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Development of information and communication technology in an educational space: Students' view

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ABSTRACT

In educational environments, students are considered to be one of most crucial subjects. Identifying and supporting students' voices concerning changes in the educational process are important for adaptation and developing Information and Communication Technology (ICT) in an educational space. This study identified the level of student readiness for changes in an educational space concerning ICT development and their views on utilizing ICTs in the educational process, thereby developing perspectives. Further, the association between student age, manner in which the study is adopted, and their level of proficiency in use of computers and the Internet were verified. A sample of 379 students at the Industrial University of Tyumen completed the survey. We used a sociological survey with a multiple-choice questionnaire about educational preferences and the weaknesses of higher learning educational space, where ICTs are used. Results have shown that there is an inverse association between age and level of proficiency in use of computers and the Internet. However, no association was observed between the manner in which the students conducted their studies and their perspective on the level of proficiency in personal computers and the Internet. Students were able to identify weaknesses in the organization of the virtual educational space, professional preparation of teachers, and problems, such as lack of self-organization skills, low level of proficiency of ICTs, etc. Students showed interest in e-learning and believed that virtual educational space makes professional education better.

Keywords: *Higher education; virtual educational space; e-learning; teachers; information and communication technology.*

INTRODUCTION

It is emphasized that education systems around the world are experiencing a range of drivers for fundamental change (Kabanova et al, 2020; Tarando et al, 2021; Zaparovanny, 2004), from both internal as well as external factors. External factors concerning the educational space in the Russian Federation (RF) include: globalization, changing concepts around the role of knowledge, workers' knowledge, and citizens' knowledge, widespread need for quality and lifelong learning, and the relentless emergence of new ICT, coupled with their growing penetration of, and impact on, all sectors of society, including the educational space of higher institutes of learning.

Internal factors are related to the natural and geographical features of the RF, such as: widespread provinces, sizeable distances between cities and rural settlements, cold, long-term

winter in most provinces, and the classroom disruption caused by noise in hallways in spring and autumn.

In this study, we examined the development of ICTs in an educational space in Tyumen region. Tyumen region is one of the biggest regions of the RF. Its territory occupies the third largest place in the RF and makes up more than 1.4 million square kilometres (8.4% of Russia) (Khairullina et al, 2015). A particular feature of this oblast is the presence of one of the largest research and educational complexes in RF. Its mainstream is specialist preparation for the petroleum complex in Siberia, RF, and other countries in the world.

ICT development is changing the educational process. ICTs consolidate branches dispersed in Tyumen oblast territory (in the cities of Noyabrsk, Surgut, Nizhnevartovsk, Neftejugansk, Tobolsk, Yalutorovsk, and Muravlenko) in the new virtual educational space.

There are different levels of ICT development caused by the manner of learning: resident instruction; nonresident instruction; and e-learning. The ICT influence on the higher learning educational space has changed students' roles in subjects in the educational process. Students are one of the most crucial subjects of the educational process.

Opportunities and requirements of students are the basis for the development of students' professional potential and human capital. Consequently, nowadays, the education task has become the adaptation of the educational space for personal potential and values of students and individualization of education.

This analysis may correct the conditions of students' education. Therefore, considering the use of ICT in the educational process, two factors must be investigated: (1) to identify the level of change and student´s view, and which altogether affect their perspective; and (2) the association between age, manner in which the students conducted their studies and the level of proficiency in use of computers and the Internet.

METHOD

This is a cross-sectional descriptive study conducted through a sociological survey. Written informed consent was obtained from all the participants.

Participants

A total of 379 students from the Industrial University of Tyumen (IUT) participated in the study. The sample calculation was based on the general population of 29,484 IUT students in the academic year of 2014–2015. Confidence level is 95%; sampling error is 5%; and characteristic frequency in the general population is 50%.

The sample was substantiated as follows: (a) students of all manner of learning face ICTs during the educational process; (b) oil and gas educational programs are the focus and are strategically important; and (c) students in the last year of education have a deeper view of the educational process and are able to understand changes in an educational space.

Recruitment of participants was done during the students' session (among students' group: resident instruction; nonresident instruction) and consultations (among 'e-learning' students' group).

The sample was representative. Through the form and program of education, the structure of the sample matches the structure of the general population. Representativeness was determined by

stratification of the sample by age and educational type. Stratification by age was based on the assumption that there is a correlation between age and views of ICT development in an educational space. The sample population, therefore, was categorized by age group as follows: 20–24, 25–29, 30–40, and > 40. Stratification by educational groups was based on the assumption that resident instruction, nonresident instruction, and e-learning in a virtual educational space have different conditions of education processes. Consequently, three groups were identified: resident instruction; nonresident instruction; and e-learning.

Both resident and non-resident classes have personal meetings in the "real" educational space of the high school. The resident students attend lectures and practical lessons at the University every day. The non-resident students visit classrooms a few times a year when they have sessions. For both, ICTs such as personal computers, simulators, projectors, and interactive boards could be used during lectures and labs.

The e-learning educational process is held only in the virtual educational space. It is a space of interactions, using all the possibilities offered by a modern virtual educational system, such as videoconference, forums, chats, virtual workshops, and laboratory works, webinars, personal student and teacher e-correspondence, and correspondence between students and tutors. In the last year of education, students move up into the releasing department in real educational space for their final qualifying work.

Setting

A paper-based student survey was conducted in academic year 2014–2015. The base of the study was the Industrial University of Tyumen (IUT). The University provides educational services for 273 educational programs, including 166 programs for higher professional education levels (72 programs at the undergraduate or Bachelor level, 55 of specialists' level, and 39 at the Master degree level and 106 education programs for secondary vocational education). Analysis of the structure of the main education programs reveals that 70–89% are education programs for technical education areas, and 11–30% are for socio-economic areas.

Among the main educational programs, the "Oil and gas processing" program was the leading choice among several students. The ICTs have a different extent of participation in the educational process, according to the type of learning: traditional education (resident and nonresident instruction) and e-learning.

Instrument

A multiple-choice questionnaire, comprising 18 questions, was given to the students in the last year of education in one of the following categories: resident instruction; nonresident instruction; and e-learning. The survey questions were designed after considering the items in a pilot study survey, conducted among the teaching staff and methodologists.

Statistical analysis

Microsoft Excel and the Statistical Package for the Social Sciences (SPSS) version 20 for Windows were used for data preparation and analysis. A descriptive analysis was completed, and a Kolmogorov-Smirnov test was used to verify whether the data has a normal distribution. Descriptive data are expressed as a percentage. A chi-square analysis was performed to examine a possible significant association between: (1) age and proficiency level of personal computers and the Internet; (2) age and manner of study; and (3) proficiency level of personal computers, the Internet and manner of study. The value of $p < 0.05$ was considered to be statistically significant.

RESULTS

The students themselves appreciated the level of ICT literacy. According to respondents' self-rating, the levels of proficiency in ICTs among students were defined as: ask for help; basic; assured; and advanced. There are students who ask for help only when complicated situations take place. In this case, it is easier for them to ask someone else to do their work on personal computers and via the Internet. There are students who assume that their level of proficiency with personal computers and the Internet is basic. Assured users have no serious difficulties with orientation in the informational environment. These students, from time to time, face situations when their level of knowledge and skills does not match the specifications of present-day education. However, such situations seldom happen; neither do they impact meaning nor lead to in the imbalance of the educational process.

Proficiency level

Most of the respondents (over 70%) were educated through industrial educational programs. Of the 379 participants, most (aged between 20–29 years) considered themselves to be assured or advanced users of computers and the Internet and studied in a non-resident manner. Characteristics of the participants are shown in Table 1.

Table 1: *Characteristics of Study Respondents - the Industrial University of Tyumen, Russian Federation (n=379)*

Age Group	**n**	**%**
20–24	121	31.9
25–29	129	34.0
30–40	95	25.1
40+	34	9.0
Level of Proficiency in computers and internet		
Category	**n**	**%**
Ask for help	24	6.3
Basic	24	6.3
Assured	161	42.5
Advanced	170	44.9
Manner of Education		
Resident	132	34.8
Nonresident	217	57.3
e-learning	30	7.9

Chi-square analysis confirmed a significant association between the age of respondents and their opinion about their level of proficiency of personal computers and the Internet: $X^2(9) = 37.50$; $p < 0.001$. Figure 1 shows that correlation and infers that the younger the students, the higher their proficiency of using personal computers and the Internet.

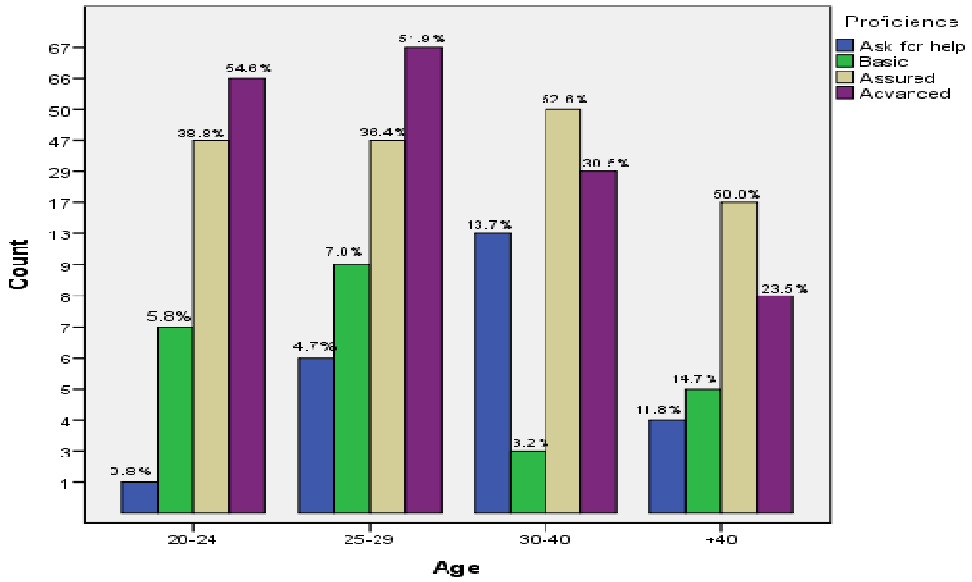

Figure 1: Clustered bar chart by age group of respondents

The color of the bars in Figure 1 is determined by the response to: "What do you think is your level of proficiency with personal computers and the Internet?" The height of each bar represents the total number of observations in that particular combination of categories.

When a chi-square analysis was performed to examine a possible significant association between the manner of study and the opinion about their level of proficiency with personal computers and the Internet, no association was found: $X^2(6) = 7.15$, $p = 0.307$.

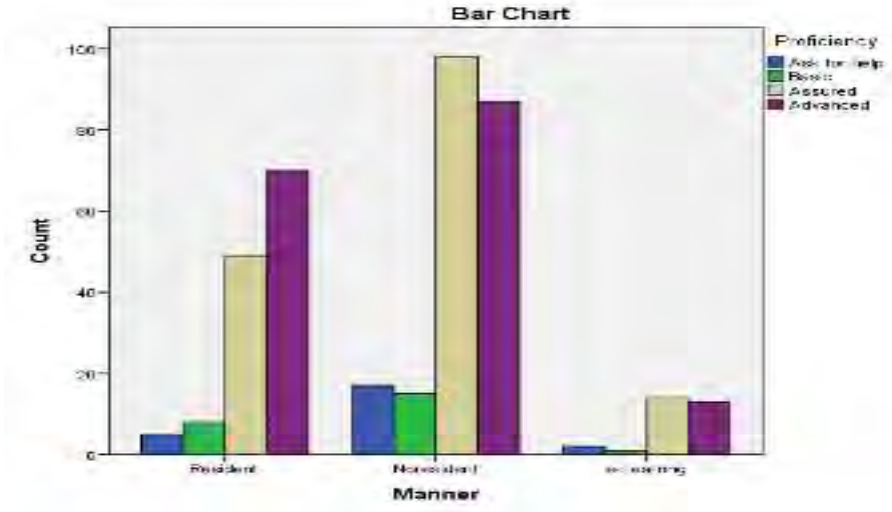

Figure 2: Clustered bar chart by manner of study

The color of the bars is determined by the response to: "What do you think is your level of proficiency with personal computers and the Internet?" The height of each bar represents the total number of observations in that particular combination of categories.

Contribution and roles of ICTs

Most of the respondents consider that ICTs contribute to raising their level of professional capacity as shown in Figure 3.

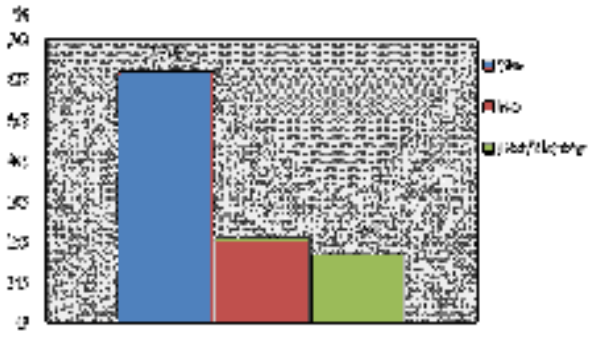

Figure 3: Bar Chart on contribution of ICT to raising level of professional capacity

The height of each bar represents the total amount of answers in absolute numbers on responses to the question: “Do ICTs utilized in the educational process contribute to raising the level of your professional capacity?”

Over 33.6% of the total number of respondents related their level of ICT proficiency to learning informatics in higher learning; 29.4% to learning informatics in school; and 37% to self-learning with support from their friends and colleagues. As shown in Table 2 below, the number of persons willing to get e-learning education and students who approve of e-learning and advise their friends to get e-learning education is increasing.

Table 2: *Students’ views concerning e-learning (% of the total number of respondents)*

Q.4. What has motivated you to choose e-learning?			**%**
1. Education without interruptions of my job			38
2. Possibility of planning the time and duration of the subjects by myself (flexible learning)			31
3. Health reasons			7
4. Opportunity to use progressive ICTs in the educational process			4
5. Advice of friends			12
6. I am on maternity leave			6
7. Other			2
Total			100
Q.5. What do you think about e-learning?	**%**	**Q.6. Will you advise your friends to get an education though e-learning?**	**%**
1. Approve	56	1. Yes	51
2. Do not quite understand its specificity	28	2. Yes, for refresher courses	37
3. Disapprove	16	3. No	12
Total	100	Total	100

Most of the respondents consider a virtual educational space vital for providing theoretical preparation for the educational process. The students' views of the role of a virtual educational space in the educational process are illustrated in Figure 4.

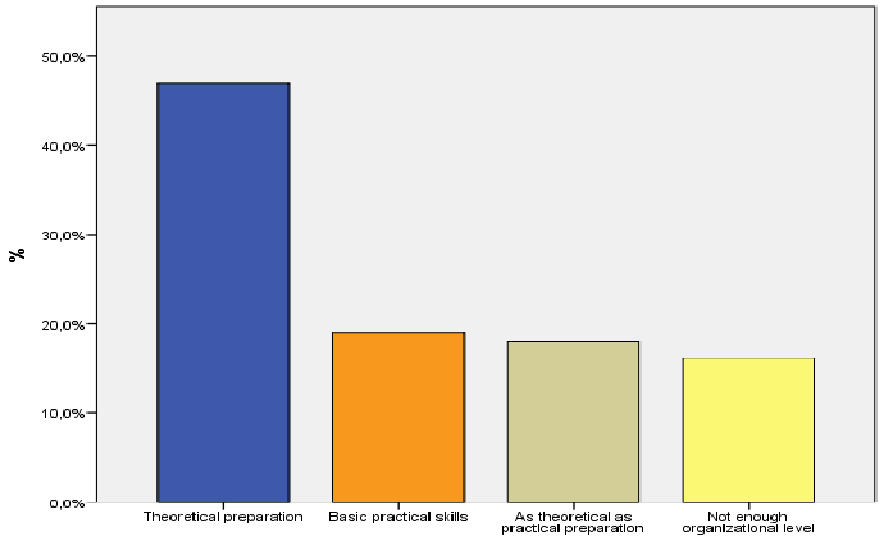

Figure 4: Bar Chart on the role of the virtual educational space

The height of each bar represents the amount for each answer in absolute numbers in response to the question: "What is the role of virtual educational space in the educational process?"

Students' views of teacher readiness for working in virtual spaces are illustrated in Figure 5. Although student's views are quite balanced, most of them think that the teachers are not prepared.

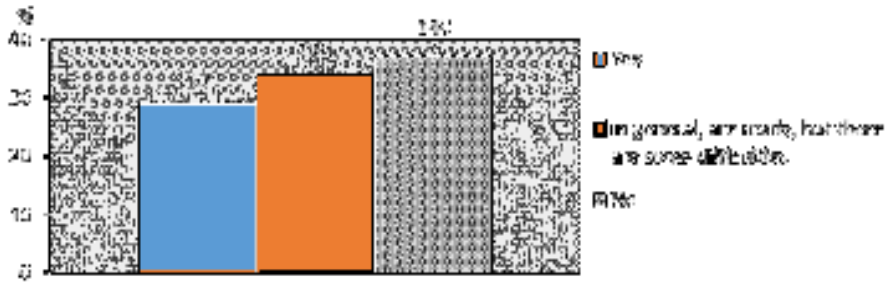

Figure 5: Student views on teacher readiness

The height of each bar represents the amount for each answer in absolute numbers in response to the question: "Are teachers ready for educating students in virtual educational space?"

Rankings (from 1 to 6) of the teachers' level of proficiency and professional skills in utilizing ICTs in the educational process according to the students are shown in Table 3. Ranking 1 shows that students consider teachers to highly possess the professional skill; ranking 6 shows that students feel that teachers do not possess this professional skill at all.

Table 3: *Students' ranking of teachers' professional skills*

Parameter	Rank
Competent to organize collective work in virtual educational space	6
Able to model network discussions	5
Able to provide emotional support	4
Able to give a quick answer	3
Able to find individual approaches for helping students	2
Able to communicate individually with students	1

Problems

Most of the respondents experienced no difficulties in the virtual educational space; however, they identified problems in the virtual educational space, such as lack of quality teachers and lack of teachers' assistance. Some students realize that their difficulties are related to their own abilities of self-organization and their levels of proficiency with personal computers and the Internet. Most of the students recognize the need to fulfil their knowledge of ICTs as shown in Figure 6.

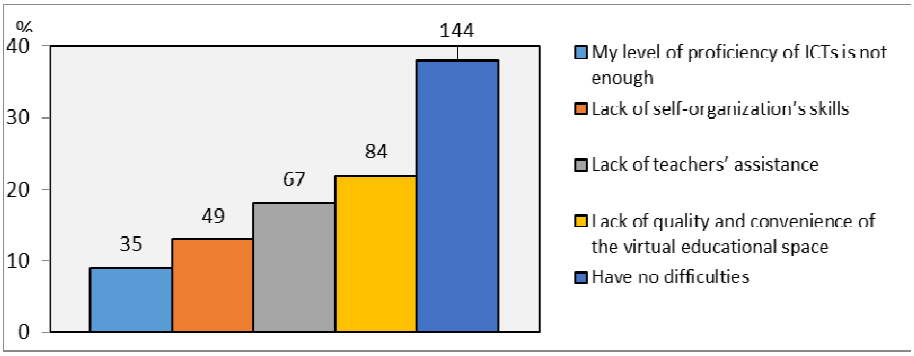

Figure 6: Student views on problems with virtual educational space

The height of each bar represents the number of responses for each answer in absolute numbers.

Satisfaction

Most of the students are satisfied with the organization of ICTs in the educational process, as shown in Figure 7.

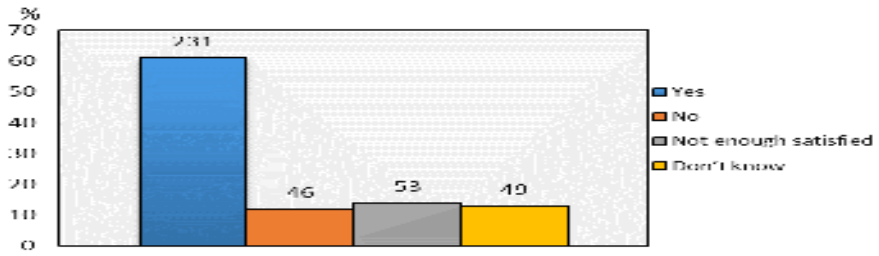

Figure 7. Student satisfaction

The percentage of the total number of respondents on the question "*In general, do you satisfy your education in the virtual educational space?*"

Regarding the perspectives of ICT development in the educational process, most respondents (70%) perceive that ICTs better develop the educational process, while 10% see no development perspectives, and 20% have no answer to this question.

Concerning the virtual educational space, 76% of the respondents consider that there are development perspectives, 8% see no development perspectives, and 16% have not answered the question.

Students think that ICT development in the educational process relies more on teachers' assistance with working with ICTs than on students' and teachers' level of motivation for working with ICTs on quality and convenience of ICTs and on students' assistance with working with ICTs, respectively.

According to students' views, development of the virtual educational space depends on: (1) the quality of education materials; (2) the teachers' level of motivation for energetic working and innovations in the virtual educational space; (3) the level of teachers' computer and Internet literacy; (4) the students' personal qualities, such as self-sufficiency and commitment; and (5) the level of students' computer and Internet literacy.

DISCUSSION

Knowing the importance of ICTs, the educational process, and the growing tendency of e-learning, we investigated the readiness for changes in the educational space concerning ICT development of undergraduate students, their views on utilizing ICTs in the educational process, and perspectives of development in the virtual educational space.

Proficiency level

The younger the students, the more confident they are with ICTs. Most of the respondents (aged 20–29 years) considered themselves to be the advanced users. Less than a half of students (aged 30–40 years and older) identified themselves as assured users. Therefore, most of the respondents have no problems with ICTs. However, students older than 40 years asked for someone's help more often compared to other students.

Such a situation could be related to the growing tendency to use information technology in RF (Dutta et al, 2015) and development of ICTs in Tyumen oblast.

Contribution and roles of ICTs

More than half of respondents agreed that usage of ICTs in the educational process improves professional education, which is likely to have contributed to the use of ICTs in the educational process.

ICTs have the potential to support the creative learning environment in development of students' professional skills (Horn & Khalid, 2017) . Appropriate use of ICTs may connect education to real-life situations (Fu, 2013).

Problems

We ranked students' problems with the virtual educational space. First, respondents noted a lack of quality and convenience in the virtual educational space. They felt that the virtual educational space is not well organized.

This can be partially explained by the lack of a good material base. Almost every other student (47% of the total number of respondents) noted that the virtual educational space provides theoretical preparation and only a theoretical basis. Our results suggested that there is a need for modern software systems that also provide practical education. For example, Crespo, et al. (2016) developed and presented a new Android application for smartphones for the remote control of a micro-cogeneration system to be accessed anywhere. The authors propose to use the application developed as a laboratory experience in which students are given the opportunity of experiencing real-life practices and "learning by doing" in contrast to most classes based on theory (Crespo et al, 2016, p. 8).

Organizational difficulties might also be conditioned by the current legislation, where e-learning is not marked as a separate manner of learning. That is why the Industrial University of Tyumen uses e-learning technologies for modernization and informatization of the educational process as a whole; however, it is poorly focused on e-learning as a separate matter.

In this study, we examined the readiness of the University to implement e-learning as the dominant paradigm in the facilitation of learning. It was revealed that, when it comes to the practicalities of implementing e-learning, there is a lack of clarity about the meaning of the idea, what it involves or implies, and the description of its exact parameters. The study by Holomisa and Dube (2014) recommended that the University should establish synergy between new initiatives as well as student reality, staff capability, and regional infrastructure and socio-economic conditions.

The students have problems related to the lack of teacher assistance. Most respondents showed that teachers were not ready for educating students in the virtual educational space or were not well prepared. Factors such as age, level of proficiency with personal computers and the Internet, and perception of value of using computers influence how teachers use ICTs to educate in the virtual educational space (Woolf, 2010).

Lack of self-organization skills was third among the students' problems. Self-organization consists of the ability to converse with oneself about one's own learning processes and observe, search, analyze, formulate, review, judge, decide, and act based on such creative encounters. Despite such complicated structure, Thomas and Harri-Augstein (2013) showed that most educational institutions pay little attention to the growth of self-organizational learning. Thus, teachers and others assume that young pupils have a natural potential for learning. It leads them to teach in ways that inhibit and disrupt the self-organized capacity to learn (Thomas & Harri-Augstein, 2013).

Satisfaction

Almost half of the respondents were satisfied with the level of ICT organization in the educational process. Still, an increasing number of students were satisfied with their education in the virtual educational space. We assume, on one hand, that this could be attributed to teacher assistance and motivation for working with ICTs and the virtual educational space and convenience of the virtual educational space. "Convenience" is the most common reason for student satisfaction (Cole et al, 2014). While on the other hand, low satisfaction of ICTs was found to be correlated

with students' problems, including lack of self-organization skills and level of proficiency with ICTs.

Development perspectives

E-learning in higher schools makes getting an education possible for various categories of the population. Therefore, e-learning has great social importance, for example, for people with disabilities, for those who live in remote cities or remote rural settlements, and for people with hectic work schedules (Dunnick, 2013; Seale, 2014). An increase in the number of people willing to get an education through e-learning indicates the need for further development of virtual education space at the Industrial University of Tyumen, including e-learning for vulnerable social groups.

We suggest that the advantage of e-learning is primarily related to the formation of the virtual educational space, which joins teachers, students, and necessary educational resources in a united cycle (Freeman et al, 2013; Goold et al, 2006).

The features of the virtual educational space are its modular schedule, the changes in the role of the teacher (largely associated with the division of course developers, tutors, etc.), division of the subjects of the educational process of distance, virtual cooperative learning, self-predominance over the control of the teacher, the use of advanced specialized technologies, and e-learning tools.

Most of the participants have responded that the virtual educational space and ICTs can better develop the educational process. These resources are known for improving individual and collaborative education and develop professional potential students for 21st century views and perspectives (Kong et al, 2014; Kurilovas et al, 2014); while development of the virtual educational space depends upon: the quality of education materials, teachers' level of motivation for energetic working and innovations, and the level of teachers' computer and Internet literacy. Other studies have confirmed the importance of these factors as conveyed by the students (Fryer & Bovee, 2016; King & Boyatt, 2015; Raspopovic et al, 2014).

STUDY LIMITATIONS

The sample consisted of students of oil and gas educational programs, and consequently, it may be not representative of all students at IUT, which includes socio-economic and humanitarian educational programs.

Another limitation can be that, for having a cross-sectional design, this study reports a picture of the students' view in this specific academic year, and no trend or views on e-learning can be measured.

Contributions

This study may serve as a guide to help other Universities interested in implementing improved use of ICTs in the educational process and virtual educational space.

CONCLUSION

There is an inverse association between age and self-rated level of proficiency in use of computers and the Internet. However, no association was found between the manner of study and learners' opinion about their level of proficiency in personal computers and the Internet. Students of oil and gas educational programs from the Industrial University of Tyumen are open

to changes in the educational space concerning ICT development. They identify weaknesses in the organization of the virtual educational space, professional preparation of teachers, and students' problems (lack of self-organization skills, low level of proficiency of ICTs, etc.). However, students are interested in e-learning and believe that the virtual educational space makes professional education better.

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