

The use of innovative tools in teacher education: a case study

Molnár, Gyöngyvér Ph.D.

University of Szeged, Institute of Education
Petofi S. sgt. 30-34, Szeged, Hungary
+ 36 (30) 4439244
gymolnar@edpsy.u-szeged.hu

Summary

This paper presents the results of a case study in the Classroom of the Future project. The purpose of this project was to assess students' attitudes and skills in solving problems using multimedia technologies and to measure how students can integrate multimedia tools in the educational process and in the curriculum. In the pilot study 40 senior and undergraduate students were involved. A project-based learning approach was used to investigate the challenges associated with the adoption and use of emerging technologies. Results showed that the students had very positive attitudes towards the project, enjoyed teamwork and became active participants in their learning process. The use of ICT tools supported the process and was an integral part of the learning environment and learning activities. Nearly 90% of the students' ICT attitude changed in positive direction during this semester. According to the survey, multimedia-oriented projects can be used as an innovative and effective tool.

Key words: multimedia learning environment, teacher education, problem-solving, problem-based-learning

This paper focuses on a case study in the Classroom of the Future project at the University of Szeged. It draws on a pilot study taking place in 2007. The project can be seen as the first step towards solving the contradiction between school knowledge and the skills needed in the job market (e.g. communications skills, critical thinking, problem-solving skills, ICT skills, creativity).

Multimedia in Education and the future of education

Many predictions have been made about the future of education already. Several theories equals future of education with distance learning, or future of education with technology mediated education, in which there is no need for the teacher any more. In the twenty-first century there is no longer doubt that a notable percentage of educational activity takes place online, but it does not mean that there is no need for the teacher any more. Moreover, there is a need for trained teachers who have expertise in their fields of subject as well as in the field of information technology.

Nobody doubts the importance of the technology and Internet in Education and nobody doubts the impact of computers, especially of those which are connected to communities on education (Hinrichs, 2000). Several courses are already offered on the World Wide Web (Radford, online), moreover, several schools and universities exist only on-line (see e.g. Capella University in the USA). One of the reasons of these processes is the new challenges that we meet through entering the Information Age and leaving the Industrial Age

behind. The importance of life-long learning, the importance of ICT, problem solving and communications skills are growing. Concerning the new expectations there is a rising number of white-collar jobs in the job market. Another reason is the attitudes and expectations of the new generation, namely the Net Generation, which reflect the environment in which they were raised (see table 1). In the 20th century it was said there is a generation lap between the different generations (such as Matures, Baby boomers, Generation X), but nowadays it is said there is a generation gap between the Generation X and the Net generation. Table 1 shows some of the distinctive characteristics (e.g. description, attributes, likes and dislikes) of these generations. There are further characteristic attributes as well, which show generational trends (e.g. attitudes towards the job, expectations of the workplace and job), one of the most differentiating is the attributes toward the Internet. “For the Net Gen, the Internet is like oxygen; they can’t imagine being able to live without it.” (Oblinger and Oblinger, 2005a) The differences between the three generations in the 20th century and the Net Gen are immense, which put new demands on the education of an information driven society that cannot be solved with traditional methods (Dolence and Norris, 1995).

Table 1. Comparing the generations of the 20 and 21 centuries, four generations – four lifestyles (source: Oblinger and Oblinger, 2005a)

| Attributes | Matures | Baby Boomers | Generation X | Net Generation |
|-------------|--|---|--|---|
| Birth Dates | 1900-1946 | 1946-1964 | 1965-1982 | 1982-1991 |
| Description | Greatest generation | Me generation | Latchkey generation | Millennials |
| Attributes | Command and control Self-sacrifice | Optimistic Workaholic | Independent Skeptical | Hopeful Determined |
| Likes | Respect for authority Family Community involvement | Responsibility Work ethic Can-de attitude | Freedom Multitasking Work-life balance | Public activism Latest technology Parents |
| Dislikes | Waste Technology | Laziness Turning 50 | Red tape Hype | Anything slow Negativity |

The Net generation calls for different type of teaching than the previous generations, because there are several changes in the possibilities and barriers of students in the Net generations, which determinate their lifestyle as well as expectations in connection with the education. Opportunities for education and educators arise from students’ familiarity with the technology, multitasking style, diversity, optimism, team orientation and acceptance of authority (Oblinger and Oblinger, 2005a). However, challenges come from the “shallowness of their reading and TV watching habits, a comparative lack of critical thinking skills, naive views on intellectual property and the authenticity of information found on the Internet, as well as high expectations combined with low satisfaction levels” (Oblinger and Oblinger, 2005a). The Net Gen socializes on colorful, rapidly changing, exciting films and hypes full of movements. They have got used to watching one-tenth-second-long scenes rather than longer ones. The Net Gen’s stimulus threshold is significantly higher than that of the parents’ generation.

From the hardware site there exists an increasing gap between the majority institutions’ IT environments and the technologies the Net Generation uses. It happens for the first time in the course of history that children teach their parents. In the Knowledge Society

the role of information is more and more important. This is the result of the development and spread of internet and technology, never seen before. There is a growing number of different specific TV-channels, journals, internet-sites etc., where we can find an unlimited amount of information. The potential of getting as much information as somebody wants to have puts up new demands on education as well. It is not the teacher any more who is the main source of knowledge. Ever growing part of student's knowledge comes outside of the school. However, neither in the media, nor on the internet is the information labeled according to its relevance. How can we manage this new situation? New skills must be taught, which helps students in coping with this huge mass of information, such as critical thinking, self-regulated learning, problem-solving. It must be taught how the new ICT tools can be used effectively, because this skill is considered to be one of the basic skills on the job market. To do this effectively new teaching methods must be used (e.g. collaborative learning, problem-based learning, project work, cooperative learning), which calls for a new teacher, specifically for a facilitator, who possess the high technology knowledge and skills the Net Gen expects from these (Roberts, 2005).

These factors pose to the greatest challenge for education, including higher education and teacher training. It is a hard task to meet the new demands, because nearly all of the leaders, faculty members and staff of these institutions belong to the earlier generations. With the attributes of the earlier generations they must be understand the Net Generation learners and through this understanding they must create learning environments which are needed to help the Net Gen students achieve their potential (Oblinger and Oblinger, 2005b).

According to the Microsoft vision (Hinrichs, 2000), learning in 2020 will be more technically-based and more impersonalized. „Once children become more familiar with study and communication habits, they need content to be served up to them even more effectively. Learning in 2020 combines the student personalization with the virtual mentor and sends the information out to coordinated work projects designed for community learning. Secured broadband video conferencing appears on every device, digital cameras capture visual content, workspaces grow more complex, and collaboration tools are linked directly to personalized digital libraries. These libraries stay with a learner for life. Digital highlighting, digital conversations, group note-taking and other personal annotations make the asset active throughout the individual's life and can be shared with colleagues at any time.”

But what does multimedia and what are the consequences of bringing multimedia in education in the early 21st century? Multimedia is not equivalent with online environment. However, because of the raising number of university students, more and more lessons and lectures are offered in the higher education sector and more and more are made available in an online environment. This is certainly not true in primary or secondary education. Using technology and multimedia in education does not mean excluding human interactions and face-to-face communications from education.

Multimedia is the combination of different digital media types, (e.g. images, sound, video, text; Molnár, 2007), which are accessed interactively via computer. Instead of the traditional teaching methods and materials, innovative teaching methods combined with multimedia elements in education make the use of an integrated multi-sensory flexible interactive application of teaching and learning processes possible (Neo and Neo, 2001). It is flexible because of the transition from analog to digital media domains. Paper-based photographs are accompanied by digital photos or videos, which allows greater functionality and adds new characteristics to the media type (such as image manipulation, compression, etc.). For the Net Gen, nearly every part of life is presented in multimedia format, moreover issues are even turned into online discussions (Windham, 2005).

Because of the multi-sensory feature of the multimedia materials, they results in increasing productivity and retention rates during acquiring knowledge, because people remember 20% of what they see, 40% of what they see and hear, but about 75% of what they

see and hear and do simultaneously (Molnár, 2007). This is the reason why we suggest that as many learning activities should be technology mediated as possible.

All in all, the multimedia learning environment can be an innovative tool for effective teaching and learning, can be an effective instructional medium for delivering information as well and finally it has the potential for the communicating information in a more effective manner (Agnew, Kellerman & Meyer, 1996). But technology alone will not result in higher achievement (Molnár, 2007). An interactive white board can be used similarly as a black board and the teacher can make the same didactical mistakes in front of an interactive white board as in front of a black board. The ideal lesson in the 21st Century calls for a large amount of collaboration, for a well trained teacher, for a well equipped classroom with conscious design and technological innovation to turn it into a positive learning environment.

The Classroom of the Future

The Classroom of the Future was built in 2007 in the Institute of Education at the University of Szeged. It is equipped with the latest multimedia tools (wireless projector, notebooks with wifi, ultra-mobile PCs, tablet PC, interactive white board, voting system, digital video cameras, web cameras) and with mobile furniture, which allow the easy and quick rearrangement of the room for different types of learning (frontal teaching, individualized learning, pair study or group work).

Molnár's (2007) paper focuses on the Classroom of the Future project at the University of Szeged, introduces the Classroom of the Future, presents several pictures of the classroom and shows the whole process of building the classroom of the future from a normal classroom. She points out the problems and questions arising during the realization of the project, highlights the benefits of some ICT tools and shows the main lines of research currently in progress in connection with this issue.

All in all, those students in teacher education who can learn in this room have access to learning tools that put the most important skills in the 21st century within reach. I think supporting education, supporting teacher training, enabling research with these tools is one of the most important tasks, because without well trained teachers we can not have well trained students with good skills, who will later be good experts. The classroom of the future provides students and teachers with effective tools, and prepares students to enter and successfully compete in the ever-expanding high-tech global marketplace.

Problem-based learning combined with multimedia learning environment

Problem-based learning (PBL) is a powerful, learner-centered educational method, where students have to work in small groups. This teaching method is somewhere between project work and cooperative learning with a new kind of task definition. PBL uses messy, ill-defined, complex, real world problems to stimulate and motivate students to identify and apply information, work collaboratively and communicate effectively. PBL is an innovative strategy to encourage students to "learn how to learn" via "real-life" problems (Boud & Feletti, 1999) and promotes life-long habits of learning. Students are given more and more responsibility and independence for their own learning. This results in a shift from traditional teacher and student roles to new teacher and student roles. The teacher is not the main source of knowledge any more, he or she is a facilitator who provides the educational materials, helps the students in their learning and gives guidance that facilitate their learning.

In the present study, PBL is combined with a multimedia learning environment, which enhances students' learning experience. The model used in the study is presented in Figure 1.

In the traditional teaching methods there is an interactive triangle of teacher, student and the content of knowledge. The main source of knowledge is the teacher, the students learn

in most of the cases in form of frontal teaching and the teaching material focuses on content school knowledge. In the traditional PBL environment the roles are changing: as mentioned above instead of content knowledge PBL focuses on complex problems; the teacher has a role of a coach, of a facilitator and the students are actually problem solvers. In the multimedia environment students learn in a similar way, but they can use multimedia tools by problem solving and by doing the project.

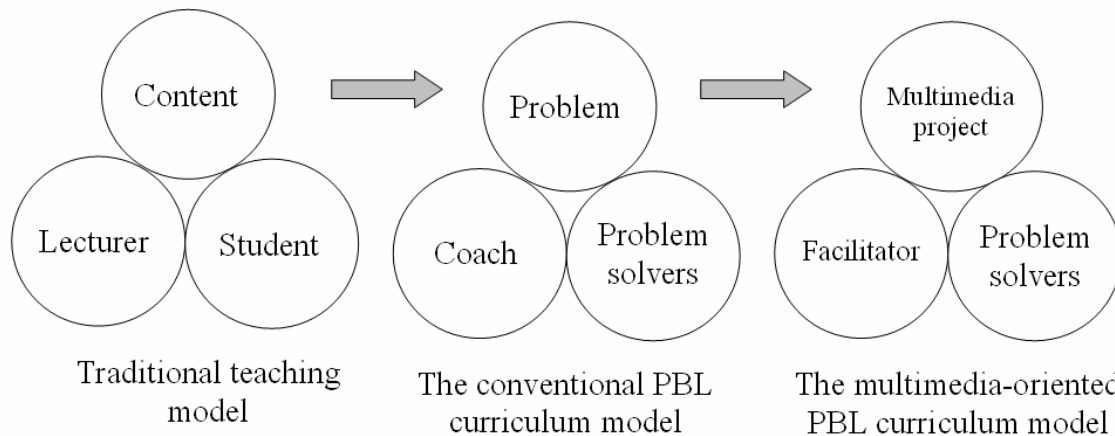


Figure 1. The multimedia-oriented Problem-Based Learning curriculum model (source by Neo and Neo, 2001)

Research

Methodology

In the pilot study 40 senior and undergraduate students were involved at the University of Szeged. During their one-semester participation in a course in educational technology, they learned how to use effectively all of the tools available in the Classroom of the Future. In the second half of the semester they had the task to propose a topic of their choice and to design and create an interactive application, a multimedia curriculum material using multimedia technology with a wide variety of sources.

There were many multimedia technologies that were available for students to create the innovative and interactive multimedia applications. These technologies ranged from hardware side such as ultra-mobile PCs, tablet PC, interactive white board, voting system, digital video cameras, web cameras, notebooks and from software side such as Movie Maker, Power Point, Interwrite and Interwrite PRS, Equation writer, Snipping pool, Ink Art, Physics Illustrator, Composition Tool, PuzzleGame.

Project-based learning (PBL) approach was used to investigate the challenges associated with the adoption and use of emerging technologies. The students worked in small groups; they could choose their own team members. Each group had to choose a topic for the project, develop it, design it and present it. By working in a group, they learned to work cooperatively and collaboratively and to accomplish a variety of activities in harmony with the project's overall aims. PBL influenced both the process by which students investigated topics related to the integration of ICT in education and the way the curriculum material was developed by the end of the semester.

With a 71 item questionnaire, at the end of the semester they were surveyed on their (1) frequency and type of different ICT tool use (in past, present and future as a teacher), (2) frequency and type of applications use (in past, present and future as a teacher), (3) changing

attitudes towards different ICT tools, (4) attitudes towards the project as a team and (5) interest and motivation in the group project work (see the relevant questions detailed in table 2). The survey used a 5-point Likert scale. Depending on the content of questions 1 stood for strongly disagree, 2 for disagree, 3 for undecided, 4 for agree and 5 for strongly agree or 1 for never, 2 for one in a month, 3 for once in a week, 4 for several times in a week and 5 for every day.

Results

Frequency and type of different ICT tools and applications use

Nearly 88% of the students used computer every day and nobody in the sample used computer once or less than once a week. Mobile phones were just as popular, 90% of the students used it every day.

The most preferred, the most frequently used applications were in connection with the students' every day life, with their habits in their spare-time and commutation forms. The top ones were the Internet browser programs ($M=4.85$, $SD=.36$), the mail programs ($M=4.70$, $SD=.55$) and the IWIW ($M=4.49$, $SD=.77$), these were followed by the chat programs such as Messenger and Skype ($M=4.10$, $SD=1.28$), however 22% of the students used chat programs only once a week or less than once a week. Software, which is more connected with learning (e.g. Word, Power Point, Movie Maker, some kind of educational software, or the usage of SDT; about SDT see Dancsó, 2007) is less popular. Figures 2 and 3 illustrate some of the percentages of students' habits in this field.

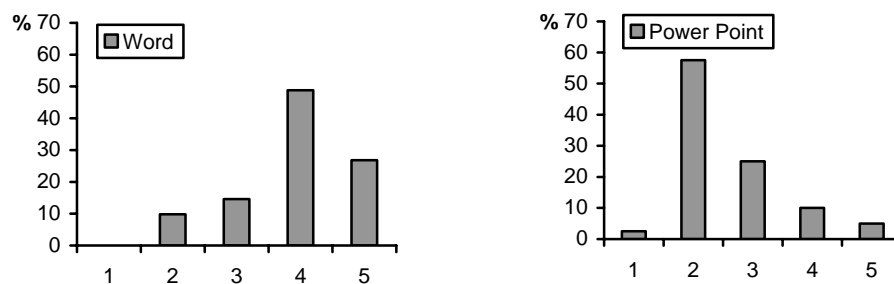


Figure 2. Frequently of the use of Word and Power Point (1 for never, 2 for one in a month, 3 for once in a week, 4 for several times in a week and 5 for every day).

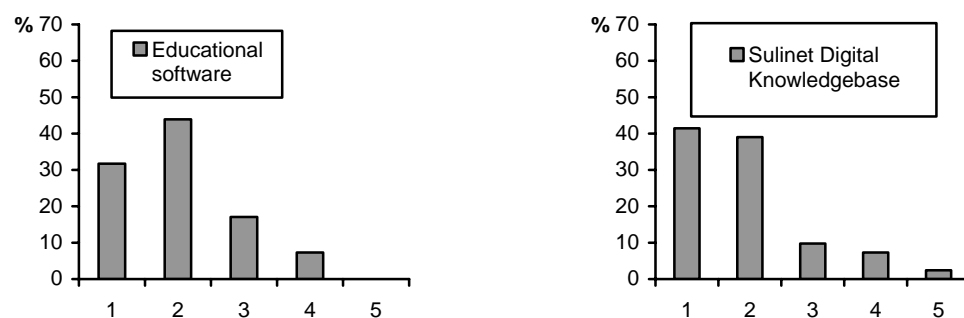


Figure 3. Frequently of the use of some kind of educational software and the Sulinet Digital Knowledgebase (1 for never, 2 for one in a month, 3 for once in a week, 4 for several times in a week and 5 for every day).

The students in the sample took part in teacher training; they will later become teachers. However, in most of the cases they did not use educational software or the SDT,

which is especially developed for teacher and contains curriculum materials in the entire field of school knowledge.

There is an opposite process noticeable in the field of internet usage. According to the results students write and read e-mails every day and search information on the WWW every day as well. Moreover, they use the internet significantly more for learning than for chatting, downloading music or playing games. This is a very positive direction in the use of the internet.

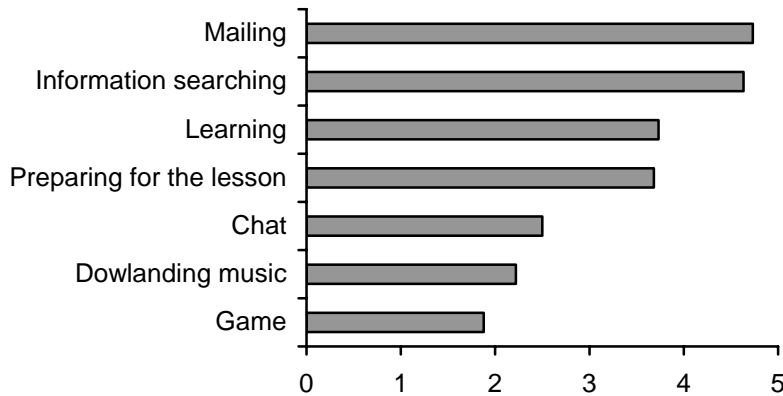


Figure 4. Frequency of the different types of internet usage (1 for never, 2 for one in a month, 3 for once in a week, 4 for several times in a week and 5 for every day).

Attitudes and changing attitudes towards different ICT tools

One part of the questionnaire contained questions regarding the frequency of usage of different ICT tools in the classroom as future teachers. In harmony with the students habits in this field the most preferred ICT tool in the classroom was the notebook and the most preferred application the internet browser. It seems the students choose among the different ICT tools according to their existing ICT skills. In most of the cases if they have some kind of ICT tool, it is a notebook. The most faculties have only notebooks and projectors and no other technical tools. It follows that nearly nobody in the sample ever used, saw or heard about the voting system, the tablet PC or the UMPC and about the interactive white board perhaps from the media, from the news before this semester.

All in all, we can say the course was successful and achieved its objectives. According to the results we can say students see the greatest potential apart from the notebook in the interactive white board and voting system. However, there are several students, who would use tablet PC and UMPC in the classroom as well. 60% of the students would use the UMPC and tablet PC minimum once a week and only 10% of the students would never use UMPC and tablet PC.

Among the different ICT tools, the inclination for the use of the UMPC proved the most predictive factor in case of using the other technical tools. Those who tend to use UMPC in the classroom, would use all of the listed ICT tools with high probability (tablet PC – $r=.83$, $p<.01$; voting system – $r=.47$, $p<.01$; interactive white board – $r=.48$, $p<.01$, projector – $r=.47$, $p<.01$, web cam – $r=.36$, $p<.05$, digital camera- $r=.33$, $p<.05$). Figure 5 and table 2 illustrate the results in connection with the frequency of use of different ICT tools and applications usage in the classroom. There are only a few significant correlations between hardware and software usage. Despite the results regarding the Movie Maker, an immense percentage of the student said this is the application that they come to like the most during the semester.

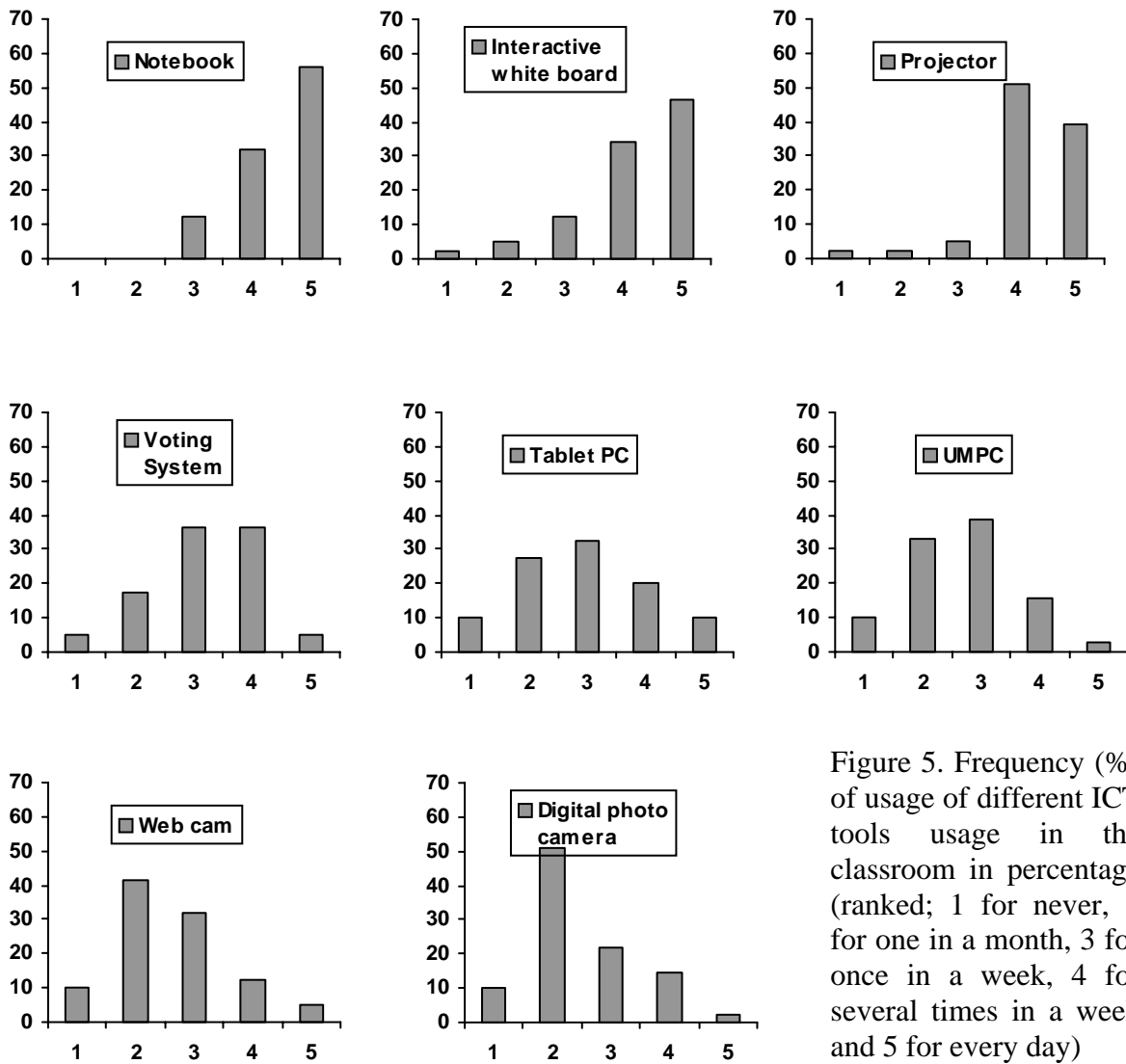


Figure 5. Frequency (%) of usage of different ICT tools usage in the classroom in percentage (ranked; 1 for never, 2 for one in a month, 3 for once in a week, 4 for several times in a week and 5 for every day)

Table 2. Frequency of use of different ICT applications in the classroom in percentage (ranked)

| | Never | Once in a month | Once in a week | Several times in a week | Every day |
|----------------------|-------|-----------------|----------------|-------------------------|-----------|
| Internet browser | | 9.8 | 12.2 | 43.9 | 34.1 |
| Word | 2.4 | 12.2 | 22.0 | 39.0 | 24.4 |
| Mailing program | 25.0 | 12.5 | 12.5 | 27.5 | 22.5 |
| Power Point | | 4.9 | 26.8 | 56.1 | 12.2 |
| Excel | 2.4 | 36.6 | 31.7 | 19.5 | 9.8 |
| Messenger, skype | 34.1 | 19.5 | 17.1 | 19.5 | 9.8 |
| Educational software | 2.4 | 12.2 | 26.8 | 51.2 | 7.3 |
| SDT | 2.4 | 14.6 | 31.7 | 43.9 | 7.3 |
| Game | 17.5 | 42.5 | 20.0 | 17.5 | 2.5 |
| Movie Maker | 5.0 | 50.0 | 30.0 | 15.0 | |

Attitudes, interest and motivation toward the project as a team

In average, the students had a positive attitude toward this multimedia-oriented problem-based learning environment. Based on the results of this part of the survey, we found five areas that were significant in shaping these students' attitudes towards the project (table 3). The first regards attitudes to the task – that is, to the project (questions 1, 2, 8 and 11 with means of 4.14, 4.45, 4.27 and 4.68, respectively). The second area regards attitudes to the motivational effect of the multimedia learning environment (questions 3 and 7 with means of 4.67 and 4.41, respectively). The third regards student's creativity and usage multimedia technology and software (questions 4 and 10 with means of 4.32 and 4.64, respectively). The fourth area regards attitudes to the deeper understanding of the subject via the project (questions 5 and 6 with means of 3.91 and 4.32, respectively) and the fifth area is the student's ability to function well as a team member, represented by questions 9 and 11, with means of 4.05 and 4.68, respectively (table 4).

Table 3. Rotated Component Matrix of the questions regarding on the interest and motivation of group work in a multimedia learning environment

| Question | Component | | | | |
|----------|-----------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 |
| p_1 | .757 | | | | |
| p_2 | .661 | | | | |
| p_3 | | .775 | | | |
| p_4 | | | .777 | | |
| p_5 | | | | .807 | |
| p_6 | | | | .847 | |
| p_7 | | .799 | | | |
| p_8 | .712 | | | | |
| p_9 | | | | | .883 |
| p_10 | | | .815 | | |
| p_11 | .529 | | | | .482 |

More than 93% of the student found they were more able to present the concept using digital multimedia, and group work with the given multimedia environment enabled them to achieve the goals absolutely. According to the results 90% of the students were strongly agree that the project in this form allowed them to be creative in their thinking, moreover, they felt very motivated doing the project. Nearly 86% of the students felt they had creative input in the project, the project enhanced their understanding of the subject and they understood the subject matter better as the project developed. Significantly less students, but still a noticeable proportion of students (80%) found the project challenging, said they were able to learn more working with their teammates and the project allowed them to think critically about the topic (table 4).

All in all, the results showed that students were very positive toward the project, enjoyed teamwork, were able to think critically and became active participants in their learning process. They realized that real life learning implies responsibility on the part of the student so that they would “own” and manage group learning. The most preferred ICT tools were the interactive white board, the UMPC and the tablet PC and the most popular programs were the voting system and the movie maker. An ambivalent result is that the students found the educational software very important and are planning to use it several times a week later

as a teachers, but based on their answers they as student use it once a month only. They do not plan to integrate messenger, skype and any kinds of e-mail programs later in the educational process.

Table 4. Means and percentages of students (ranked)

| <i>Questions asked</i> | <i>Mean score</i> | | <i>SD</i> | |
|---|-------------------|------------|--------------|------------|
| | <i>point</i> | <i>(%)</i> | <i>point</i> | <i>(%)</i> |
| 11. The group was able to achieve its goals | 4.68 | 93.6 | 0.48 | 9.5 |
| 3. We were better able to present the concept using digital multimedia | 4.67 | 93.3 | 0.66 | 13.2 |
| 10. The team was able to create the project with the existing software | 4.64 | 92.7 | 0.58 | 11.6 |
| 2. The project allowed me to be creative in my thinking | 4.45 | 89.1 | 0.74 | 14.8 |
| 7. I felt very motivated doing the project | 4.41 | 88.2 | 0.73 | 14.7 |
| 4. I was able to have creative input in the project | 4.32 | 86.4 | 0.57 | 11.4 |
| 6. The project enhanced my understanding of the subject | 4.32 | 86.4 | 0.78 | 15.6 |
| 8. I understood the subject matter better after the project development | 4.27 | 85.5 | 0.63 | 12.6 |
| 1. I found the project challenging | 4.14 | 82.7 | 0.71 | 14.2 |
| 9. I was able to learn more working with my teammates | 4.05 | 80.9 | 0.9 | 18.0 |
| 5. This project allowed me to think critically about the topic | 3.91 | 78.2 | 0.87 | 17.4 |

By integrating multimedia into the teaching and learning process, the conventional teaching model is reinforced. The multimedia project in this course enabled the students to exercise their creative thinking, problem-solving and ICT skills, work collaboratively to gain team-based experience. According to the survey, multimedia-oriented projects, like many other problem and project-based learning solutions, can be used alternatively as innovative and effective tool.

Acknowledgments

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