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Implementation of SMART Technology into Primary Schools

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Abstract: The study deals with the current issue in the primary educational field on the local Czech scene it deals with the introduction of interactive white-boards and tablets into the process of education where the economic aspect is highlighted. Usage of digital devices from the local and global perspective is discussed in the literature review, state of art in the implementation of tablet devices into school is briefly described and the core of the paper is in calculating the costs of a purchase of SMART technology equipment per one class in the primary school. The utilization of ICT and teachers problem-solving skills are also in the article evaluated.

Key words: Benefits, costs, education, implementation, SMART technologies, utilization

INTRODUCTION

The integration of advanced technologies into the process of education is being discussed in government, academic and public environments. Advanced technologies have even become a part of framework educational programme for basic (i.e., primary and lower secondary) education within the system of curricular documents.

There is a great deal of proponents who advocate massive implementation of advanced technologies into the system of education but there are opponents among professionals on the local Czech scene as well. The indisputably significant trend in implementation of smart technologies is evident. Primary and secondary schools have already been equipped but there are plenty of them which are going to purchase smart devices like Interactive White-Boards (IWB) and tablets. Each project contains an integral financial segment. The study discuses one fragment of the economic issue it is focused on working out costs on purchase of SMART technology equipment per one class in the primary school.

'SMART' is a term with a wide range of meanings; sometimes it is perceived as a change of education system. This change reaches the national policy, especially in the form of investment into educational information technology, into implementing smart advanced devices like tablets and interactive whiteboards into the process of education. Crook discusses import of SMART technology into education as a challenge for traditional practises which have to adapt to interactive opportunities (Crook, 2016).

The following definition of the term 'SMART' is taken from a scholarly journal Interactive Technology and Smart Education: Smart Education "SMART" is used as an acronym that refers to interactive technology that offers a more flexible and tailored approach to meet diverse individual requirements by being "Sensitive, Manageable, Adaptable, Responsive and Timely" to educator's pedagogical strategies and learner's educational and social need's.

The information and communication technology has played its nearly unreplaceable role in our lives where education is no exception. As for tertiary education, computer based education, e-Learning as well as m-Learning has been well established, the situation in kindergartens, primary and secondary schools differs, even if a significant shift has been made. Still not all kindergartens, primary or secondary schools are equipped with at least one interactive white board which could be used by children and students. A study was run with 10 primary schools, researchers found out that only 60% of these schools used interactive white board. The researchers could see financing as one of key problems (Skutil and Manenova, 2012).

Currently strong government involvement can be seen. Ministry of Education announced their plan to introduce tablet devices into schools (Kopecky, 2016). "The objective of the project is the implementation of ICT into the curricula of primary and secondary schools and increase of ICT competences of teaching staff at schools when using touch devices in the educational process both in didactics and in classes".

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Literature review: This chapter brings a list of relevant academic papers covering various aspects of the discussed issue like rules in the usage of tablet devices (Goh *et al*., 2015) pros and contras in utilization of Interactive White Board (IWB) and tablet computers (Fekonja and Umek, 2015) creating of teaching materials (Lapenok *et al*., 2015) ongoing classroom presence for the hospitalized children (Hopkins *et al*., 2014), middle school student's perceptions regarding the integration of tablets into the learning process (Gorhan *et al*., 2014) digital pencil (Thienen *et al*., 2015) and digital writing tool versus traditional writing tool (Thienen *et al*., 2015; Wollscheid *et al*., 2016) effectiveness of touchscreen devices (Wollscheid *et al*., 2016). An interesting qualitative study takes readers to primary school setting to the first grade classes. Positives and negatives of an interactive whiteboard and tablet PC were explored by means of a multi-perspective approach (Fekonja and Umek, 2015). Utilization of smartphones, tablets for study purposes at the primary school setting and for free time is discussed in the study covering national and international scene. Flipped classroom and web based teaching is a study illustrating a local Czech scene, see more (Spilka and Manenova, 2014).

The intention to introduce tablets to school isn't just a topic of the Czech Ministry of Education, the same plan adopted Turkish government as well. "Tablets in Education" was a research with nearly one thousand participants which was run in Turkey (Gorhan *et al*., 2014). The last inhere mentioned paper deals with digital devices and teachers and their readiness to create and use electronic educational material. Methodological support of teacher training together with the system of assessment were elaborated and consequently presented in the study (Fekonja and Umek, 2015).

MATERIALS AND METHODS

The research procedure consisted of the following phases:

- The first phase dealt with the introduction to the topic of implementation of technology into schools and into the process of education
- Another explored area was the readiness of teachers to use advanced technology when getting prepared for the classes and during the teaching process itself
- The next phase discussed selected economic aspects of introducing technologies into primary schools

Following primary and sources were used. Selected websites of primary schools in two regional cities in Hradec Kralove and Pardubice were analyzed. The other relevant secondary source contained web-sites on digital devices and education, e.g., EDUIN, boxed, technical literature, information gathered from professional journals, discussions or participation at professional seminars or conferences. Next step concluded selection and categorization of available information from published papers and documents.

Work in the field followed: top management of selected institutions was contacted and then appointments and meetings with directors and teachers from three primary schools were organized. Information on costs of purchase and implementation of technology, its maintenance and teacher's training was collected in individual schools. Gained data were processed and presented in an anonymous form to avoid possible problems and misunderstandings or legal pitfalls.

The amounts in calculations are listed in both CZK and EUR. The calculations were based on an exchange rate when 1 EUR equaled 27 CZK.

Economic aspects of implementation of tablets to school and readiness of teachers to use advanced technology: At the preparatory stage of the introduction of technology into schools it is necessary to calculate the budget with expenses that are related to the implementation of technology. Another area of key importance is to ensure readiness and a level of competences of teachers to use advanced technology when getting prepared for the classes and during the teaching process itself or to ensure administration of technology management and regular software updating, etc.

Results from OECD: Information and Communication Technology (ICT) is a major component of economic growth in all OECD countries. Table 1 is based on data drawn from the survey of adult skills (OECD., 2016), it shows that 47% of primary and secondary teachers have good ICT and problem solving skills. This proportion ranges from 64% in Korea and 62% in England. Czech Republic got 59%. On average across participating countries and subnational entities, 83% of teachers have moderate or good ICT and problem solving skills. In the Czech Republic is this value also 83%. In the comparison with average results 4% refused the computer-based assessment, 5% failed ICT core test, 32% has moderate ICT and problem-solving skills and 59% has good ICT and problem solving skills. A sign 'c' in the Table 1 means that there are too few observations to provide reliable estimates, a sign 'm' in the Table 1 and 2 means that the data are not available.

Table 1: Teacher's skills and readiness to use information communication technologies for problem solving (%) (OECD., 2016)

Parameters	Czech Republic	OECD
Group 0 (no computer experience)	c	m
Group 1 (refused the computer-based assessment)	4	m
Group 2 (failed ICT core test or minimal problem-solving skills)	5	11
Group 3 (moderate ICT and problem-solving skills)	32	36
Group 4 (good ICT and problem-solving skills)	59	47

Table 2: Teacher's use of ICT at work, ICT skills required at work and teachers´confidence in their computer skills (OECD., 2016)

Parameters	Czech Republic	OECD
Index of use of ICT skills at work	1.9	1.9
Moderate or complex ICT skills required at work (%)	72	73
I have the computer skills needed to do my job (%)	99	87

Important is not only question of teacher's skills and readiness to use ICT for problem solving but also teacher's use of ICT at work, skills required at work and teacher's confidence in their computer skills. Table 2 presents the situation in this area.

Primary and secondary teachers, 25-64 years-old, participated in the survey. In the survey of sdult skills (OECD., 2016) respondents were asked if they had the computer skills needed to do their job. In all national and sub-national entities that participated in the survey, 87% of teachers replied that they did. In the Czech Republic (99%) and Korea (97%) more than 95% of teachers replied affirmatively. In general, the use of ICT skills at work is around the average in the Czech Republic. Results show the positive relationship between teacher's use of ICT skills at work and the percentage of teachers with good ICT and problem-solving skills. The proportion of teachers with good ICT and problem solving tends to increase as teachers use those skills more at work.

Equipment of one class in the primary school-budget and costs: Interactive whiteboards, tablets, laptops, netbooks, smart mobiles are defined as digital devices as technology which supports the learning/teaching process. The budget will be elaborated for primary schools but it will be possible to apply it in secondary schools as well. Each classroom will be equipped with one interactive whiteboard and one tablet of higher quality for the teacher and 20 tablets for students. Currently, according to, the Ministry of Education the minimum number of students is 17 and maximum 30. The number of pupils in the class may, also, be influenced by the kind of school, e.g., schools with multiple-classes are recommended to have lower number of pupils than regular schools.

Calculations are based on the data from the statistics of the Ministry of Education with average amount 19.7 of children per class in the primary school in 2014/15. Calculation of tablets for learning/teaching will be based on these data from the statistics. But there are 28-30 pupils in plenty of primary schools. Calculations can be modified accordingly.

The tablet for the teaching/learning purposes will be selected from the wide current tablet offerings. The screen size should be 10.1" as recommended in Test of Tablets. Depending on the size of the interactive whiteboard, the holder and other equipment is supposed to be greater and more robust than equipment in kindergarten.

A special station could be bought where the tablets will be regularly docked, charged, synchronized, restored, monitored or blocked. Part of this special device is a Wi-Fi access with installation, service and training costs. This sort of equipment usually works with selected kinds of notebooks, e.g. with already mentioned Acer Aspire Switch 10, the Lenovo IdeaPad Miix 2 10" or the Asus T100 HA. In this case the company which offers these products will not be explicitly stated. However, it can be noted that this company has low prices in the Czech market. In case of selecting another company increase in costs can be expected.

Even though the technological readiness of teachers in the Czech Republic is at a good level and that teachers have gained good literacy competence it can be expected that teachers will get enrolled into a training course where they will learn how to work properly with a new equipment and how to use special software. Stated figures come from the current prices of primary teacher trainings.

There is a possibility that within a new programming period of funds from the European Union a set of free seminars will be announced, e.g. EDULAB organization (MEYS., 2016) already offers applications for primary schools.

Costs on training and preparation of technical staff will be incorporated into the budget. If possible, those required services will be provided within the device installation and delivery. In the future if teachers themselves will not be able to provide proper maintenance, these services will be done by special technician at school or they will be outsourced if necessary. At the same time it is expected that primary schools will have to update used educational applications. It means that further costs will have to be spent on the purchase of new interactive device applications that will be used with children in the class in the future.

Basic technical knowledge should be ensured for managers of individual educational institution as well. Access to the internet in primary schools is a standard issue but there is also frequent problem with the signal which doesn't cover all school area. That is why

Table 3: Non-recurring expenses-primary school

Costs	Price (CZK)	Items	Total (CZK)	Total(EUR)
Training of managers	3,000	1	3,000	111
Training of teachers	3,500	1	3,000	111
Training of technical staff	3,500	1	3,500	130
Purchase of the IWB and its accessories (holder, PC, etc.)	64,000	1	64,000	2,370
Purchase of the educational applications	1,500	20	30,000	1,111
Purchase of the tablet for the teacher	8,019	1	8,019	297
Purchase of the tablets pupils	7,725	20	154,500	5,723
Tablet station	18,174	1	18,174	673

there might arise initial nonrecurring expenses on implementation of stronger Internet access with wider network coverage depending on the size of the school to some 50,000 CZK (1,852 EUR).

The calculation is based on one teacher in the class as is usual in the Czech Republic. A lesser amount of money from the budget will go on training and preparation of the technical staff. It is evident that new applications will have to be purchased into the interactive device which will be used during classes. Managers are supposed to have or gain basic competence in the use of advanced technology as well.

Charges for regular yearly trainings together with charges for updates of materials will belong to the category of regular charges. Charges for the internet or servicing equipment will be excluded from the calculation because the school would the internet connection even without SMART technologies. These charges are estimated at 8,000 CZK (296 EUR) per year. Updating of materials will likely be the most costly part. In Table 3 there are described the non-recurring expenses expected for primary schools.

Nonrecurring expenses associated with the introduction of SMART technologies into the process of instruction in primary school can be calculated at about 284,193 CZK (10,526 EUR) per class in case that twenty educational applications will be purchased. If there is no tablet station the costs will be lower, they will go down to 266,019 CZK (9,853 EUR). If the station is bought together with 30 tablets which can be docked there the costs will reach 361,443 CZK (13,389 EUR).

The purchase of apps licenses might result in an increase in costs in nonrecurring expenses. As an illustration can be used EDU-LAB (Anonymous, 2016) organization. It offers whole packages where Mathematics for primary schools with 5,498 educational materials costs 69,900 CZK (2,589 EUR). Then it offers a variety of opportunities to learn the English language from over 19,900 CZK (737 EUR)-39,900 CZK (1,478 EUR). Applications and implementation of technology is more financially advantageous for greater schools because school licenses may be used throughout the school. The more classes will be involved, the lower cost of application purchase per student.

Digital material for educational purposes called DUMY for short is a widely utilized web which offers wide range of free electronic materials. These materials differ from materials designed by Edu-Lab. (2016). Free materials are less interactive than materials from EDULAB. Another known and widely used product is a program Colored stones (Emerald Group, 2017).

RESULTS AND DISCUSSION

Necessity of the introduction of tablets and interactive devices into primary schools in the coming years has been and will be a hot topic in the Czech Republic, currently, according to data from the Czech Statistical Office there are 22.4 computers per 100 pupils in the primary school. If we focus on computers with an Internet connection available to children in the primary school, the situation still isn't at the sufficient level. In the primary school the statistics shows 16.3 available computers. For this reason, we can see great potential in introducing modern technologies in primary schools.

In the Czech Republic there is a wide span in the approach, acceptance and utilization of SMART technology in the primary education. 99% of teachers believe that their competence in the use of ICT is very good and 72% cited moderate or complex ICT skills required at work. According to the test 91 % of teachers have moderate ICT and problem-solving skills or good ICT and problem-solving skills. In the language of numbers, we are high above the OECD average.

School top management is currently waiting for the new projects launched by the European Union for the program period 2014-2020. A lot of schools face problems with finances and planning. That is why this study discussing the economic aspects of the financing of introduction of advanced technologies into the educational process has been written. The study elaborated presumed costs which are connected with introduction of new SMART technology into schools.

The cost of investment of SMART technologies into one class may be around 115,000 CZK (4,259 EUR). As for primary schools, the costs will rise by eventual training of technical staff and purchase of tablet for students.

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There is an issue which might raise a discussion is there dependency between sources and spending? In case that the school will fund new equipment from the project or gift and not from own budget it could be expected that the school will not consider the price of the equipment as a major criterion and we can assume that the project costs will rise. Another question stems from the hypothetical situation when the school dares to invest more into the technical equipment than is necessarily required, e.g., into more powerful internet to cover all institution premises. Will the costs finally increase or decrease? Could higher investments lead to lower operational costs?

Currently new possibilities of applying for projects are announced. The key principle of the operational programme research, development and education is the development of human resources for the knowledge economy and sustainable development in a socially cohesive society and is supported by interventions in the context of several priority axes. Supported areas include e.g., equal access to quality preprimary, primary and secondary education and technical assistance.

CONCLUSION

In conclusion, implications of advanced technology on students are discussed. There is a wide range of possible implications ranking form positive to negative ones. Among positives ranks the chance to explore or visualize the study field which is difficult or even impossible without this kind of technology, e.g., video footage of a complex experiment. If smart devices aren't financed from family budget another positive should be highlighted; children from lower income families or families not willing to buy or disapproving this kind of devices will have chance to learn and practice how they work. When it comes to negatives, the ICT dementia, dependence on technology or merge of real and virtual worlds are worth mentioning. Some positives can become at some stage negatives and vice-versa. The role of the family is irreplaceable.

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