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Knowledge of ICT of Secondary School Graduates

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Abstract. The paper analyses the results of the computer literacy survey conducted among the 11th and 12th form students in gymnasiums and secondary schools in Lithuania. The basis for the questionnaire was taken from previous surveys carried out in Vilnius Pedagogical University. The questionnaire is divided into five topics, such as computer hardware and software, information handling, text and hypertext, the Internet, spreadsheets and presentations. The following article discusses only the first three topics.

The data was collected from April to September 2010 through an online survey internet site `www.apklausa.lt`. The sample of the survey includes 1596 students from Lithuania.

The aims of the paper are to record students' knowledge about information technologies, explore the main topics and recommend improvements for the discipline of information technologies.

Keywords: ICT knowledge, students and ICT, survey of ICT.

1. Information and Communication Technologies in Lithuanian Schools

Nowadays information and communication technologies occupy more and more areas of our life. Knowledge of ICT enables us to access a number of IT-based services and helps to ensure success in the labour market. It also provides a considerable return to the society. Every year ICT knowledge is obtained at an earlier stage. The standard of students' computer literacy states that it is necessary for each member of the present society to have at least a basic competence of using the computer and the ability to use ICT tools for a personal and public activity. A secondary school and gymnasium education play an important role in solving this problem (Mokinių . . ., 2008).

In Lithuania, Information Technology is taught as a separate subject and the national curricula are open to ICT integration in other subjects and cross-curricular learning. Requirements for ICT knowledge, skills and attitudes which a student is expected to develop are closely correlated to the ECDL (European Computer Driving Licence) standards.

A compulsory ICT course has been taught in the 9–12th grades in Lithuanian schools since 1997. The possibility to take advanced optional modules has also been provided. ICT course topics are very similar to the ECDL standard and include: computer hardware,

Table 1
ICT topics

Compulsory course, 9–10 grades	Compulsory course, 11–12 grades	Advanced (optional) course, 11–12 grades
Computer (principles of the work)	Advanced elements of text editing	Data base
Text processing	Presentation	Multimedia
Information (basics of information handling)	WWW and electronic mail	Programming
Algorithms (main concepts and commands)	Social and ethical issues of using IT	
	Spreadsheets	

basic concepts of the user interface, information management, text processing, presentations, spreadsheets, information and communication, and social, ethical and legal aspects. The curriculum of ICT in Lithuanian schools is described in the following table (Table 1).

The Information Technology as a separate subject has been introduced to the 5th and 6th grades since 2005.

Teaching of ICT in Lithuania follows old traditions compared to other countries. Computer science is not a 'core subject' in the USA. According to Belgian practices, the key system for forming basic ICT competences is to incorporate them into daily classroom activities (no separate subject). In the Netherlands there is no national curriculum. Schools incorporate ICT competences including them into almost all other subjects. The ICT curriculum in the Czech Republic, Estonia, Latvia, Portugal and Greece is similar to the Lithuanian ICT curriculum. France has got a separate IT certificate for an ICT subject which is mandatory to some universities (European . . ., 2012).

According to Petkūnas and Jucevičienė (2006), penetration of information and communication technologies in secondary schools is divided into 4 stages:

(a) implementation – assurance of computer access,
(b) application – ICT as a supplement for a bigger effectiveness,
(c) integration – ICT as a tool for extending possibilities of learning and teaching,
(d) change – ICT as an instrument which transforms teaching and learning (Petkūnas *et al.*, 2006).

A detailed analysis of the stages is described in one of the analytical articles published by the Ministry of Education and Science (Navickaitė *et al.*, 2008). Each stage is characterised by infrastructure, competence of teachers, presentation of training contents, application of ICT and other factors. According to the analysis, some schools reach the third stage, i.e., integration, by having a wideband internet access, using training materials through the network and integrating ICT into the contents of education. Information technologies become more accessible to secondary school students. The training of digital literacy is more successful if the required prerequisites are implemented in secondary schools.

The concept of computer literacy can be defined as an entirety of knowledge and competences, information search and management of a basic computer user, as opposed to a professional. All these components are required to satisfy personal, professional, public and cultural demands (Pečeliūnaitė, 2006). This definition was transformed into a wider digital literacy definition during the recent years.

Digital literacy is a deep understanding of ICT technologies which are spread in the labour market and at home. It also includes knowledge and competences at the user level required to use technical equipment and software which is popular both in the labour market and at home (Kalvaitis, 2009).

ICT knowledge of secondary school students is directly and indirectly explored in various surveys. The survey of computer literacy of the 10th and 12 form students in Lithuanian secondary schools was conducted in 2003 upon the request of the Ministry of Education and Science (Jucevičienė *et al.*, 2003). The conclusion drawn from the survey is that a main reason leading to computer literacy is having computer access at home. A possibility to solve various teaching tasks using the computer and find the information online is also an important factor for computer literacy. There is no need to discuss the differences in computer literacy between the students in city and village schools.

Preidys *et al.* (2007) conducted a research during the years of 2003–2007. The authors investigated the tendencies of ICT knowledge of candidates to colleges and universities. The sample of the research includes 1930 students from Vilnius College, Vilnius Cooperation College and Vilnius Business and Law Academy. The questionnaire of the research was prepared using the requirements of secondary school and ECDL programs . The results show that students' knowledge is not of a high level. Students have got good skills in text processing, using the computer, managing files, making presentations and using the internet. However, they display a low level of knowledge in spreadsheets, databases and main concepts of ICT (Preidys *et al.*, 2007).

Surveys of general computer literacy have been carried out in Lithuania since 2002. Participants are residents of Lithuania aged 15 and above. Computer literacy centre of Kaunas Technological University conducted such surveys during the years of 2004–2007. The findings of the research indicate that both men and women display similar levels of computer literacy (Otas *et al.*, 2007). The following conclusions are drawn from the findings, namely computer literacy decreases in small towns and villages, as opposed to cities, and the level of computer literacy correlates with the age of respondents. However, the age and social status of respondents are not determining indicators when evaluating computer literacy.

A similar research carried out by Kalvaitis (2009) highlights that only about 40% of working age residents have got a sufficient knowledge of digital literacy to be able to use information technologies based equipment of various complexity and purpose in their everyday life. The remaining part of working age residents encounters various problems. This group includes mainly women, elderly people, people with lower income and lower level of education and people living in villages.

All above mentioned surveys form only a small part of a big set of analogous surveys. Each survey is exclusive, with its own methods, samples of respondents, conditions and aims. Therefore, it is difficult to compare and summarise them.

2. Description of IT Survey of Secondary School Students in Lithuania

As the use of information technologies increases in our everyday life, secondary schools must gradually change their curriculum of ICT. In this survey we selected particular year groups with a similar ICT curriculum. The 11th and 12th form students were taught ICT using an older version of the curriculum. However, a wider ICT curriculum is introduced to the 10th form students.

The focus of the survey is to conduct an investigation into the ICT knowledge of the 11th and 12th form students in Lithuanian secondary schools and gymnasiums and explore its correlation with certain social factors.

The aims of the survey are to determine the level of students' ICT knowledge on entry to colleges and universities and find out which topics require less (or maybe more) attention when teaching the discipline of ICT in the institutions of higher education. .

The methodology includes the analysis of literature, examination of students' knowledge using the online questionnaire and methods of statistics, such as Lithuanian program package Skibis (Bitinas, 2008), to evaluate the results.

The research is a quantitative study based on a questionnaire created by the authors of the article. The questionnaire method has been used in several surveys in Lithuanian University of Educology since 2003. The questionnaire consisting of 22 questions was applied in schools for the first time. Questions can be divided into 4 categories according to the type of a possible answer:

(a) questions with one correct choice;
(b) questions with several correct choices;
(c) finding a connection between two concepts (concepts are in two columns and respondents must connect those having a logical tie);
(d) questions with open answers.

One of the tasks of the ICT curriculum in secondary schools is to reach the level where students could "explain basic concepts and conceptions of computing and information and communication technologies" (Informacinės . . ., 2008). The majority of questions in the questionnaire examine the knowledge of basic concepts. However, some questions are related to practical skills. The Lithuanian standard of school students' computer literacy describes guidelines of achievement in six thematic areas. Our questionnaire covers five of them:

(1) computer hardware, user interface;
(2) information management;
(3) text processing;
(4) spreadsheets;
(5) presentations.

Examples of the questions include the following: to mark necessary parts of the computer, find definitions of concepts, such as "directory", "file", "document", "font", "paragraph", "hypertext", "multimedia", list components of Windows interface, find logical ties between concepts, namely "symbol", "1,44MB", "Windows", "800x600", "mp3", "Arial and others, from one side, and concepts, namely "operating system", "sound", "Sans Serif", "floppy disk", "screen" and others from another side.

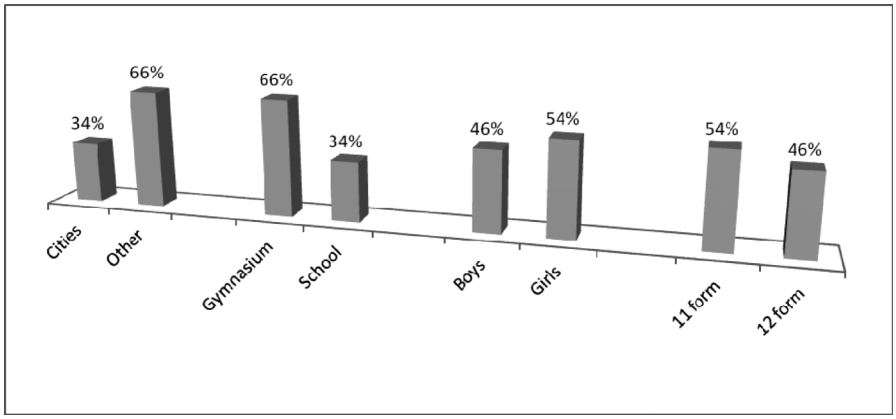

Fig. 1. Demographic characteristics of respondents.

The questionnaire does not include questions neither about safe and legitimate use of information nor about using the internet. These topics form a part of the standard of school students' computer literacy and the curriculum of ICT in secondary schools. Also there are no questions from the extended ICT curriculum, namely programming, databases and e-publishing. Students had a sufficient knowledge from the main set of ICT topics to answer our questions. Additionally, almost all topics are taught up to the 10th form in a secondary school.

The article explores only the first 3 topics out of five mentioned above. These topics are the oldest topics of the ICT curriculum. According to some surveys described above, secondary school students have got a sufficient knowledge about them. So, the question can be raised whether the topics need to be duplicated in the ICT discipline in higher education.

The sample of the survey includes 1596 respondents who are the 11th and 12th form students in Lithuanian schools. About one third of them live in the biggest cities of Lithuania (Vilnius, Kaunas, Klaipėda, Šiauliai, Panevėžys). The remaining part of respondents comes from smaller towns and villages. Almost one third of respondents are secondary school students and two thirds – students of gymnasium. Quantities of the 11th and 12th form secondary school students and boys and girls are almost equal (Fig. 1).

3. Knowledge of Different Topics

Only three topics out of five included in the questionnaire are discussed in this article.

The first question of the questionnaire asked about the main parts of the computer and was formulated indirectly. It required the respondents to name the components without which computers are out of service. Therefore, some respondents misunderstood an expression "out of service". Does it mean a possibility to turn on the computer (system unit)? Is it related with some characteristic noise? According to the authors, a concept "computer" at the user level is clearly explained in school textbooks. It might be that

some respondents simply ignored important parts, such as a ‘mouse’ and ‘keyboard’ due to sophisticated formulation of a question. In addition, there is another reason which could have led to a misunderstanding of a word ‘computer’. When a desktop computer is purchased, computer sellers specify only a price of the system unit with necessary parts inside and inform that a mouse and keyboard is a present from them. A computer display needs to be bought separately. Respondents replied correctly about necessary parts of the computer, such as a system unit’ and ‘processor’, but they were unsure about other parts. The diagram below (Fig. 2) shows a percentage of correct answers about each component of the computer whether it is necessary or not.

The diagram illustrates that distractor questions, such as a modem, CD-ROM mechanism and speakers, have no significant influence on students’ correct answers. Everybody knows that these parts are not necessary for the computer. The sophisticated formulation of the question could explain incorrect choices about the mouse and keyboard. However, it is evident that some pupils also do not know whether the computer needs a memory or display. The summary results show that only 9% of respondents answered the question with one mistake or less and even 52% of respondents made 2 or 3 mistakes.

Several questions explored secondary school students’ knowledge about the main concepts of ICT, such as classification of software, file and directory definitions, multimedia, computer document and hypertext (Fig. 3).

The findings indicate that the best known concept is the ‘computer document’. More than 80% of respondents answered the question correctly. Other concepts still require more attention. Our teaching experience and the results from previous surveys confirm that the majority of candidates to colleges and universities have got good information management skills, including copying files, creating folders, changing names, deleting and others. However, less than half correct responses to the majority of questions indicate that these skills are not based on knowledge. A cause for concern is the definition of

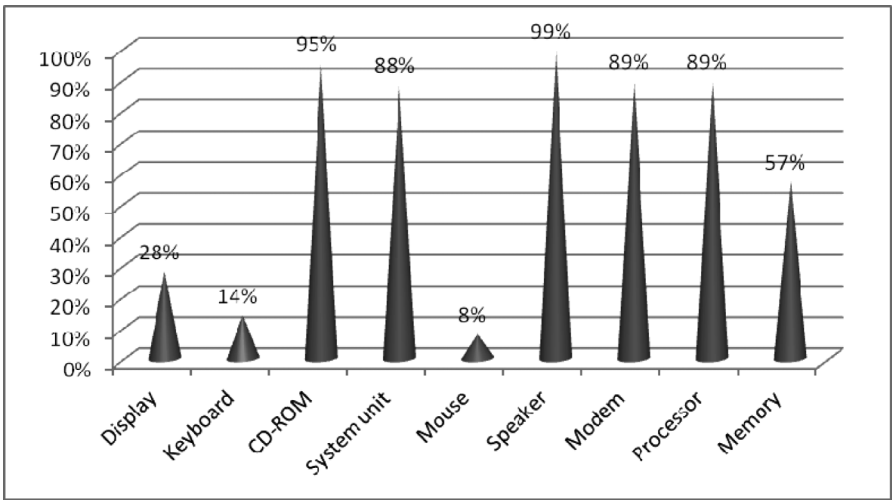

Fig. 2. Knowledge about necessary components of the computer.

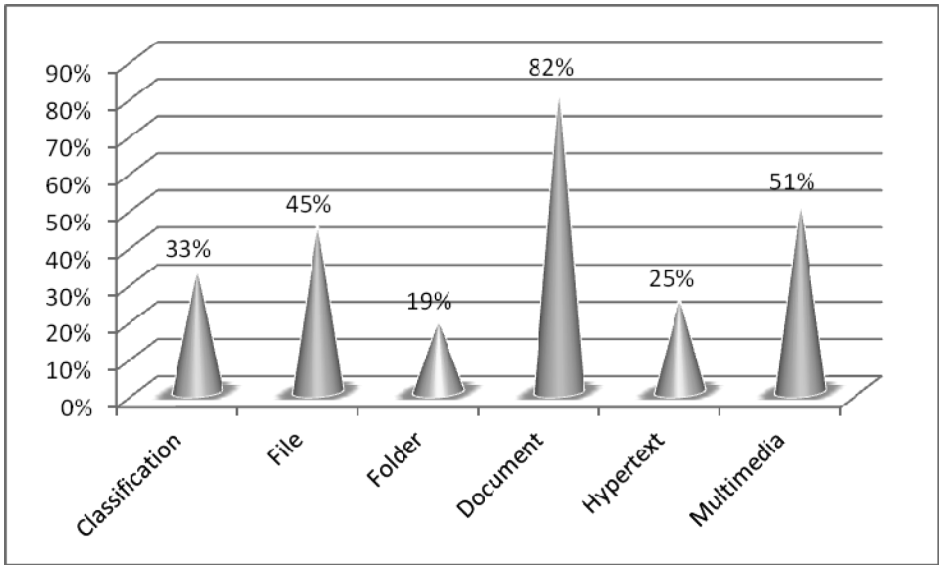

Fig. 3. Knowledge about ICT basic concepts.

the "folder" which had less than 20% correct answers. This could be due to a technical reason, namely the directory (folder) is like a file in the OS UNIX environment. However, textbooks, dictionaries and encyclopedias provide clear definitions of the folder, file and hypertext. Therefore, we argue that these concepts require more attention. The similar situation (one third of correct answers) is with a concept of software classification, even though it is important, according to the standard of computer literacy of school students.

Not all respondents are familiar with the names of components of OS Windows starting interface (Table 2).

According to the findings, the best known element is the 'desktop'. 82% of respondents named it as a necessary part of the interface. Distractors, such as speaker symbol and scroll bars, had almost no influence on correct answers. Nearly everybody knew that these parts were not necessary in starting interface. However, 17% of respondents were unsure about the 'scroll bar'. Even though the 'taskbar' is always visible, about half of the respondents did not pay attention to it or simply did not know the name of it. The 'window' is a necessary part when working with any programs, but it is not visible in the

Table 2

Knowledge about OS *Windows* components

	Window	Taskbar	Speaker	Desktop	Scroll bars	Icons	Internet Explorer
Quantity of correct answers	40 %	46 %	96%	82%	83%	60%	28 %

'starting interface', and only 40% of respondents knew about it. The standard of the user interface, such as Common User Access by IBM, raises additional doubts about whether the window is a component of OS starting interface. According to the standard, starting interface (Presentation) must have a window. The responses in relation to the Internet Explorer, with only 28% of respondents knowing that it is not a necessary starting element, might have a simple explanation. Programmers of OS Windows tend to advertise their products by automatically placing the Internet Explorer icon on the desktop in many versions of Windows. The findings suggest an influence of such advertising.

The summary results are as follows: no mistakes were made by 19% of respondents and 1–2 mistakes were made by 39% of respondents. The findings show that more than 60% of school students know the names of components of the interface well enough.

The best answers were provided to theoretical and practical questions in the text processing topic. 78% of students know that a punctuation mark must be straight after the word (with several exceptions) followed by a space. 66% of students are aware that a keyboard key 'Enter' must be used only at the end of the paragraph, as opposed to the end of the line. Almost 60% of students are familiar with the definitions of 'font' and 'paragraph'. We conclude that even secondary school students have a good grasp of the text processing concepts . As a result, the concepts do not require more attention.

4. Correlation Between Knowledge and Social Factors

We used methods of factor analysis to separate main variables and get two-dimensional distributions. The method of main components helped us to get weights of significant variables which are presented in Table 3. The first factor includes 8 tasks and describes 21% of factor loadings. The tasks belong to the type of questions with several correct choices. Consequently, factor analysis indicates that questions with several correct choices are sufficient to evaluate the knowledge of school students.

Task performance was estimated using 3 step scale (0, 1, 2) and selection of a distractor – 2 step scale (0, 1). Students could get a mark from 0 to 10. The scale was

Table 3
Weights of main variables

No.	Task – computer will not work if we will not connect:	Weight
6	Display	0,50
7	Keyboard	0,59
10	Mouse	0,52
14	Memory	0.46
15	Estimate of task performance	0.86
	Task – components of Windows interface	
20	Taskbar	0.30
24	Icons	0.38
26	Estimate of task performance	0.64

Table 4
Characteristics of rank scale

0 (0–2)	1 (3–4)	2 (5–6)	3 (7 and more)
332 21.50%	482 31.22%	484 31.35%	246 15.93%

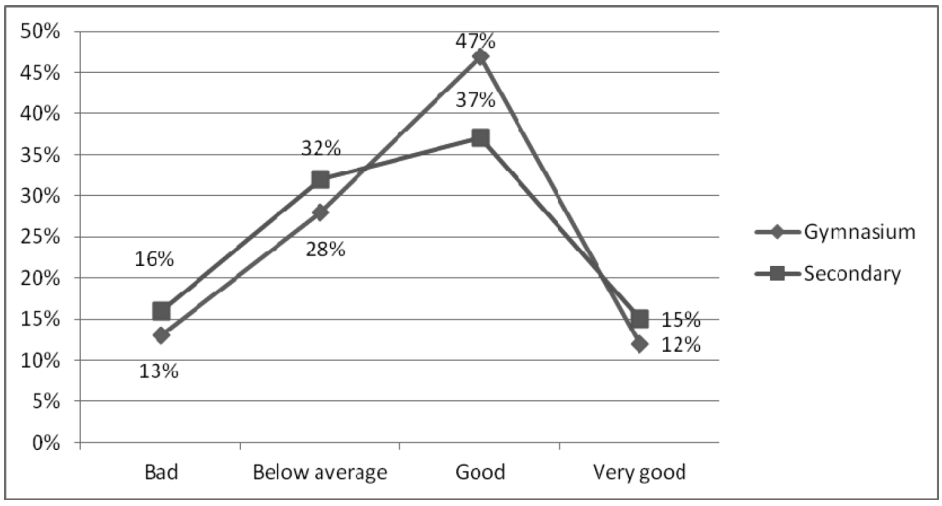

Fig. 4. Knowledge of gymnasium and secondary school students.

transformed into the rank 4 grades scale using median of distribution as a basic value for the convenience of the analysis. We state that school students have got a satisfactory or weak knowledge if their grades are below the median. Students with grades above the median have got a good or very good knowledge (Table 4). The average of grades is 4,3 and median is 3,9.

Groups below average include about 53% of respondents and above average – about 47%. In this chapter we discuss only summary dependences without separating single questions of our questionnaire.

Differences in knowledge between respondents from cities and small towns and villages are not very significant ($\chi^2 = 7.5$ with 3 degrees of freedom, $p = 0.058$). The respondents from cities have got a greater part of answers evaluated very well. More respondents from small town and villages provided *below average* and *above average* responses. However, reliability criteria do not permit us to state that these differences are significant.

Significant differences ($\chi^2 = 12.72$ with 3 degrees of freedom, $p < 0.01$) are noticed when comparing the answers provided by gymnasium and secondary school students. At first glance it might be that gymnasiums have a greater authority and attract more good students. But the findings from our survey show that gymnasium students do not always display better knowledge (Fig. 4).

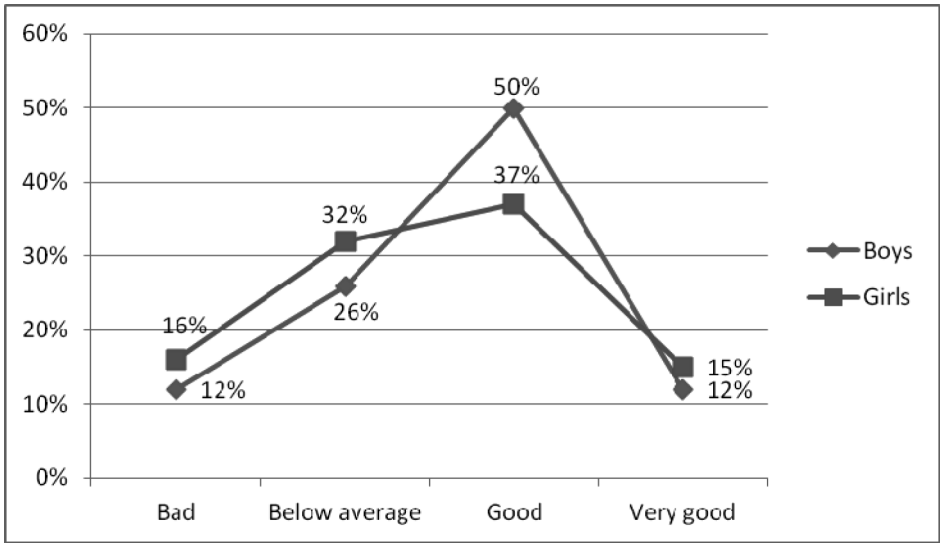

Fig. 5. Differences of the knowledge between boys and girls.

Interestingly, both the worst and the best group of respondents include 3% more students from secondary schools. The biggest difference is seen in the good group which has 10% more students from gymnasiums. Summary results show that gymnasiums have 7% more respondents in the *good* and *very good* groups. In general, gymnasium students have better knowledge; however there are more students from secondary schools in the best group.

The biggest reliability of differences ($\chi^2 = 27.73$ with 3 degrees of freedom, $p << 0.001$) can be seen when comparing the knowledge between boys and girls (Fig. 5).

The distribution of answer differences is very similar to the differences displayed in Fig. 4. There are more girls in the worst and the best groups. Boys are clustered mostly in the good group (just above average). We assume that boys like technology (in this case computer) more than girls; therefore they know better the main concepts. Girls are more precise when reading textbooks, thus more of them fall into the best group of respondents. Summary results of good and best answers include 62% of boys and 52% of girls.

There are no significant differences between the 11th and 12th form school students. Both groups had a similar curriculum. Although the 12th form students are older and possibly more experienced, the 11th form students could have started to use a computer at a younger age. As a result, both groups have a similar experience as IT users.

We will discuss separately topics of significant importance, namely questions with several correct choices about computer components and about components of OS Windows interface. There are significant differences in the knowledge on these topics between students from secondary schools and gymnasiums and between boys and girls. Gymnasium students have a better understanding of computer components (Table 5). 63% of respondents made up to 3 mistakes. However, more secondary school students fall into the best group of respondents (reliability of difference $p < 0.05$). Boys' and girls' groups

Table 5
Differences in the knowledge about computer components

	4–6 mistakes	2–3 mistakes	0–1 mistakes
Gymnasium	37%	54%	9%
Secondary school	41%	48%	11%
Boys	30%	61%	9%
Girls	46%	44%	10%

Table 6
Differences in the knowledge about OS Windows interface

	3 and more mistakes	1–2 mistakes	No mistakes
Gymnasium	39%	41%	20%
Secondary school	46%	35%	19%
Boys	36%	43%	21%
Girls	45%	36%	19%

have similar differences: 70% of boys and only 54% of girls made up to 3 mistakes ($p < 0.01$).

Students of gymnasiums have a better understanding of components of OS Windows starting interface (Table 5) than students of secondary schools (reliability of difference $p < 0.01$). 61% of respondents of the first group made up to 2 mistakes in comparison to 54% of respondents from the second group. Even greater differences are noticed between answers of boys and girls (reliability of difference $p << 0.01$). 64% of boys display a *good* and *very good* knowledge about OS Windows interface in comparison to 55% of girls.

5. Conclusions

Secondary school students experience some problems in perception of basic concepts about computer hardware and software and managing of information. These topics require more attention in gymnasiums and secondary schools.

The majority of students have got good text processing skills. Therefore, less attention could be paid to the topic, even with a possibility of withdrawing it from the ICT course taught in colleges and universities.

There is a significant, but not always correct, influence of marketing specialists (sellers of hardware and software) in perception of basic concepts. Similar conclusions were published in the survey of Preidys *et al.* (2007). It means that there are no big changes in ICT knowledge during the last several years. Secondary school teachers should pay more attention when explaining differences between marketing aids and reality.

According to the findings from our research, students of gymnasiums understand ICT concepts better than students of secondary schools. The majority of gymnasium students provided good and very good responses. However, more secondary school students were among the best respondents.

The findings also indicate that boys understand ICT concepts better than girls. The majority of boys responded well and very well. However, more girls fell in the best group of respondents.

There are no reliable differences of knowledge between respondents of cities and small towns and villages and between the 11th and 12th form school students. Similar conclusions were published in the survey conducted by Jucevičienė *et al.* (2003) and partly in the survey carried out by Otas *et al.* (2007).

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Baigiamųjų klasių moksleivių IT žinios

Eugenijus VALAVIČIUS, Kęstutis BABRAVIČIUS

Šiame straipsnyje analizuojami Lietuvos gimnazijų ir vidurinių mokyklų baigiamųjų klasių (11–12) moksleivių žinių testo rezultatai. Testo klausimai sudaryti pagal autorių anksčiau naudotų klausimyną, kuriuo buvo tikrinamos VPU studentų žinios. Duomenys rinkti 2010 metais nuo balandžio iki rugsėjo mėn. Anketa buvo patalpinta svetainėje `www.apklausa.lt`. Žinių tikrinime dalyvavo 1596 Lietuvos mokyklų moksleiviai. Jo tikslas: užfiksuoti iš vidurinės mokyklos į aukštąsias mokyklas atsinešamas informacinių technologijų žinias, nustatyti mažiau dėmesio reikalaujančias temas.

Kompiuterinių žinių tikrinimo klausimynas buvo sudarytas iš penkių teminių dalių: kompiuteris ir vartotojo sąsaja, informacijos tvarkymas, tekstas – hipertekstas – įvairialypė aplinka, skaičiuoklės, pateiktys. Mūsų straipsnyje aptariamos tik pirmųjų trijų temų žinios.