

## COMPUTER USE IMPACT ON STUDENTS' HEALTH IN THE CONTEXT OF ECOLOGICAL APPROACH TO OCCUPATIONAL SAFETY

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**Abstract.** The intensity of the use of Information and Communication Technology (ICT) in the study process is increasing. The most typical example of the use of ICT is the use of computers. To avoid harmful effects on the students' health caused by long term work at a computer it is necessary to follow ergonomic conditions set out for the consistent use of computers. The aim of the study is to find out whether the changes in the process of computer use initiate appropriate changes in the environment arranged for the computer use. The theoretical basis of the study is the ecological approach, which has been transformed from Uri Bronfenbrenner's ecological theory of human development and its triangulation with ergonomics. An ecological experiment and triangulation of data collection to determine the impact of computer use on the students' health have been carried out. It was found that during a study process the intensity of the use of computers increase. More than 70 % of the respondents consider that their knowledge on how to use computers is sufficient to ensure that they use them in compliance with the requirements of ergonomics for computer use. All respondents had more than a five year experience in the use of computers. However, almost 90 % of respondents, including employees and future specialists of occupational health and safety, do not follow the conditions set out for healthy work with a computer. As a result, 95 % respondents have identified symptoms testifying that the use of computers has adverse effect on health. The key factors are: ocular discomfort, pain in one's back or shoulders and wrist joint. It is therefore particularly important to continue the study on the causes of non-compliance with the occupational health and safety requirements and minimization of their effect.

**Keywords:** ecological perspective, ergonomics, work safety, computers, student.

### Introduction

The use of Information and Communication Technology (ICT) in education is related to the intensive use of computers in learning environment at universities and students' places of residence. To avoid harmful effects on the students' health caused by long term work at a computer it is necessary to follow the ergonomic conditions set out for consistent use of computers.

The aim of the study: to find out whether the changes in the process of computer use cause appropriate changes in its environment. In the study context – whether the increasing intensity of computer use facilitates to introduce any changes in the environment where computers are used by following the requirements of ergonomics.

The theoretical basis of the study: the ecological approach, which has been transformed from Uri Bronfenbrenner's ecological theory of human development [1].

Bronfenbrenner's Ecological Perspective is useful for understanding the dynamic relationship between the student and environment. Urie Bronfenbrenner has defined the ecology of human development [1]: *The ecology of human development involves the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate settings in which the developing person lives, as this process is affected by the relations between these settings, and by the larger contexts in which the settings are embedded.*

This definition can be transformed to the studies in occupational health and safety, where the immediate settings are work or educational settings, but growing human being a person in certain working settings, i.e., in our study it is a student working at a computer.

The study also allows for the triangulation of the ecological approach and ergonomics [2], as the definition of ergonomics (approved by the Council of the IEA in 2000) also includes interactions among humans and other elements of a system (settings):

*Ergonomics (or human factors) is the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimize human well being and overall system performance [3].*

Bronfenbrenner and his followers have improved the ecological theory of human development. In addition to ecosystem also endosystem and chronosystem have been included, and the importance of a process in human development has been stressed. The bio ecological theories of human development and Process-Person-Context-Time System have been established. [4-8]

Ecosystems or context is characterized by the concepts of microsystem, mesosystem, exosystem, and macrosystem, but chronosystem by the concepts of micro-, meso- and macrotime.

There are four levels in endosystem [4]: a physiological level, a motoric level, a psychological level and a level of overall functioning. The level of endosystem of overall functioning is the top level of all previous levels, which determines attitudes in action, responsible use of knowledge and skills. The model developed by Laura Hirsto [4] focuses on developmental psychology.

In the context of our study, the physiological level and the level of overall functioning of endosystem are particularly important; the result of ICT development is the increased influence of psychological factors on an employee. His non-structured collaborative observations, which the author has carried out for many years, determine that evaluation of the importance of the psychological level and overall level of functioning (attitudes in action, responsible use of knowledge and skills) in occupational health and safety not comply with the development of the use of ICT.

The use of computers is the most typical example of the use of ICT in a learning process. They are widely used in communication (Skype, e-mail), looking for information (Internet), research (SPSS, etc.), making presentations (PowerPoint, Prezi), in writing reports and theses. That is why an ecological experiment to determine the impact of computer use on the students' health has been carried out.

### Materials and methods

In accordance with Urie Bronfenbrenner *The Experimental Ecology of Education* [9] the ecological experiment took place in real-life educational settings. Interrelation between the students' performance and the learning environment, in which they learned to use computers and used the computers, was studied.

The task of the study was to ascertain: 1) whether the amount of time spent at a computer (load of using a computer) while studying increases, 2) whether students and occupational health and safety specialists, who have gained knowledge about ergonomic hazards in working environment and their minimizing, apply the acquired knowledge in real life situations, 3) how the use of computers affects the students' health.

The data obtained: 1) in non-structured observations, which the authors of the article have carried out for more than ten years, 2) students participated in an anonymous survey. For the purpose of data triangulation [2] the study was conducted in three universities of Latvia (Latvia University of Agriculture, University of Latvia, Riga Technical University) in four study programs (Table 1). In order to comply with the ethics of the study, the names of the programs and their relationship with the university have not been specified.

All respondents had several year experience in using computers, while 75 % of respondents had experience more than 10 years. All respondents learned about the computer ergonomics in occupational health and safety training courses, which is substantial to avoid health problems caused by the intensive use of computers. Distribution of the respondents by gender: women - 68 %, men - 32 %. All students studying at occupational health and safety programs apart from studies at universities worked in various professions such as business executives, lawyers, engineers, builders, as well as in the field of topography, etc.

### Results and discussion

The authors' observations and discussions with the students show that the students use laptop computers more often. Unfortunately, the students do not always follow the requirements of ergonomics provided for the arrangement of their workplaces.

The self-assessment survey on the knowledge of how to use a computer, 72 % of the respondents admitted that their knowledge is sufficient (Table 1). When assessing the impact of the study load on the time the students use a computer, 79 % of the respondents said that it is increasing.

In three study programs the load differences were statistically significant ( $p < 0.05$ ) [11]. Statistically significant ( $p = 0.029$ ) difference of the load of using a computer has not been established only for the students studying at a master's level (EQF level 7) program. It might have already taken place when taking up studies in the respective study programs of EQF level 6.

Table 1

**Impact of the use of computer on students' health  
Survey results**

<b>Profile of respondents</b>								
Study program	Occupational safety		Other		Total			
EQF level[10]	7	7	6	5				
A study year in program	2	2	4	2				
Number of respondents		22	11	78	19	130		
Respondents' age, in years	20 -30	12	2	78	19	111		
	31 - 40	4	4	0	0	8		
	> 40	6	5	0	0	11		
Respondents' sex	Female	12	7	66	4	89		
	Male	10	4	12	15	41		
<b>Computer Use</b>								
Experience in the use of computers, in years	5 - 10	8	3	11	10	32		
	$\geq 11$	14	8	67	9	98		
Self-assessment of knowledge on computer use	Sufficient	17	9	56	11	93		
	Insufficient	4	2	22	4	32		
	Partial	1	0	0	2	3		
Do you always follow conditions regarding harmless to health work at a computer?	Yes	1	1	7	0	9		
	No	19	10	67	19	115		
	Another option	2	0	4	0	6		
Workload of working at a computer under study impact	Increased	16	8	64	15	103		
	Did not increase	4	2	5	3	14		
	Did not pay attention to changes	2	1	9	1	13		
Level of statistical significance of workload differences $p$ [11]		.03	.29	.00	.01	.00		
<b>Impact of Computer Use</b>								
Health changes or symptoms caused by working at a computer (self-assessment)	Ocular discomfort	10	7	59	13	89		
	Back and shoulder pain	19	10	11	11	51		
	Pain in wrist joint	6	2	16	3	27		
	Pain in elbow joint or forearm	2	2	3	3	10		
	Other health changes	3	1	2	5	11		
Total		40	22	91	35	188		

Taking into account that the time spent at a computer, i.e., the load of using a computer is increasing, it is more important to follow the requirements of ergonomics. However, 88 % of the respondents do not follow the conditions set out for harmless to health work at a computer. As a result, 95 % of the students experienced health changes or some symptoms. The most frequent (% of total health changes or the number of symptoms – 188): ocular discomfort – 47 %, pain in back or shoulder – 27 %; pain in wrist joint – 14 %.

Comparing the number of the respondents who do not follow the conditions for a healthier work at their computer, it can be concluded that there were no statistically significant differences between the students studying at occupational health and safety programs and other programs. This is

particularly alarming because some students studying at occupational health and safety programs have been working in occupational health and safety sector for several years.

Most often the respondents replied that the reasons for not using the knowledge acquired on how to use computers correctly are the following: lack of time and suitable conditions; focus is on the result of the work being performed rather than correct posture, or giving a rest to their eyes. The respondents also gave the following answers, "I do not consider it necessary to create working environment complying with the requirements of ergonomics, because I use a computer on a temporary basis", possible effects have not been evaluated, the interest in what one does is greater than a desire to have a rest, no attention is paid to fatigue.

Having evaluated the experimental study it can be concluded that studies at university increase the workload connected with the use of computers. However, the change in workload is not followed by adequate ergonomic improvements in computing environment, as well as work and rest periods are not respected. In order to clarify the causes for non-compliance with the requirements of ergonomics it is necessary to continue the study in a more detailed way.

In similar research studied by the authors, it had been stated that it was necessary to review the training of students in computing both in the view of information technology and in the context of the students' quality of life [12]. It was found that scientists offer the research on a wider introduction of information technologies in educational environment, but only a few studies have been conducted on the influence of these technologies on the students' health, which has a tendency to deteriorate by a long-term use of computers, and non-compliance with the requirements of ergonomics [13]. A survey conducted among the Irish secondary school teachers showed that the teachers had insufficient knowledge on the requirements of ergonomics for computer use [14]. There are different types of software designed to carry out ergonomic risk assessment in working environment [15], but no methods on how to change the people's attitudes have been offered, to make people appreciate the sustainable basis for health.

Evaluating the authors' experience, as well as the earlier studies [16; 17] it can be stated that a formal approach to occupational health and safety forms in macro time already in general secondary education institutions. It is common not only in microenvironments, but also on the highest levels of the environment – in Latvian society. It is necessary to conduct studies in order to solve these problems, where possibilities to change the attitude to occupational health and safety would be evaluated, by understanding the processes that take place on the physiological level and overall level of functioning of endosystem.

## Conclusions

1. Having evaluating Bronfenbrenner's ecological perspective of human development it was stated that it can be transformed into the theoretical basis for the study of the problems faced by occupational health and safety. The triangulation of ergonomics and ecological perspective are also possible in the studies.
2. While carrying out the ecological experiment a statistically significant ( $p < .05$ ) increase of the load (intensity) of computer use was determined when compared to the load the students had before taking up studies.
3. More than 70 % of the respondents of the survey believe that their knowledge regarding the use of computers is sufficient to ensure that computers are used in conformity with the requirements of ergonomics. However, almost 90 % of the respondents, including employees and future occupational health and safety professionals, do not observe the conditions set out harmless to health working with a computer. As a result, 95 % of the respondents have identified symptoms that have negative effect on health due to computer use.
4. Further studies on the causes of non-compliance with occupational health and safety conditions are especially topical. It is necessary to evaluate the possibilities to change the attitude towards occupational health and safety, by understanding the processes that take place on the physiological level of endosystem and overall level of functioning.

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