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ERGONOMICS OF WORKSTATION IN THE COMPUTER CLASSROOM AT A PRIMARY SCHOOL

Abstract

This article deals with the ergonomics of computer workstation at primary school. There were chosen 19 primary state schools (9 urban, 10 rural schools) what represented 27 computer classrooms in the Banská Bystrica Region (Slovak Republic). The survey was realized by elaborated questionnaire that was aimed at type of computers, display screen, keyboard, work desk and work surface, work chair, space requirement. We found that a big problem in all computer classrooms is stable table (monitor, keyboard is too high, not foot support) and chairs are without moving and impossibility of height adjustment, which results in uncomfortable seating for pupils from first to ninth grades.

Key words: ergonomics of workstation, computer classroom, primary school.

ERGONOMIA STANOWISK ROBOCZYCH W PRACOWNI KOMPUTEROWEJ SZKOŁY PODSTAWOWEJ

Abstrakt

Artykuł ten podejmuje temat ergonomii komputerowego stanowiska roboczego w szkole podstawowej. Wybrano 19 szkół podstawowych (9 miejskich, 10 wiejskich), co stanowiło 27 pracowni komputerowych w regionie Bańskiej Bystrzycy (Słowacja). Ankieta została przeprowadzona z wykorzystaniem sondażu diagnostycznego, który uwzględniał rodzaj komputera, ekranu, klawiatury, biurko komputerowe oraz powierzchnię do pracy, krzesło oraz wymogi dotyczące przestrzeni roboczej. W wyniku sondażu stwierdzono, że dużym problemem we wszystkich klasach komputerowych jest stabilny stół (monitor, klawiatura jest za wysoko, brakuje oparcia na stopy), a krzesła nie są mobilne oraz nie można ich dostosowywać do różnych wysokości, co w konsekwencji powoduje, że uczniowie w klasach od pierwszej do dziewiątej siedzą w niewygodnych pozycjach.

Słowa kluczowe: ergonomia stanowisk roboczych, pracownie komputerowe, szkoły podstawowe.

Introduction

We would say that the jobs where some work at the computer is predominated above the other activities have been increasing. Millions of people work with computers every day[1] or a large part of the day. At the same time, it is also important to point out the negative aspects of this work in the case of the basic work principles connected with the computer and the basic principles for ergonomics workstations which have not been kept.

Ergonomics is the Greek word and its means Laws of Work. It is a science that studies work in various environments and the tools used to perform tasks in those environments, with the main goal to match the capabilities and limitations of the human body[2]. Ergonomics is the study of how we interact with our working environment and how these interactions can be improved so that our well-being is maximised[3]. It is important to incorporate ergonomic principles to work when the working posture can affect performance, attention and creating pain to help with breathing, circulation, attention, concentration. Correct chair height, adequate equipment spacing and good desk posture can help the stay comfortable[4].

Sitting in a bad posture can cause back ache and also affect spine and rib cage which in turn can have negative effect on heart and lungs. It can also affect our energy output, make us look heavy and out of shape, cause stress, and cut off circulation [5]. Kelly[6] adds that the poor sitting posture inhibits blood flow, creates muscle shortening, stresses back muscles and compresses spine, can inhibit learning, compresses diaphragm – affects breathing, influences voice quality.

Eye and vision problems connected with computer use are dry or red eyes, double vision, eyestrain, headaches, blurred distance or near vision, neck/back ache, and light sensitivity.

Survey of American professionals, who observed the causes of headaches and frustration when working with the computer recognizes that 94 % of respondents indicated that their personal life is affected by computers and the internet. Every third of this group confirmed the symptoms of stress due to the lack of knowledge on work with computer (new versions) and technical difficulties while working on the computer (restarting, freezing or general slowness of the system)[7]. Digital literacy of nowadays pupils and students means some ability to orient effectively and critically in order to gain, to elaborate and to create information by the help of widespread scale of digital technologies which will result into success on the future labour market[8]. Life with computer is a matter of course for children, pupils, students. Therefore it is

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[1] *Computer Workstations eTool. Occupational Safety & Health Administration*, http://www.osha.gov/SLTC/etools/computerworkstations/ [2015-05-15].

[2] M. Kelly, *Ergonomics in the Classroom: Position for learning*. 2013, www.gatfl.org [2015-05-15].

[3] *Office ergonomics: workstation comfort and safety*, http://www.mydr.com.au/pain/office-ergonomics-workstation-comfort-and-safety [2015-05-15].

[4] Council Directive 90/270 EEC of 29 May 1990 on the minimum safety and health requirements for the work with display screen equipment of Article 16 (1) of Directive 87/391/EEC.

[5] *5 everybody habits that are killing you slowly!*, http://kokofeed.com/2015/01/15/5-everyday.habits-that-are-killing-you-slowly/ [2015-05-15].

[6] M. Kelly, *Ergonomics in the Classroom: Position for learning*. 2013, www.gatfl.org [2015-05-15].

[7] M. Bórik, *Ako predchádzať stresu a chorobám z počítača*, http://www.zive.sk/clanok/44912/ako-predchadzat-stresu-a-chorobam-z-pocitaca [2015-05-15].

[8] J. Véghová, *Moderná škola potrebuje digitalizáciu*, http://profesia.pravda.sk/tlac/283525-moderna-skola-potrebuje-digitalizaciu/ [2015-02-04].

needed to educate everyone to be able to avoid all negative influences while working on the computer, with respecting the main principles of ergonomics.

Above all, the most important are those computer workstations at the primary schools[9], where the aim should be not only to teach the pupils how to work with the computer well (not only to gain and to work out information) but also to use the computer without any effort and eliminating the burdens such as:
- eyesight,
- musculoskeletal disorders (MSDs),
- neuropsychical stress.

The aim of this realized survey is the ergonomics of computer classrooms at the primary schools – ergonomics of computer workstations and the computer layout in each primary school in the Banska Bystrica region.

The reasons why we have decided to deal with this topic are:
- above mentioned information,
- information from school webpage dealing with testing the chosen primary school pupils – the ninth grade classes "Testovanie 9" for the next year via the computer (online)[10],[11], Fig.1.

Fig. 1. Testing via the computer (online)

Methodology of the survey

For our survey, we had chosen only the state schools – urban and rural ones, from the total number of 37 primary schools in the Banská Bystrica region (Slovak Republic). The survey, dealing with ergonomics of computer classrooms, was directly realized in 19 primary schools (9 urban, 10 rural schools) what represented 27 classrooms, in the period from 12.3.2015 to 7.5.2015.

We elaborated the questionnaire to gain data in the framework of:
- Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment[12] ,

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[9] *ERGOKIDS. Safe Computer Workstation Design for Children*,
http://working-well.org/Website/kidstation.html [2015-05-15].

[10] *Deviatakov z 200 škôl otestujú tento rok online*, http://www.skolskyportal.sk/clanky/deviatakov-z-200-skol-otestuju-tento-rok-online. [2015-02-04].

[11] *O rok budú prvé maturity a testovanie 9 cez počítač*,
http://www.skolskyportal.sk/clanky/o-rok-budu-prve-maturity-testovanie-9-cez-pocitac [2015-02-04].

[12] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

- Council Directive 90/270 EEC of 29 May 1990 on the minimum safety and health requirements for the work with display screen equipment of Article 16 (1) of Directive 87/391/EEC[13],
- Decree of the Ministry of Health of Slovak Republic No. 527/2007 Coll. of the details of the requirements for facilities for children and youth[14],
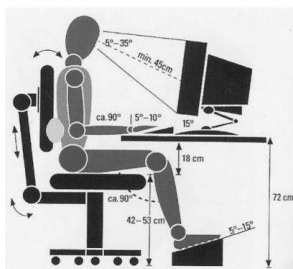- ideal set-up of workstation ergonomics[15] by Fig. 2.

Fig. 2. Scheme of workstation ergonomics – ideal set-up

The questionnaires were distributed in the particular schools and then together with the specialists, who teach in these computer classrooms or with the directors, were finally filled in.

In the questionnaire, we focused on:

- the type of computers,
- display screen (swivel and tilt, with no flickering, being free of reflective glare and reflections, distance pupil – detail 500 ÷ 700; minimum 400 mm),
- keyboard (tiltable; matt surface to avoid reflective glare; if symbols on the keys are adequately contrasted and legible, separate from the screen; the space in front of keyboard to provide support for the hands and arms),
- work desk (sufficiently large, low-reflectance surface, flexible arrangement of the screen, keyboard, documents…, work desk height, holder for documents),
- work chair (stable without movement or with movement, easy freedom of movement, comfortable position, seat adjustable in height (260 ÷ 460 mm), the seat back adjustable in height and tilt, footrest),
- space requirements – 2 m^2 per 1 workstation,
- computer workstation layout.

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[13] Council Directive 90/270 EEC of 29 May 1990 on the minimum safety and health requirements for the work with display screen equipment of Article 16 (1) of Directive 87/391/EEC.

[14] Decree of the Ministry of Health of Slovak Republic No. 527/2007 Coll. of the details of the requirements for facilities for children and youth.

[15] Pracovisko s počítačom. Príručka pre postup zamestnávateľov a zamestnancov. Pravidlá dobrej praxe BOZP. NIP, 2005.

Results and discussion

The results of the survey are the following:

Monitor
In the urban computer classrooms there are mainly LCD monitors; in the rural computer classrooms it is only 50 %, Tab. 1.

Table 1. Monitor

Type of monitor	LCD monitor	CRT monitor	LCD/CRT monitor	Σ classrooms
Urban schools	12		2	14
Rural schools	6	2	5	13

The image on the screen was stable, with no flickering or other forms of instability. The screens were free of reflective glare and reflections. There is an opportunity to tilt the display screen but there is not the one to set the height of the display screen in some cases. I think, there isn´t possibility to suit the needs of the pupils easily and freely.

Work desk or work surface
According to the Directive[16] and the Government Regulation[17] the work desk has to be sufficiently large for flexible arrangement of the screen, keyboard, document. Our findings are as follows, see in Tab. 2, 3.

Table 2. Length of the work desks (l)

Type of school	Government Regulation No. 276/2006 Coll., l = 1200 mm		
	l [mm]	most often l ≥ 800 mm	l = 600, 650 mm
Urban schools	600 ÷ 1200 mm	10 classrooms	3 classrooms
Rural schools	600 ÷ 1400 mm	8 classrooms	4 classrooms

The most often **length of the work desks** in computer classrooms is the length l ≥ 800 mm which doesn´t fulfil the basic conditions of the Directive[18] and the Government Regulation[19]. The length of the work desks of 600 or (650) mm is in 3 urban and in 4 rural schools. The first problem of this dimension is by classical arrangement of keyboard with length of 450 mm and mouse pad of 200 mm. There is no place for pupils´ documents, books, mouse pad and so on. This lack can be a main problem when testing via computer. The pupils are able to follow some

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[16] Council Directive 90/270 EEC of 29 May 1990 on the minimum safety and health requirements for the work with display screen equipment of Article 16 (1) of Directive 87/391/EEC.

[17] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

[18] Council Directive 90/270 EEC of 29 May 1990 on the minimum safety and health requirements for the work with display screen equipment of Article 16 (1) of Directive 87/391/EEC.

[19] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

information at schoolmate´s display screen on the left and on the right too, because there is no space between work desks.

Table 3. Width of the work desks (w)

Type of school	Government Regulation No. 276/2006 Coll. w = 750 mm		
	w [mm]	most often l ≥ 700 mm	w = 450 ÷ 600 mm
Urban schools	500 ÷ 900 mm	10 classrooms	4 classrooms
Rural schools	450 ÷ 800 mm	5 classrooms	8 classrooms

The width of the work desks is more suitable in the urban schools, the value approximates to the value in Regulation[20]. The width of 800 to 900 mm can be problem in the case of using the special atypical work desks (laboratory) with the increased surface where monitor is placed. It cannot be set.

In 12 classrooms (8 rural and 4 urban) the width of work desks ranges only from 450 to 600 mm. In cases of the CRT monitors (with width of 420 mm and width of keyboard 160 mm) the whole work surface is covered with monitor and keyboard. The problem of small width of work desk is also with LCD monitors. In this arrangement there is no space in front of keyboard to provide support for the hands and arms and the basic pupil´s distance – detail is not met there (minimum of 400 mm).

The document holder is not used in the computer classrooms.

Keyboards were classic, no ergonomics shape, tiltable, with matt surface, symbols on the keys are adequately contrasted and legible, they are separated from the screen. The space in front of keyboard does not provide adequate support for the hands and arms in some cases that is given by small width of work desks.

The height of the work desk must correspond to the body height (650 mm for women and 750 mm for men, if it is adjustable so in this range, the Government Regulation[21]). For assessing the height of work desk in computer classrooms the main document was Health Ministry Decree No. 527/2007 Coll.[22], on the details of the requirements for facilities for children and youth, Appendix (Size table of school furniture), Tab. 4.

Table 4. Height of the work desks (h)

Type of school	Health Ministry Decree No. 527/2007 Coll. h = 460 ÷ 760 mm	
	h [mm]	most often l = 750 mm
Urban schools	700 ÷ 790 mm	9 classrooms (keyboard at about 100 mm below)
Rural schools	640 ÷ 780 mm	5 classrooms (keyboard 640 ÷ 720 mm)

[20] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

[21] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

[22] Decree of the Ministry of Health of Slovak Republic No. 527/2007 Coll. of the details of the requirements for facilities for children and youth.

We believe that the height of the table (which is most often 700 ÷ 750 mm) is disproportionately high, because in the classrooms there appear pupils from the first up to the ninth grade, which corresponds to the height of children from 100 ÷ 172.5 cm, (Health Ministry Decree No. 527/2007   Coll.). The obtained values of the table heights rather correspond to the men's body size (Government Regulation No. 276/2006 Coll.)[23].

Tables are of different types – computer, classic school desks, made yourself, not adjustable in height, Fig. 3.

Fig. 3. Tables and work chairs of different types
Source: own work

Work chair must be stable, to allow easy freedom of movement and comfortable work position. The seat should be height-adjustable so that the feet are effortless and reach the floor with entire surface (footrest). According to the Government Regulation No. 276/2006 Coll.[24], the seat should be adjustable in height in the range of 400 ÷ 520 mm. According to the Health Ministry Decree No. 527/2007 Coll.[25], for school chairs this interval is from 260 mm to 460 mm, Tab. 5.

Table 5. Work chair

Type of school	Health Ministry Decree No. 527/2007 Coll. h = 260 ÷ 460 mm	Classrooms with chairs without movement	Classrooms with chairs with movement
Urban schools	440 ÷ 450 mm	upholstered (5) wooden (4)	upholstered (5)
Rural schools	450 mm	upholstered (6) wooden (5)	2 Upholstered (2)

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[23] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

[24] Government Regulation of Slovak Republic No. 276/2006 Coll. on the minimum safety and health requirements for the work with display screen equipment.

[25] Decree of the Ministry of Health of Slovak Republic No. 527/2007 Coll. of the details of the requirements for facilities for children and youth.

Quality work chairs are probably the most important in reducing the burden of MSDs, and our survey shows that the schools paid little attention to these ones. 20 classrooms have chairs without movement the seat and the seat back are not height-adjustable. It is impossible to observe basic rules of seating and using the computers, especially in terms of complying with the rules of right angles (of hands and legs). There are different types of wooden chairs , armchairs and the like used. School chairs with a metal frame are very heavy and any manipulation with them is difficult. Neither of the classrooms is equipped with a footrest.

According to the Health Ministry Decree No. 527/2007 Coll.[26], there must be at least 2 m^2 of computer room per pupil. Only for 3 computer classes this value is lower.

Even if the space requirements is satisfactory, there is problem in arranging the computers in a U shape (only from the viewpoint of dimensions), when the centre of the classroom is free. Computer work stations are close to each other and the inadequate table width limits the freedom of movement and comfort seating.

Conclusion

The urban computer classrooms are better equipped than the rural ones mainly in: having greater number of LCD monitors, larger work desk but the height was too big. In the rural computer classrooms the work surface is smaller but the height of work desk corresponds more to the legislation. Lack of width of tables causes discomfort when using the computer and does not allow easy movement.

Work chairs in 20 classes (urban and rural) are not mobile, the seat and the seat back are not height-adjustable.

To sum up, we found that a big problem in all computer classrooms are stable tables (monitor, keyboard is too high, no foot support) and chairs (impossibility of height adjustment), which result in uncomfortable seating for pupils from the first to the ninth grades (head extended, rolled and elevated shoulders, extended arms, wrist higher than elbows, feet not flat on floor).

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