightly older children and adults benefit more from the use of quality images supplemented by text and/or video clips.

In the didactic sense, multimedia denotes the teaching and learning tools that merge graphics, audio, video, animation and text, with which a student can interact on nearly the same intellectual level as with a teacher.

The simultaneous inclusion of multimedia elements in the curriculum allows students to make internal connections between theoretical models and their own previous knowledge and experiences, which leads to a better understanding and knowledge acquisition.

The various media and their elements possess different characteristics that affect the experience of a student in different ways.

But, aside from properties of media and media content, selection can also be made according to the criteria related to the learning outcomes and educational goals and according to the teacher's attitude and his/her qualifications, as well as the availability of media content and availability of equipment.

III. MULTIMEDIA EDUCATION AND PRIMARY SCHOOL TEACHERS IN CROATIA

From the methodical aspect, teachers should create conditions for the development of children's current and potential capabilities and be responsive to the needs of students.

However, today's teachers were not born into the digital world and must learn to communicate in the language and style of their students.

While teachers have a habit of long-term planning and expectations, the new generation of students is essentially all about "now" and "as soon as possible".

Elderly teachers, who remember a time before computerization and digitization, consider such impatience as a lack of attention, a lack of social skills and a lack of personal contact.

But new generations of students are born in the digital era, with fewer books and even fewer television hours, which results in different modes of attention. Their attention is linearly focused and they are able to focus on several things at once.

In the new technology enhanced multimedia environment teachers are faced with new requirements, they are expected to be lifelong learners, but also to be both information and computer literate.

So far the lifelong training of teachers has only been applied in the methodological area, which is no longer enough. Given the disparity between information or computer literacy of students and teachers (where students tend to have a higher

level of literacy), it is necessary to improve teachers in technical and technological fields: they need to learn how, when, what and for what purpose to use multimedia [11].

However, teachers do not have to master all new technologies. But, they need to find ways to use the language that students understand, encouraging them to use technology for educational purposes, giving them assignments that will activate them and motivate them for learning. It is important for teachers to have a positive attitude towards the implementation and use of computers in education.

That does not mean the traditional curriculum needs to be changed.

The basic skills: reading, writing, knowledge of mathematics and logical thinking are still important, but the new content and the one that will follow are digitally and technologically dictated.

Today's students are used to the fast pace of computer games, instantaneity of hypertext, fast receiving of information and its continuous availability, as well as to immediacy of hypertext and instant messaging, which makes them absolutely impatient for the traditional slow systematic transfer of the learning content.

Methods of learning step by step are no longer effective for students who spend most of their free time playing video games.

Their core competence is multitasking. Also, they use different parts of their brain for information processing, compared to children born in previous generations [12].

They look for immediate feedback on their knowledge and prefer the content presented by graphics, sound and video more than text.

They have to learn surrounded by dynamic media with a high level of interactivity, they use random access to content rather than the linear one. As soon as they are offered the static text and graphics, they lose interest and their attention drops significantly.

Most of them are visual types. Therefore, the verbal or textual content supported by the visual content raises their motivation for learning and capability to memorize details [13].

Since they have grown up with video games, they perceive the learning method of trial and error as a metaphor for learning.

The above described learning habits of students require the design of teaching materials that allow students to experiment with the content, avoiding lessons with narration and lecturing style, and enabling them to learn course concepts and new skills through play [14].

The question is which approach a teacher should take to educate the students, since he/she has to change the methodology of acquiring basic knowledge and skills, but in the same time also needs to be educated and open-minded to new tools and technologies.

Today's older generation socialized in some other way and is now learning a new language, a language spoken by students of the 21st century, the native speakers of technology.

The new technology and multimedia environment put forward new requirements to teachers; they are expected to

become lifelong learners, but also to be informational, multimedia and IT literate.

On the other hand, the educational system in Croatia is still based on the traditional approach that does not take into account the difference between today's students and their teachers and as such faces lot of difficulties in reaching today's students.

In the next sections we present the results of our research study on teachers' use of multimedia in their everyday teaching in Croatia.

Also, we give the analysis of their attitudes on the importance of multimedia literacy education in the elementary education and the analysis of the level of teacher's personal motivation in the process of multimedia literacy education.

IV. ANALYSIS OF EMPIRICAL RESEARCH ON TEACHERS' USE OF MULTIMEDIA

In the first part of the study, a quantitative method involving a survey questionnaire as a measuring instrument was used. The analysis and interpretation of teachers' attitudes towards multimedia literacy education was conducted on a sample of elementary school computer science teachers.

The aim of the survey was to identify teachers' use of multimedia in their everyday work, as well as their awareness of the important role of teachers in multimedia literacy education.

Computer science teachers were selected as a target group since they tend to be the core promoters of computer and multimedia literacy education in school.

The respondents were teachers who use textbook "My Portal" [15] with accompanying multimedia CD, which is the most frequently used textbook in Croatian elementary schools.

Also, according to the evaluation criteria for interactive educational resources, the multimedia CD (Fig. 1.) accompanying the textbook ranks the highest among all other multimedia textbook supplements [16].



Fig. 1. The screenshot of the "My Portal" multimedia CD-ROM

The research was conducted with computer science teachers from ten elementary schools in the City of Zagreb and Zagreb County.

The aim of the first part of the study was to determine the teacher's own assessment of his/her degree of knowledge and skills required for work with multimedia materials.

Also, the use of the accompanying multimedia CD in the classroom was examined, as well as the level and frequency of its use in computer science curriculum.

Furthermore, the teachers' attitudes towards the effect of multimedia aids in the computer science curriculum were determined.

Finally, we analyzed whether teachers encourage students to use multimedia instructional materials, as well as methods of teacher training in information technology and multimedia.

Regarding the structure of the sample, we discovered the following: the majority of computer science teachers are female, who make up 70% of total respondents (Fig. 2).

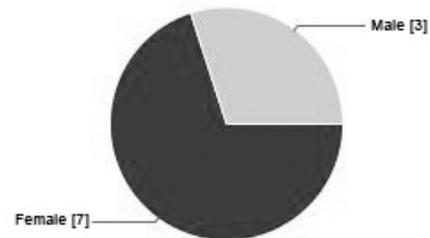


Fig. 2. The structure of teachers' sample with regard to gender

The age distribution in Fig. 3 shows that we obtained quite interesting distribution pattern when it comes to the age of respondents.

A majority of the respondents were aged between 40 and 49 years, followed by teachers aged between 50 to 59 years.

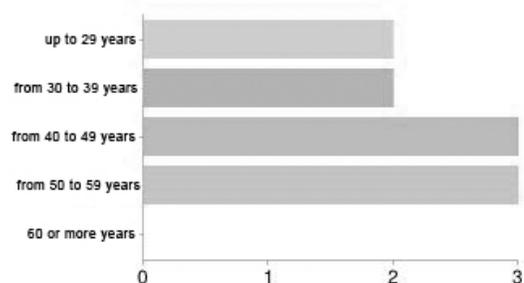


Fig. 3. The structure of teachers' sample with regard to age

Given that teachers voluntarily entered into the research collaboration, it is a surprising discovery that teachers of younger age were underrepresented in this sample, which indicates that the older generation of teachers are also interested in promoting computer and multimedia literacy education.

Furthermore, due to different professional background of teachers in primary schools, the initial research task was to determine the level of knowledge and skills needed to work with multimedia tools. For this task, the method of self-assessment was used.

Teachers were asked to evaluate their level of multimedia knowledge and skills in a way that they chose one of the three

offered responses that are considered to best reflect the level of their multimedia knowledge and skills.

Half of the respondents believe that they possess good knowledge and skills to work with multimedia, 10% of them consider that they possess sufficient knowledge, while 40% presume they possess excellent multimedia knowledge and skills, as presented in Table 1.

	Num (n)	Percent (%)
Sufficient knowledge and skills to work with multimedia	1	10
Good knowledge and skills to work with multimedia	5	50
Excellent knowledge and skills to work with multimedia	4	40
TOTAL	10	100

Table 1. Self-assessment of knowledge and skills to work with multimedia

An important task was to examine whether teachers use the accompanying multimedia CD in the classroom and, more importantly, to examine the level and methods of using the accompanying CD in order to perform a further research in the form of student assessment.

According to teachers' answers, presented in Fig. 4., we determined that all teachers use the accompanying CD, with the only difference in the method being used and frequency of its use in the classroom.

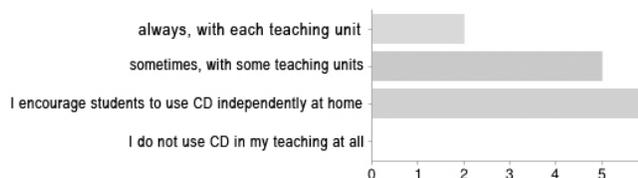


Fig. 4. The use of the multimedia CD accompanying the textbook

Three teachers declared they always use the CD, with each teaching unit. Two teachers acknowledged that they use the CD sometimes, only with particular content. Finally, one teacher admitted that he encourages students to use the CD at home, independently.

The remaining teachers, three of them, selected multiple responses, declaring that they use CD sometimes with particular content, but also encourage students to use CD independently at home.

In addition to this CD, we wanted to determine whether teachers use some other programs and tools to create multimedia instructional materials on their own.

Several tools for the creation of multimedia instructional materials were offered several tools for creating multimedia

materials, and teachers had to choose one or multiple answers to this survey question.

Among all multimedia tools, Movie Maker is being used the most often by these teachers.

Furthermore, we discovered that not a single teacher has selected the option "none" and also none of the teachers uses Raptivity tool, which is a commercial tool, but with the free trial version (Fig. 5).

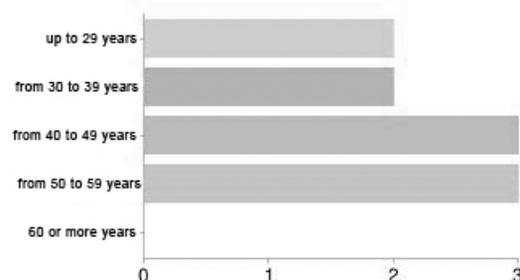


Fig. 5. The use of tools for the creation of multimedia instructional materials

Teachers also stated that, in addition to their classes, they make presentation in PowerPoint and Prezi, as well as different quizzes.

In response to a question about the use of tools for creation of online quizzes and tests, 50% (5 teachers) indicated that they use none of the tools from the list.

Since we wanted to investigate the frequency of use of such tools, we actually found out that Moodle is being used the most often for the creation of interactive online quizzes and tests (Fig. 6).

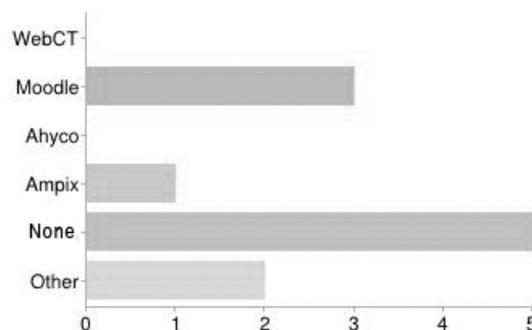


Fig. 6. The use of tools for the creation of multimedia interactive online tests and quizzes

The following group of questions aimed to determine if teachers encourage students to use multimedia materials and in what ways they assist them. Since all teachers responded affirmatively, they also listed following modes of encouragement:

- Instructing students to use multimedia materials that may be found on the Internet, providing exact web addresses
- Combining multiple tools for the creation of a single piece of work

- Referring students to specific websites that offer free multimedia tools and applications
- Preparing additional material for the recapitulation or covering additional learning content according to their wishes
- Developing small projects for computer science or some other school subject that requires use of a multimedia tool
- Encouraging students to work with different multimedia tools at home
- Through homework and recapitulation
- Solving practical tasks in class
- Creating their own Movie Maker clips based on their photos and videos

After a group of questions about the tools and the use of multimedia, we wanted to determine what are the attitudes and opinions of teachers about the goals of using multimedia content (a combination of images, animations and sound) in school.

They were given the following list of goals to choose from:

- To encourage student's curiosity
- To motivate students' to acquire knowledge and skills
- To raise students' attention and interest
- To facilitate the process of learning and teaching
- To enrich student's knowledge introducing new content

As seen from the Fig. 7, the most important goal of using multimedia in education is raising student's motivation, according to opinion of teachers.

Rising of the motivation for learning is followed by encouraging student's curiosity, facilitating teaching and learning as well as the enrichment of his/her knowledge, while encouraging student's attention tends to be one of the least important goals for the use of multimedia in teaching.

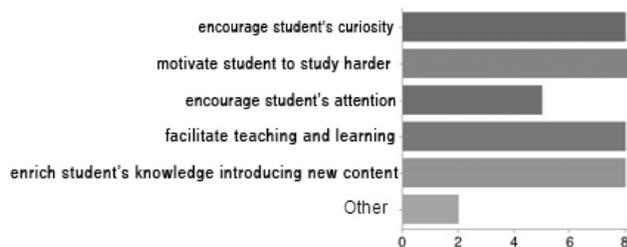


Fig. 7. The goals of using multimedia materials in the educational process

Given the impact of the use of multimedia in teaching, the teachers fully agreed that students are more successful when they use multimedia materials, apart from traditional teaching materials.

V. COMPUTER SCIENCE CURRICULUM ON MULTIMEDIA AND STUDENTS' QUIZ

The aim of the second part of the study was to determine the level of computer and multimedia literacy students achieve during the primary education through computer science course.

This course was chosen because computer science teachers are, unlike a number of other primary school teachers, trained to use computers and are more aware that computer offers new opportunities for learning.

Our hypothesis was that the evaluation of the level of computer and multimedia literacy of students and the analysis of motivation and satisfaction of teachers in the process of multimedia literacy education can reveal the current situation in primary schools in Croatia.

Analyzing the computer science curriculum, it was decided that assessment will be carried out on 6th grade students, since the computer science curriculum for primary schools introduces teaching about multimedia in the 6th grade.

In the 6th grade, students acquire knowledge of the key multimedia concepts: multimedia, media types (text, image, sound, animation, video), a microphone, sound recording programs, storing of sound recordings, WAV, MP3 playlist, video capture, mounting frames, video transition, timeline, inserting sound files, inserting images, inserting video clips, trailers, the quality of the video file, etc.

Acquired skills refer to the ability of a student to recognize an audio file, record sound or voice via microphone and save the recording in a sound file. The student may use any available media player (e.g. MediaPlayer).

Using a digital camera he/she should be able to create a small video clip in web-quality from several separate video clips. He should also be able to make a creative video clip in Windows MovieMaker.

With the help of the teacher (or on his own), he should manage to insert a video clip, set its duration, set transitions between clips, insert audio recorded through the microphone, insert the music file and add sound effects.

The student can add text and images to his video clip, specify its duration and ultimately save the video clip to a file.

Furthermore, 6th grade students acquire new skills and key terms about presentations, working in different programs to create presentations and acquiring skills to:

- work with PowerPoint interface
- to open, create and save presentations
- to shape and shade the text on the slide
- to insert and format illustrations
- to move slides in the slide view
- to copy and delete slides and
- to print presentation.

They can also acquire knowledge about the use of ready-made animation schemes and, creating animations from the already available effects.

The student should master the skills to solve tasks related to multimedia independently, quickly, thoroughly and accurately.

They should also be able to use program interface on their own, independently prepare a multimedia presentation and save it to their hard drive.

Interactive multimedia quiz for students was developed for research purposes in HotPotato application and implemented in Croatian Academic and Research Network (Carnet's)¹

¹ Croatian Academic and Research Network: www.carnet.hr/en

learning management system - Loomen, in order to assess the students' knowledge of the previously studied teaching unit - processing text in MS Word.

The quiz consisted of 24 questions of different types (single and multiple choices, drag and drop, embedded answers, true and false, etc.). These questions were designed similar to exercises in tutorials and materials available on "My Portal" multimedia CD-ROM (Fig. 8, 9, 10 and 11).



Fig. 8. Teaching and learning materials on "My Portal" multimedia CD-ROM covering teaching unit on multimedia

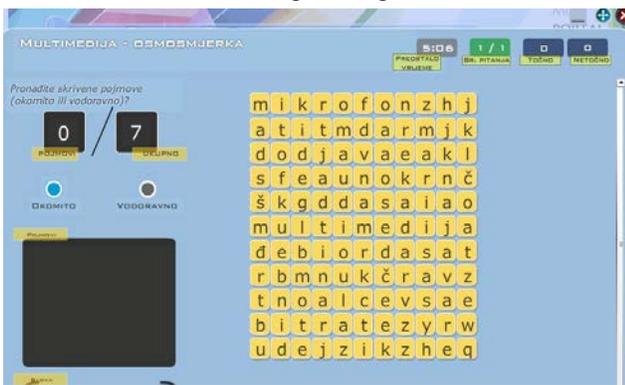


Fig. 9. Brain teaser exercise on "My Portal" multimedia CD-ROM

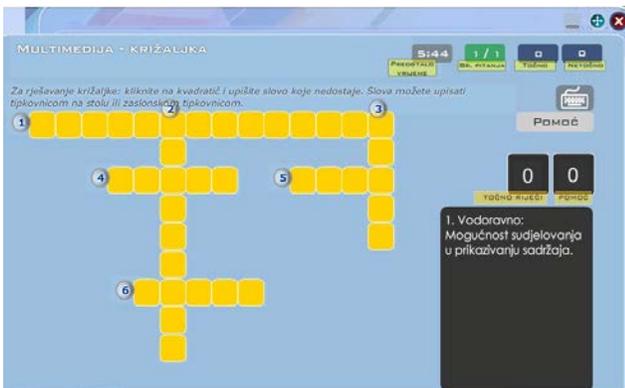


Fig. 10. Crossword exercise on "My Portal" multimedia CD-ROM

The quiz also had a time limit. Unlike a conventional quiz consisting of above listed types of questions, an interactive multimedia quiz gives students immediate feedback and can be very motivating.

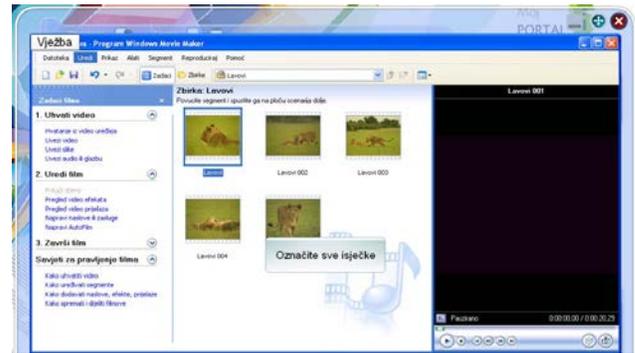


Fig. 11. Video capture exercise on "My Portal" multimedia CD-ROM

VI. COMPARATIVE ANALYSIS OF STUDENTS' QUIZ RESULTS AND TEACHER SURVEYS

Analyzing the results of the survey, we found out that most of the teachers do not use accompanying multimedia CD-ROM regularly and that most of them use it only occasionally in the classroom, leaving up to students to decide whether they will use multimedia resources independently at home, in an uncontrolled environment.

Furthermore, a significantly small number of surveyed teachers have time and opportunity to use multimedia instructional materials accompanying the textbook in the classroom.

In other words, there is a significant difference between teachers who use multimedia materials during the class time in primary schools and those who do not, which is reflected in a better way of knowledge transfer in favor of the former.

Fig. 12 graphically presents data on the use of multimedia CD-ROM by teachers in all surveyed schools.

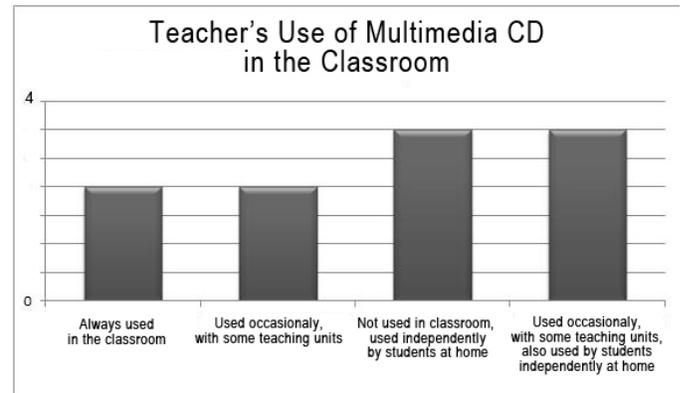


Fig. 12. Teachers' use of the multimedia CD-ROM in the classroom

The comparative analysis revealed that there is a statistically significant difference in the acquisition of knowledge between children that use multimedia CD regularly

in school and children who use it in school only occasionally and / or independently at home.

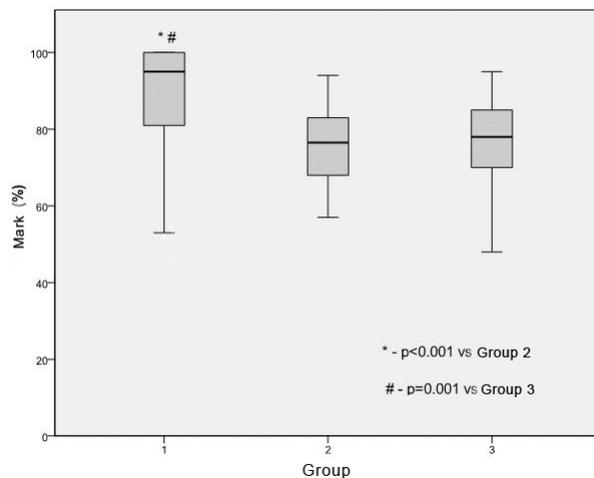


Fig. 13. Comparison of the mean of quiz scores for 3 groups of students

According to the frequency of use of multimedia CD-ROM in the classroom, 6th grade students were divided into three groups.

Group 1 - use multimedia CD continuously, with each lesson;

Group 2 - use multimedia CD occasionally in class

Group 3 - use multimedia CD occasionally in class and additionally at home on their own, following the teacher recommendation

The group 1 consisted of 41 students: 17 boys (41%) and 24 girls (59%). In the group 2 there were 56 students: 33 boys (59%) and 23 girls (41%). In the group 3, there were 65 students: 36 boys (55%) and 29 girls (45%).

The average score on the quiz for each group was:

- Group 1: 85.68% \pm 17.39%
- Group 2: 75.48 \pm 9.88%
- Group 3: 76.42 \pm 9.98%.

Analysis of variance (ANOVA) showed statistically significant differences between the results obtained in these three groups of students

- $F(2, 159) = 9.691$
- $p < 0.001$.

Tukey's post-hoc analysis of three groups (Fig.13) indicates that students belonging to group 1 ($M = 85.68$, 95% CI [80.19 - 91.17]) achieved significantly better results than students in group 2 ($M = 75.48$, 95% CI [72.84-78.13]) $p < 0.001$

They also achieved better results than students in the group 3 ($M = 76.42$, 95% CI [76.44-80.44]) $p = 0.001$.

Results of students in group 2 and group 3 did not statistically differ from each other ($p = 0.908$).

Furthermore, a comparative statistical analysis of the results proved that there is a significant correlation between results students achieved in the quiz and the teacher's use of multimedia CD in the classroom.

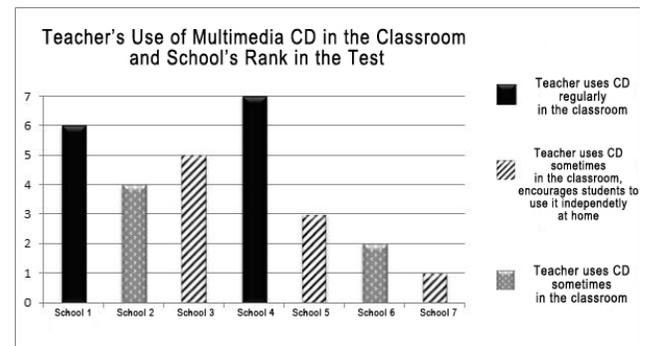


Fig. 14. Correlation between student's achievement in the computer quiz and the teacher's use of multimedia CD in the classroom

Fig. 14 provides insight into the significant differences in the use of multimedia CD (e.g. in a controlled environment or individually at home, always or occasionally) with respect to the school that students attend school and with respect to the school's rank in the quiz.

Thus, two schools where students achieved the best quiz results (rank 1 and 2, respectively or rank 7 and 6 in the reverse ranking) use multimedia CD with each teaching unit, while in the other schools (where the multimedia CD is used only occasionally in the classroom or the occasional use of the CD in the classroom is combined with independent use at home) students scored lower in the quiz and, consequently, school achieved the lower rank.

VII. CONCLUSION

This paper presents the results of our attempt to capture the links between teacher's attitudes and motivation for the introduction of multimedia literacy education in elementary schools and the student's success in the computer science course.

The research revealed that, along with (still irreplaceable) traditional approach to education (where a teacher serves as a primary source of knowledge and controls content of the course as well as the teaching and learning process), the use of high-quality multimedia materials can contribute to a better acquisition of knowledge.

Our study actually proved results already reported in other research studies.

A study by Perry [17] has shown that pupils using multimedia have higher achievement ratings, higher retention and acquire more information in less time.

The reasons are self-paced control of the learning process, one-on-one approach to information acquiring, immediate interaction and feedback as well as constant, highly effective reinforcement of the content.

Multimedia learning resources present pupils with more opportunities to apply what they learned as well as repeated interaction with the material.

Advantages of multimedia learning are:

- higher achievement ratings
- higher retention
- acquiring more information in less time
- self-paced control of the learning process

- one-on-one approach to information acquiring
- immediate interaction and feedback
- more opportunities for repeated interaction with the material

But, a better acquisition of knowledge can happen only if such materials adapts to the specific learning styles and knowledge levels of students and only if a student uses them independently (at home, in an uncontrolled environment).

We also proved that, although teachers are expected to have a positive attitude towards the implementation and use of multimedia and technology in schools, the current use of multimedia instructional materials in the classroom depends on the initiative and perseverance of teachers who are inspired and motivated by a wide range of different attitudes towards the role and applicability of the multimedia, technology and computers in teaching.

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