ICT literacy as part of the higher education core

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Abstract—With rapid advances in the development, information and communication technologies (ICT) has become central to life in the 21st century. Nowadays higher education generally work in an ICT rich environment. As public awareness has grown, the need for ICT literacy has become extremely influential. ICT significantly influences the overall development of the younger population as well as on education process. Despite broad consensus about the need for ICT literacy among students, there is little information available that tells us about the student's level of ICT literacy. In order to determine possible differences in ICT literacy, according to the attendance of the course of study, which dealt with ICT, the research was undertaken at the Faculty of Humanities and Social Sciences, University of Mostar (the students are divided into two categories, those who have attended such courses and those who have not). ICT literacy was tested with a questionnaire in the form of knowledge test. For each question in the test, the difference in ICT literacy was determined by a chi-square test. Correct answers on the test were treated as total score, i.e. simple linear combination of those answered correctly, and the differences were tested using Student t-test. It was determined that students who attended an ICT course in average achieve higher scores on the test.

Keywords— ICT courses, ICT literacy, students, higher education

I. Introduction

Broadness of information and communication technology (ICT) has brought rapid technological, social, political and global economic transformation, and in a very short time has become one of the basic building blocks of modern society. Nowadays understanding of ICT and mastering its basic skills is considered as part of the core education with reading, writing and arithmetic.

The application of ICT has become pervasive in society, leading to everyday needs for ICT skills, and thus the need for ICT literacy has become extremely influential. Thanks to intensive technological progress, especially during the last two decades, information has become a basic resource.

Higher education system is responsible for the production of knowledge and people that are qualified and capable of working in a dynamic and turbulent environment. Taking into account these tasks, it can safely be maintained that higher education plays a key role in building a modern society. [2]

In the information society, ICT's influence can be noticed on several levels, covering a wide range of practices and in almost all fields of knowledge, from the natural sciences to the humanities. Although education has always taken them into account with the aim of enriching its practices and the educational objectives, the relationship between education and ICT has not always resulted in ICT's integration and total adoption. [8]

In order for students to meet the challenges in the era of ICT dominance, they need to acquire skills and competencies related to ICT use, and for that they certainly need ICT course. In ICT environment that we live in, an individual who lacks ICT skills has fewer abilities for personal improvement. Students who lack ICT skills cannot fully benefit from learning opportunities in the classroom or beyond it. [3]

During the past years it was continuously observed that the introduction of ICT in education led to improved learning results changes in practices, with a positive effect on learning. In this respect, ICT is a proper channel to be used for developing knowledge acquisition, to change structures of classroom activities, to increase students' control over their own learning, and to enhance motivation in science classes. [4]

The ICT revolution has been giving great impacts on all kinds of human activities. Educational and training activities are no exception. Rather, it could be said that the impact on them is larger than those on others. Also, the constantly changing knowledge requires constant learning, that is, life-long learning (LLL) and anytime & anywhere learning. Globalisation creates a market of education services, with identical rules as in any other service market. Educational organizations and institutions move from a fragmented information culture populated with disparate legacy systems to what is known as a "contextual collaborative" culture, a real-time, knowledge-sharing system. Because of this, many

academic institutions, even those with high prestige, are found in a situation where they might loose some of their students in favour of other institutions, which although they are located at greater distances are better anchored in the education market. The development of ICT, particularly the Internet, has eased the development of the globalization and therefore the quality of education. [10]

The benefits of ICT can be listed as:

• *Use of ICT requires no limit in time and space*

It is possible to use the ICTs anytime and anywhere, 24 hours a day, 7 days a week via asynchronous learning/teaching no matter what the time lag is between the delivery of instruction and its receptor. The only condition needed would be the access to the Internet. Teleconferencing, radio or TV broadcast would also be possible for those in diverse areas.

• *Resources are no more remote with ICT*

With ICT it is possible to access a wealth of learning materials in almost every subject from anywhere at any time by unlimited number of people. ICT also facilitates access to resource persons, mentors, experts, researchers, peers, writers, poets, artists, professionals, politicians, etc. all over the world. With the Internet it is possible to find any information about any subject.

• *ICT provides no limit in fun*

There are many Internet resources that provide fun for 24 hours. Music, comics, funny movies etc are there to help those to enjoy life. Downloadable materials also make the family gatherings become a ceremonial event.

• *ICT brings no limit in communication*

Such communication sources as Facebook, Skype, Msn, Twitter, Google talk, Yahoo talk, and others facilitate the communication between people on the two edges of the world, which prevents isolation as well.

• *ICT provides no limit in learning*

Technology helps schools provide opportunity to value deep understanding in the disciplines and take into account students' needs, interests, and strengths. Students with different learning styles can benefit from the facilities ICT provides.

• *There is no excuse for not using the ICT*

ICT helps to improve the quality in education, prepare individuals for the workplace, and develop inventive thinking and effective communication. It is particularly important to use ICT to enhance the quality of education by increasing learner motivation, to provide better teacher professional career, to facilitate a student-centered environment. Distant courses, remote resources, different techniques of providing information underpin the multiple intelligent learning. [1]

II. ICT LITERACY IN HIGHER EDUCATION

Today information about the world around us comes to us not only by words on a piece of paper but more and more through the powerful images and sounds of our multi-media culture. [12]

The ICT in higher education aims at preparing youth to participate creatively in the establishment, sustenance and growth of a knowledge society leading to all round socio-economic development of the nation and global competitiveness. The introduction of ICT in the higher education has profound implications for the whole education process ranging from investment to the use of technologies in dealing with key issues of access, equity, management, efficiency, pedagogy and quality.

1) Student-centered Learning: ICT provides a technology that has the capacity to promote and encourage the transformation of education from a teacher directed enterprise towards student-centered models. As more and more students use computers as information sources and cognitive tools, the influence of the technology will increase to support their studies.

2) Supporting Knowledge Construction: Learning approaches using contemporary ICTs provide many opportunities for constructivist learning and support for resource-based, student centered settings by enabling learning to be related to context and to practice.

3) Anyplace Learning: With the help of ICT, educational institutions can offer programs at a distance mode.

Today many students can use this facility through technology-facilitated learning settings.

4) Anytime Learning: Technology-facilitated educational programs remove the geographical barriers. Students are able to undertake education anywhere, anytime and at any place. This flexibility has provided learning opportunities for many more learners who previously were constrained by other commitments.

5) Information Literacy: The growing use of ICT as tools of everyday life have seen the pool of generic skills expanded in recent years to include information literacy. It is highly probable that due to the future developments and growth in technology, it will help further for information literacy. [13]

The assessment domain included a draft progress map of student achievement in ICT literacy. The draft progress map, shown in Table. 1, describes the assumed 'typical' growth of students' ICT knowledge, understandings and skills. The draft progress map has been a key reference for both the development of the assessment items and the consequent construction of the ICT literacy scale. The progress of student achievement in the ICT literacy processes can only be demonstrated with consideration of the communicative context, purpose and consequences of the medium. As such, the ICT literacy progress map is based on three strands:

Strand A – Working with information

Strand B – Creating and sharing information

Strand C – Using ICT responsibly. [7]

Table. 1 ICT Literacy Draft Progress Map [7]

	Strand A: **Working with Information** This strand includes identifying the information needed; formulating and executing a strategy to find information; making judgements about the integrity of the source and content of the information; and organising and storing information for retrieval and reuse.	**Strand B:** **Creating and Sharing information** This strand includes: adapting and authoring information; making choices about the nature of the information product; reframing and expanding existing information to develop new understandings; and collaborating and communicating with others.	**Strand C:** **Using ICT responsibly** This strand includes: understanding the capacity of ICT to impact on individuals and society, and the consequent responsibility to use and communicate information legally and ethically.
6.	Uses a range of specialised sourcing tools. Seeks confirmation of the integrity of information from credible, external sources. Uses tools, procedures and protocols to secure and retrieve information.	Uses specialised tools to control, expand and author information. Produces complex products. Critiques work and applies knowledge of conventions that shape interpretations when communicating across a range of environments and contexts.	Understands the impact and influence of ICT over time, recognising the benefits, constraints and influence of social, legal, economic and ethical issues on participation in society.
5.	Searches for and reviews the information needed, redefining the search to limit or expand. Judges the quality of information for credibility, accuracy, reliability and comprehensiveness. Uses appropriate file formats and procedures to store, protect, retrieve and exchange information.	Uses tools to interrogate, reframe and adapt information. Uses a range of tools to create and enhance the design, style and meaning of information products to suit the purpose and audience.	Understands the social, legal, economic and ethical consequences associated with using ICT across a range of environments and contexts.
4.	Develops questions or keyword combinations and selects appropriate tools to locate information. Appraises located information for relevance, currency and usefulness. Uses tools to structure, group and reorganise information for retrieval.	Integrates and interprets information from multiple sources. Selects and combines software and tools to structure, link and present work. Communicates work for different purposes, environments and contexts.	Understands the need for laws, codes of conduct and procedures for ICT use in different contexts. Recognises the potential for misuse of ICT and that there are procedures to address this.
3.	Identifies a search question, terms and suitable sources. Browses and retrieves information. Compares and contrasts information from similar sources. Organises and arranges relevant information and files.	Reorganises information from similar sources, using the main ideas. Selects software and tools to combine and transform text, images and other elements. Communicates work using different representations for particular contexts.	Recognises fair use, software restrictions and legal requirements. Identifies responsible use of ICT in particular contexts.
2.	Identifies and uses keywords in a search to locate and retrieve information from various sources. Identifies and records relevant content.	Uses the functions within software to edit, format, adapt and generate work to achieve a specific purpose and when communicating with others.	Identifies codes of conduct and ergonomic practices for ICT. Understands ICT terminology and use of computers in society.
1.	Uses keywords provided to retrieve information from a single, specified source. Recognises information required. Opens software and saves files.	Identifies and uses some of the basic symbols and functions of software to record ideas.	Understands and uses basic terminology and general procedures for ICT. Describes uses of ICT in everyday life.

Higher education institutions have started to recognize ICT as basic competence. Effective integration of ICT literacy will be achieved when students become able to choose the technologies that will help them to develop their technological competencies, to analyze and synthesize the information they have received from the ICT and present it professionally.

Since the beginning of recorded history, the concept of "literacy" meant having the skill to interpret "squiggles" on a piece of paper as letters which, when put together, formed words that conveyed meaning. Teaching the young to put the words together to understand (and, in turn, express) ever more complex ideas became the goal of education as it evolved over the centuries.

Different social and technological discoveries redesign almost every aspect of human life, generating the need for new literacies such as - ICT literacy, digital literacy, computer literacy, technological literacy, media literacy, information literacy, and others.

All these literacies are connected with learning process in a way that: ICT literacy, computer literacy and technological literacy are preparing individuals for using ICT resources, information literacy makes possible for individuals to identify and use relevant information found using ICT, and digital and media literacy are training them for ICT use in every days life.

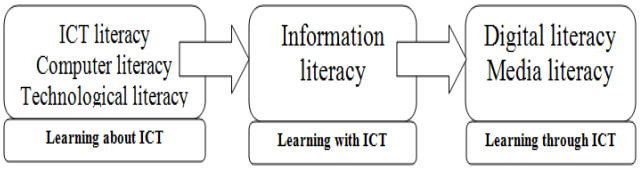

Fig. 1 The relationship between new literacies and learning process

ICT literacy is one of 21st century literacy. In January 2001, Educational Testing Service (ETS) in an International ICT Literacy Panel defined ICT literacy as the ability to use digital technology, communications tools, and/or networks to access, manage, integrate, evaluate, and create information in order to function in a knowledge society. [5]

ETS joined forces with seven leading colleges and university systems to create the National Higher Education Information and Communication Technology (ICT) Initiative. Together, they identified seven areas that needed to be measured in a higher education environment, and what information would help faculty and administrators gauge the effectiveness of current teaching strategies and curricula, identify the best practices and initiate better approach. The seven areas are: define (using ICT tools to identify and appropriately represent an information need), access (collecting and/or retrieving information in digital environment), manage (using ICT tools to apply an existing organizational or classification scheme for information), integrate (interpreting and representing information, such as by using ICT tools to synthesize, summarize, compare and contrast information from multiple sources), evaluate (judging the degree to which information satisfies the needs of the task in ICT environments, including determining authority, bias and timeliness of materials), create (adapting, applying, designing or inventing information in ICT environments) and communicate (communicating information properly in its context, i.e. audience, media, in ICT environment). The charter colleges worked with ETS to conceive design and build the first test of a person's ability to use ICT to think critically and solve problems. [6] [14]

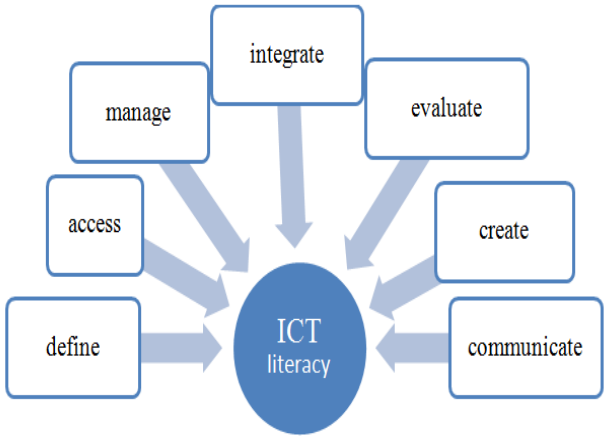

Fig. 2 Basic components of ICT literacy in higher education

ICT in the process of education raise changes. Currently it is obvious that education supported by ICT enables easier and more complex realization of the instructional process, it offers choice of place, time and pace for studying. At the same time the ICT-supported education allows an individual approach to students preferring various learning styles. [9]

III. ICT Literacy Research

A. Research Rationale

Technology has brought a vast new world of information resources into our homes, classrooms and offices, and there is considerable pressure upon us to use it. It is clear that in today's world, having a computer is not enough - increased exposure to technology does not automatically lead to increased ability to use it. A measure of success today is how well one can evaluate, manage and communicate all forms of information within a technological environment. These are the ICT skills. [14]

Despite broad consensus about need for ICT literacy among students, there is little information available that can tell us whether higher education institutions provide students with an ICT environment and whether the students that study in such an environment more ICT literate than students that learn about ICT by themselves, since there is a misconception that today's generations of students do not need any form of ICT courses because they have grown up in a world saturated with ICTs.

The main hypothesis of this study is that students who are in the ICT environment and who meet with ICT during their studies are more ICT literate.

B. Methodology and Respondents

In this survey, which was conducted among 807 students of Faculty of Humanities and Social Sciences, University of Mostar we wanted to determine the possible differences in ICT literacy with regard to the attendance of courses that dealt with ICTs. Students are divided into two categories - the group that attended described courses and the group that did not attend.

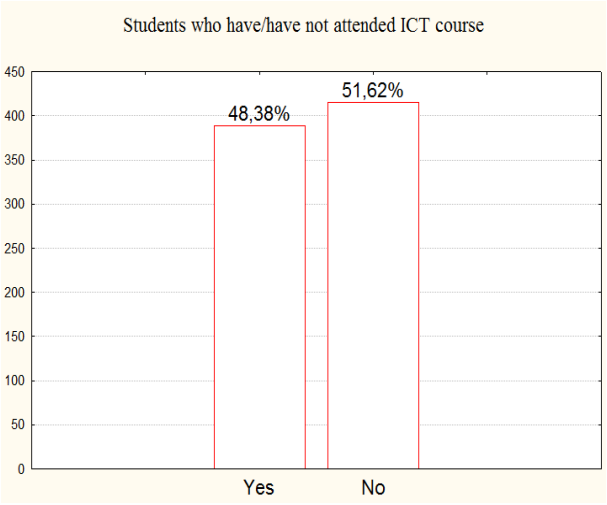

Fig. 3 Students who have/have not attended ICT course

Student's ICT literacy was tested in an anonymous questionnaire in the form of knowledge test constructed of 15 questions. For each of the questions in the knowledge test, chi-square test showed if there were any differences in the accuracy of the answers, i.e. in ICT literacy, with respect to the attendance of some ICT courses.

Questions were composed based on a definition of literacy and literate individuals used by many subject areas (e.g. political, science, historical literacy etc.), where a person that is literate in a field demonstrates basic interest in and knowledge of a subject, but is not an expert in the field. [5] Therefore, questions referred not only to knowledge and skills relevant for using ICTs, but also to general acquaintance and familiarity with different aspects of ICTs.

Furthermore, the correct answers on the test of 15 questions were treated as total score, or a simple linear combination of exact answered questions and differences were tested with Student t-test, with respect to the groups who attended the ICT course.

Statistical analysis was performed by program Statistica 7.0.

When you submit your final version, after your paper has been accepted, prepare it in two-column format, including figures and tables.

C. Figures

The results of all tested students are shown in the following table.

In the table we used the following phrases:

f - frequency

% - percentage

X^2 - chi square

p - p-value

df - degrees of freedom

Table. 2 ICT literacy test

ICT Course		Answer		Suma	X^2	Df	p
		False	True				
1. Which are the digits the computer world is build on?							
Yes	f	90	299	389	22	df =1	0,00
	%	11,19%	37,19%	48,38%			
No	f	136	279	415			
	%	16,92%	34,70%	51,62%			
Suma	f	226	578	804			
	%	28,11%	71,89%	100%			
2. Which of the listed represents the operating system?							
Yes	f	211	177	388	0,838	df=1	p=0,359
	%	26,28%	22,04%	48,32%			
No	f	239	176	415			
	%	29,76%	21,92%	51,68%			
Suma	f	450	383	803			
	%	56,04%	43,96%	100,00%			
3. What is Facebook?							
Yes	f	2	387	389	1,769	df=1	p=0,184
	%	0,25%	48,13%	48,38%			
No	f	6	409	415			
	%	0,75%	50,87%	51,62%			
Suma	f	8	796	804			
	%	1,00%	99,00%	100,00%			
4. What is http?							
Yes	f	298	90	388	2,617	df=1	p=0,106
	%	37,11%	11,21%	48,32%			
No	f	298	117	415			
	%	37,11%	14,57%	51,68%			
Suma	f	596	207	803			
	%	74,22%	25,78%	100,00%			
5. Which company was founded by Steve Jobs?							
Yes	f	68	320	388	5,599	df=1	p=0,018
	%	8,47%	39,85%	48,32%			
No	f	101	314	415			
	%	12,58%	39,10%	51,68%			
Suma	f	169	634	803			
	%	21,05%	78,95%	100,00%			
6. Which number in the picture represents the space bar button?							
Yes	f	52	337	389	5,502	df=1	p=0,019
	%	6,47%	41,92%	48,38%			
No	f	81	334	415			
	%	10,0%	41,54%	51,62%			
Suma	f	133	671	804			
	%	16,54%	83,46%	100,00%			
7. What does the shortcut Cut mean?							
Yes	f	273	116		3,062	df=1	p=0,08
	%	33,96%	14,43%	48,38%			
No	f	314	101	415			
	%	39,05%	12,56%	51,62%			
Suma	f	587	217	804			
	%	73,01%	26,99%	100,00%			
8. What is the latest operating system produced by Microsoft in the year 2011?							
Yes	f	277	112	389	6,942	df=1	p=0,008
	%	34,50%	13,95%	48,44%			
No	f	328	86	414			
	%	40,85%	10,71%	51,56%			
Suma	f	605	198	803			
	%	75,34%	24,66%	100,00%			
9. Which one of the listed is an IP address?							
Yes	f	183	205	388	7,193	df=1	p=0,007
	%	22,79%	25,53%	48,32%			
No	f	235	180	415			
	%	29,27%	22,42%	51,68%			
Suma	f	418	385	803			
	%	52,05%	47,95%	100,00%			
10. Which function on the computer reruns the computer?							

Yes	f	53	336	389	0,429	df=1	p=0,512
	%	6,60%	41,84%	48,44%			
No	f	50	364	414			
	%	6,23%	45,33%	51,56%			
Suma	f	103	700	803			
	%	12,83%	87,17%	100,00%			
11. @ sign is an integral part of:							
Yes	f	37	352	389	2,774	df=1	p=0,096
	%	4,60%	43,78%	48,38%			
No	f	55	360	415			
	%	6,84%	44,78%	51,62%			
Suma	f	92	712	804			
	%	11,44%	88,56%	100,00%			
12. Which one of the listed represents a wireless network?							
Yes	f	115	271	386	6,580	df=1	p=0,010
	%	14,37%	33,88%	48,25%			
No	f	159	255	414			
	%	19,88%	31,87%	51,75%			
Suma	f	274	526	800			
	%	34,25%	65,75%	100,00%			
13. What is the meaning of the abbreviation PC?							
Yes	f	94	294	388	2,727	df=1	p=0,099
	%	11,71%	36,61%	48,32%			
No	f	122	293	415			
	%	15,19%	36,49%	51,68%			
Suma	f	216	587	803			
	%	26,90%	73,10%	100,00%			
14. Which program is used for website browsing?							
Yes	f	203	159	362	1,776	df=1	p=0,183
	%	27,14%	21,26%	48,40%			
No	f	235	151	386			
	%	31,42%	20,19%	51,60%			
Suma	f	438	310	748			
	%	58,56%	41,44%	100,00%			
15. Which file extension makes only an image file?							
Yes	f	49	339	388	0,004	df=1	p=0,952
	%	6,10%	42,22%	48,32%			
No	f	53	362	415			
	%	6,60%	45,08%	51,68%			
Suma	f	102	701	803			
	%	12,70%	87,30%	100,00%			

Most students (71.89%) are familiar with the fact that computers are functioning across the binary system. However, there were differences between tested groups of students ($p<0.05$). Although both groups of students equally often know the right answer, when it comes to incorrect responses, students who did not attend any of the ICT courses during their studies often made more mistakes (16.92%).

Among offered answers, more than half of tested students did not know how to recognize what an operating system was (56.04%). Also, there were no identified differences between groups ($p>0.05$), respectively, students equally often gave correct or incorrect answers to this question, no matter whether they had ICT courses during their studies.

Almost all students (99%) know the answer to question "What is Facebook?" regardless of whether they had an ICT course during their studies ($p>0.05$).

A large number of students (74.22%) did not know the answer to "What is http?" irrespective of whether they had an ICT course in the current education at the Faculty.

About 79% of the students knew that the company Apple was founded by Steve Jobs. However, among students who did not know the answer to this question were mostly students who had not attended ICT courses ($p<0.05$).

The majority of students (83.46%) can recognize the space bar key on the keyboard. However, there were differences between groups ($p<0.05$). Students who had attended ICT courses rarely made mistakes in this matter (6.47%) compared to students who had not attended (10.07%).

In most cases (73.01%), students did not know "What does shortcut Cut mean?" no matter whether they attended the courses that dealt with computers and computer work ($p>0.05$).

Most students (75.34%) did not know, at the time of testing, what the latest Microsoft operating system was. However, students who have attended ICT courses knew the answer to this question (13.95%) more often than the group that did not attend those courses (10.71%). Also, the group that attended these courses rarely made mistakes answering questions (34.5%) than the group that did not attend any (40.85%).

About 50% of students knew how to recognize an IP address among offered answers. Also, among the 50% of students who did not know the answer, students who had not attended ICT courses made mistakes on this matter more often (29.27%) than students who had attend (22.79%).

Most students knew which function reruns the computer (87.17%). Also, there were no differences in the frequency of knowing of this function, considering the group they belong to ($p> 0.05$).

Students in most cases knew that the @ symbol is an integral part of the e-mail address (88.56%). There were no differences in knowledge among the groups considering the attendance of ICT courses.

About two-thirds (65.75%) of tested students knew that the WLAN stands for wireless network. However, the group that did not attend computer courses made mistakes more often (19.88%) than the group who attended the mentioned courses (14.37%).

About 73% of students know that the abbreviation PC stands for "personal computer". There were no differences in the frequency of (in)correct responses between the groups with regard to the attendance of ICT subjects ($p>0.05$).

The majority of students did not know the answer to the question "What program is used for website browsing?" (58.56%), no matter whether they attended ICT courses.

Tested students mostly knew which extension in the name signifies only an image file (87.30%), regardless of whether they attended ICT courses during current education ($p>0.05$).

Furthermore, the correct answers on a test of 15 questions were treated as total score, i.e. as simple linear combination of exactly answered, and differences were tested with Student's t-test, considering the groups who had attended ICT courses. It was found that students who attended ICT courses on average scored higher results on the test of ICT literacy ($p<0.05$).

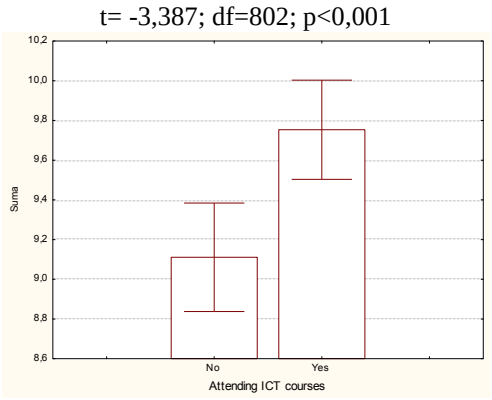

Fig. 4 Graphic preview of ICT literacy considering attendance of ICT courses

IV. Conclusion

ICT plays the main role in the development of higher education. Each young person will have to use ICT in many ways in order to fully participate in modern society. They must be able to access information from a variety of sources, to analyze and evaluate information, and then integrate it into a personal database. Successful use of ICT can help students to develop appropriate skills that they will need in their future professional and academic life.

This research has found that more than 50% of students (i.e. 51.62%) during their education at the Faculty of Humanities and Social Sciences, University of Mostar did not have a course that dealt with some form of ICT, which means that Faculty has not yet adapted to the changes brought about today's technological age. Institutions of higher education in the 21st century must allow students learning and teaching in the ICT environment.

Also, it was found that students made the least mistakes on the question "What is Facebook?" (1.00%), which is probably the prevalence of social networks, rather than of ICT literacy, i.e. the question that had the most incorrect answers was "What is latest operating system produced by Microsoft in year 2011?" (75.34%).

Issues that have more than 50% of the incorrect answers are: "What is http?" (74.22%), "What shortcut means Cut?" (73.01%), "What program is used for website browsing?" (58.56%), "What of the listed represents the operating system?" (56.04%), "Which one of listed is an IP address?" (52.05%). On all these issues, the students who had ICT courses during their studies also made more mistakes indicating that during current courses those have not learned the answers to these questions.

Issues that show no differences ($p>0.05$) with regard to attendance or not attendance of a specific ICT courses are: "Which of the listed represents the operating system?", "What is Facebook?", "What does the shortcut Cut mean?", "Which function on the computer reruns the computer?", "The sign @ is an integral part of:", "What is the meaning of the abbreviation PC?", "Which program is used for website browsing?", "Which file extension makes only an image file?".

Issues that show differences ($p<0.05$) are: "Which are the digits the computer world is build on?", "Which company was founded by Steve Jobs?", "Which number in the picture represents the space bar button?", "What is the latest operating system produced by Microsoft in the year 2011?", "Which one of the listed is an IP address?", "Which one of the listed represents a wireless network?". On all these issues that are shown students who attend some form of ICT courses show better results (or more accurately correspond to specific questions or provide less incorrect answers).

In general, students who have attended some of the courses that dealt with ICT rarely made mistakes in knowledge about the binary functioning of computers, the founder of Apple, knowledge of the function of the keyboard, marks of IP addresses and the label for the wireless network.

Student t-test (Fig. 4) showed that students who attended ICT courses on average scored higher on the test of ICT literacy, which confirmed our hypothesis that the ICT environment in higher education is developing ICT literacy.

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