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Abstract

Our changing society is forcing higher education to improve teaching habits in the context of higher level of information literacy (IL) among students. IL is necessary not for only education but is a skill needed for successful engagement in professional and private life. An IL test and a survey on information and communication technology (ICT) usage were conducted among students from seven different faculties in Slovenia. The presented research in progress presents a preliminary analysis of the IL testing and ICT usage among students, to propose the model of factors influencing the level of students' IL skills. According to the results, there are differences in IL, but they do not depend on the origin (faculty) of the student. ICT devices and applications usage could be an appropriate predictor of IL.

Keywords: Information literacy, Students, Influence, Factors, Application use, ICT use

1 Introduction

Information literacy (IL) is defined as an intellectual framework for understanding, finding, evaluating, and using information (ACRL, 2000). IL competencies and skills have been a significant subject in the area of higher education, influencing the design, content, teaching methodology and management of academic courses for the past two decades. Boh Podgornik, Dolničar, Šorgo, and Bartol (2015) argue that proficiency in IL skills may be accomplished by a combination of information and communication technology (ICT) skills, investigative methods, logic, critical thinking, discernment, and reasoning.

IL skills have been identified as one being crucial for successful academic studies, work and personal life (Eisenberg, Lowe, & Spitzer, 2004). Furthermore, IL is becoming increasingly important due to rapid technological development (Welsh & Wright, 2010). Students are expected to gain, deepen, and continuously improve their knowledge; therefore, the demand to use diverse information resources and a spectrum of methods available to use such resources is rising. Contemporary lecturers assume that students have certain IL skills in the current digital society. Thus, students in higher education are facing significant challenges in the enhancement of their study approaches.

According to Detlor, Julien, Serenko, and Booker (2010), student learning outcomes are influenced by IL program components. Limberg, Sundin, and Talja (2012) further define IL as "the ability to search for, select, critically evaluate and use information for solving problems in various contexts, such as independent project work in schools". Research by Johnston and Webber (2003) found IL to be a key discipline of the information society. The library is among the first places where a person becomes familiar with the concept of IL (Julien & Given, 2003; Robertson & Jones, 2009); furthermore, on some campuses, libraries are responsible for IL

education (Hutchings & Willey, 2014). Higher education institutions represent the second step in the acquisition of IL competencies of a student.

A significant contribution to the stable integration of IL in higher education institutions in Slovenia has been the authorized translation of the US publication "Information Literacy Competency Standards for Higher Education" (ACRL, 2000; Stopar, Kotar, Pejova, & Knap, 2010). Since then, IL has been positioned as a key educational priority of higher education in Slovenia (Boh et al., 2014).

Despite the integration of IL standards into the educational process, students do not come to university well trained for academic research (Salisbury & Karasmanis, 2011). Johnston and Webber (2003) propose the "information literate university", where the focus is not only on teaching students to be information literate. Such a university requires a connected and coordinated work of all members of the university (Johnston & Webber, 2003). The aim of the information literate university is to enhance IL in order to give students an edge in academic, work and private environments throughout their lives (Maybee, 2006).

To identify the obstacles and develop an insightful and extended concept of IL competencies of students, researchers from six Slovenian faculties cooperated in a national project "Development of student IL as a support to solving authentic science problems" (J5-5535). The aim of the project is to develop and evaluate an efficient educational model for the IL of students. Integration of problem-based learning concepts into the educational process will be performed considering the criteria and indicators of IL in higher education.

This paper is organized as follows: in Section 2, a brief presentation of methods used in this research is given, including the development of the questionnaire. In Section 3, results of the research are presented. Based on the presented results, Section 4 includes a discussion of proposed hypotheses. In Section 5, conclusions and implications for future research are given.

2 Literature review

There are many studies on IL assessment in different contexts, developing and using various tests as research instruments (e.g. Mery, Newby, & Peng, 2012; Mittermeyer, 2005; O'Connor, Radcliff, & Gedeon, 2002). Most of them follow the recommendations of various IL standards (e.g. Gross & Latham, 2012; Thornton, 2008). However, most of the studies are conducted by librarians, sometimes in cooperation with researchers or IL educators. A detailed review of IL assessment tools, design, and content of available IL tests (ILT) and questionnaires are presented in Boh et al. (2015). However, there is no final general agreement on which methodology or which specific IL test format serves best to evaluate the IL of students in higher education. Furthermore, there are few studies investigating factors influencing IL skills.

Previous research showed weak knowledge of ICT literacy (Katz, 2007) and digital literacy (Eshet-Alkalai & Amichai-Hamburger, 2004) among college and high school students. Factors affecting IL achievement in high schools, focusing on teachers', librarians', and student's perspectives, are presented by Varlejs & Stec (2014). Authors propose that understanding and commitment of school leaders is necessary to improve the IL of students. Although there are indices, that the performance in IL depends on the major topic of the study, there is no doubt, that IL knowledge

can be improved with courses that teach and require IL skills to be used (Kiliç-Çakmak, 2010; Williams & Evans, 2008).

Detlor, Julien, Willson, Serenko, and Lavallee (2011) propose three basic groups of factors affecting IL instructions at business schools: learning environment factors, IL program components, and student demographics. Although the IL student learning outcomes are affected by several individual factors, they are rarely under the control of librarians and teachers (Martin, 2011). Demographic and academic characteristics that may predict success in an IL test are presented by Godbey, Ladd, and Fabbi (2014). Only one of the proposed group of factors considering the influence of school (principals monitoring of teachers' ICT use), and both items considering individual attributes of a student (gender and parental socioeconomic status), have a significant impact on students' computer and information literacy (Lorenz, Eickelmann, & Gerick, 2015). Experiments on digital literacy shed further insights into information skills (Eshet-Alkalai & Amichai-Hamburger, 2004), in which older experiment participants performed better in information literacy compared to the younger participants who performed better in computer use.

Although, according to Šorgo, Bartol, Dolničar, and Boh Podgornik (n.d.), attributes of digital natives are poor predictors of information literacy, and the frequency of digital devices usage does not directly influence information literacy, the aim of this research is to evaluate and propose constructs in order to determine if they could be eligible factors that affect the IL of students.

3 Methodology

3.1 Study design and participants

The presented research is part of a broader study on the use of problem-based learning (PBL) in an e-learning environment to improve students' IL skills. The study was designed as a natural experiment, where control and treatment groups of students were observed in their natural study environment. Courses, in which the experiment was conducted, were selected based on the possibilities to employ a PBL in an e-learning environment. The IL-related content was designed and implemented by university professors, with problem-based examples from the domains of the study programme. Pre- and post-tested students completing an ILT and ICT usage questionnaire before taking any IL-specific classes were considered to be a control group, while students pre- and post-tested after participating in a PBL-IL course were a treatment group. To assess the impact of PBL e-learning use on IL, two questionnaires were administered pre- and post-participation in the course. This study focuses only on the pre-test results of the two measuring tools: Information Literacy Test and ICT usage questionnaire.

Testing of the students began in the 2013/14 academic year and will be finished by the end of the 2015/16 academic year. The current group of 850 tested students consisted of students from two different Slovenian universities (six faculties) and one autonomous faculty. All students were involved in different courses, which included IL topics. Participation was voluntary. Surveying was performed as an e-learning activity with the supervision of an educator.

3.2 Instruments and variables

The ILT was developed as a measure to evaluate students' IL. The final test consists of 40 multiple-choice questions. Each question offers a choice of four possible answers, arranged in alphabetical order. Only one of the possible answers is the correct answer. It is not possible to select "No answer" or "Other" as an answer. The detailed process of the ILT development is presented in Boh Podgornik, Dolničar, Šorgo, and Bartol (2015).

According to ACRL standards (ACRL, 2000), the IL assessment was divided into five groups defining the information-literate student:

1. Determines the nature and extent of the information needed (ACRL1).
2. Accesses needed information effectively and efficiently (ACRL2).
3. Evaluates information and its sources critically and incorporates selected information into his or her knowledge base and value system (ACRL3).
4. Individually or as a member of a group, uses information effectively to accomplish a specific purpose (ACRL4).
5. Understands many of the economic, legal, and social issues surrounding the use of information and accesses and uses information ethically and legally (ACRL5).

The five groups of ACRL standards are measured in detail as constructs in the test; they are all measured with several different items (questions). Construct ACRL1 was measured with 15, ACRL2 with 10, ACRL3 with five, ACRL4 with four, and ACRL5 with seven items. Due to an easier comparison of constructs' scores, the ratio of achievements for each construct was calculated. The reliability test with a Cronbach's alpha value of 0.723 confirms the reliability of the ILT with 40 questions.

In addition, a survey aiming to explore the habits and use of ICT among students was conducted. There were 35 questions aiming at the exploration of students' habits regarding the ICT application and device usage. The students were asked: a) which ICT devices they own and how often they use them, b) to what extent they use different ICT applications, c) to what extent they use ICT and applications for educational purposes, and d) how self-confident they feel when working on the internet.

Among the 35 questions on ICT usage, there were four about the usage of ICT devices, focusing on the usage of the smartphone, tablets, portable, and stationary computers. The items were measured on a 5-point Likert-type scale of frequency, on which "1" means "never" and "5" means "more than once per day". According to the distribution of answers, values of skewness and kurtosis, it was decided that data about the usage of ICT devices should be represented as dichotomous variables. Therefore, all answers marked from 1 or 2 on the Likert scale were recoded to 0, stating that the student does not use advanced applications, and answers marked from 3 to 5 on the Likert scale as 1, stating the student uses advanced applications more than several times per week and is thus considered to be a user of advanced applications.

The questionnaire included 16 questions regarding the usage of different ICT applications. Since the questions on ICT application usage are quite diverse, five groups of questions are proposed based on our tentative assumptions. Exploratory Factor Analysis (EFA) was conducted to

evaluate the proposed groups or latent constructs. EFA confirmed a hypothesized five latent constructs structure. The latent constructs and their items are proposed in Table 1.

Latent construct	Item
Application usage for learning	Using bibliographic databases (e. g. Cobiss, Scopus, Web of Science, EBSCO)
	Prepairing seminar and project works
	Reading e-books and scientific papers
	Working with office tools (MS Office, Open Office)
Application usage for searching and communication	Searching for information (e. g. Google)
	Watching videos (e. g. YouTube)
	Communication (e-mail, MSN, Skype)
	Using web maps (e.g. Google Maps, Google Earth)
	Reading newspapers and daily news at the Internet portals
	Using social networks, forums and blogs (e. g. Facebook, Twitter)
	Using e-learning materials and e-textbooks
Professional advanced application usage	Programming
	Designing web pages
Freetime advanced application usage	Editing and processing photos (e. g. Picasa, Photoshop)
	Editing and processing videos and animations
Other	Playing games

Table 1: Constructs and items to measure ICT application usage.

Items presented in Table 1 were measured on a 5-point Likert-type scale of frequency, on which "1" means "never" and "5" means "more than once per day".

The first question of ICT and application usage for learning was about the total number of courses in which the student was involved the current year. Furthermore, the extent of ICT and application usage for educational purposes was measured as the ratio of courses where ICT and applications were used as:

- Individual usage at the faculty (e.g. simulations, animations, programming)
- Web interaction with lecturer to perform study assignments (e.g. Moodle)
- Individual search of sources and information on the web for seminar assignment
- Advanced search in specialized databases

In addition, self-confidence when working on the internet was measured with 10 items on a 5-point Likert-type scale for the level of agreement, on which "1" means "strongly disagree" and "5" means "strongly agree".

4 Results

In this paper, an analysis of the pre-test results of ILT and ICT use is presented. A total of 750 students (69% female and 31% male) participated in the pre-test survey. The age of the respondents ranges from 18 to 52 years with an average age of 21.42 years and standard deviation 3.342 years. The proportion of different study fields (faculties) are represented in Figure 1; 47% of students came from natural sciences studies and 53% from social sciences.

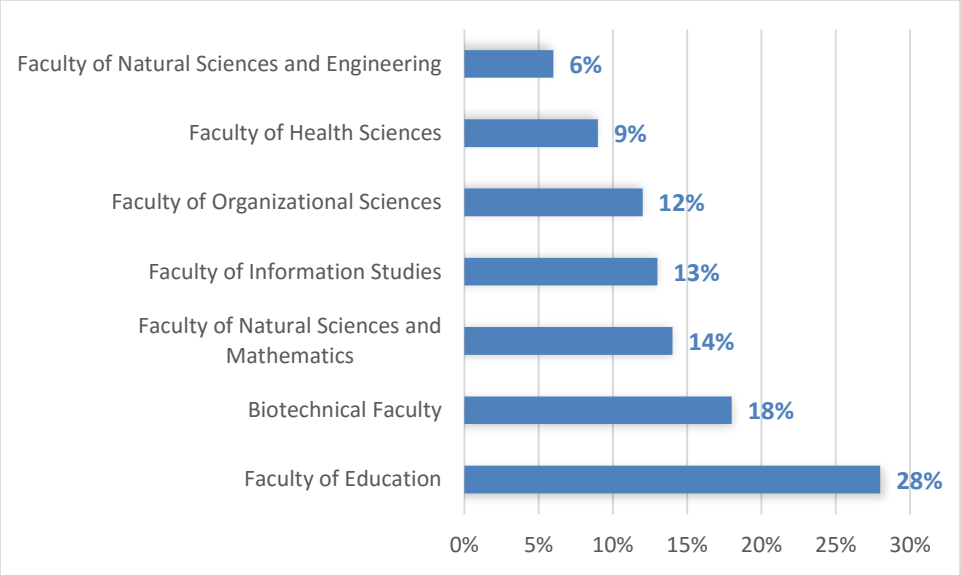

Figure 1: Shares of respondents from different faculties.

The ILT maximum value is 40 (each correctly answered question accounts for 1 point). The ILT revealed that the average achievement at the pre-test was 26.60 points with an SD of 4.90. This means that the average achievement was 67% of the total score, while the minimum and maximum achievements were 20% and 98% respectively, with an SD of 4.902%.

The level of IL skills increases with the year of study, from the first and second year of study, where the average score achievement is 66% of the maximum score, the average score rises to 68% and 73% in the third and fourth years of study, respectively. There are no significant differences in achievements regarding the gender of the respondent. We performed ANOVA to test for differences in score achievement between the faculties. ANOVA revealed that there were no statistically significant differences at 5% significance level in the results of the ILT between seven faculties involved in the testing. Figure 1 shows the overall ILT score achievement of the pre-tested students at individual faculties. Overall students have similar results in IL skills.

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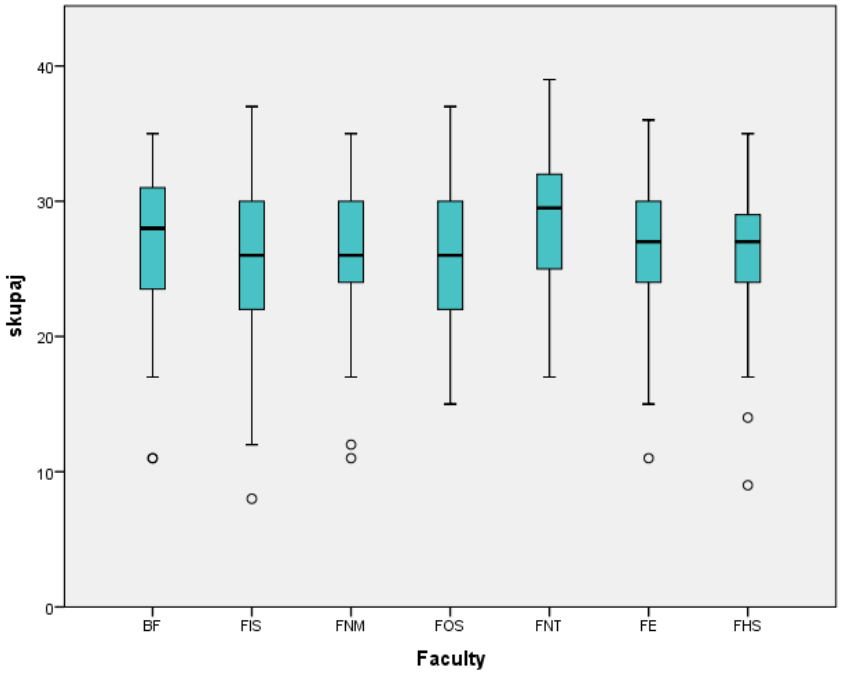

Figure 1: Score achievement at the ILT pre-test.

The results of ACRL standard groups showed different levels of IL in individual components, as presented in Figure 2.

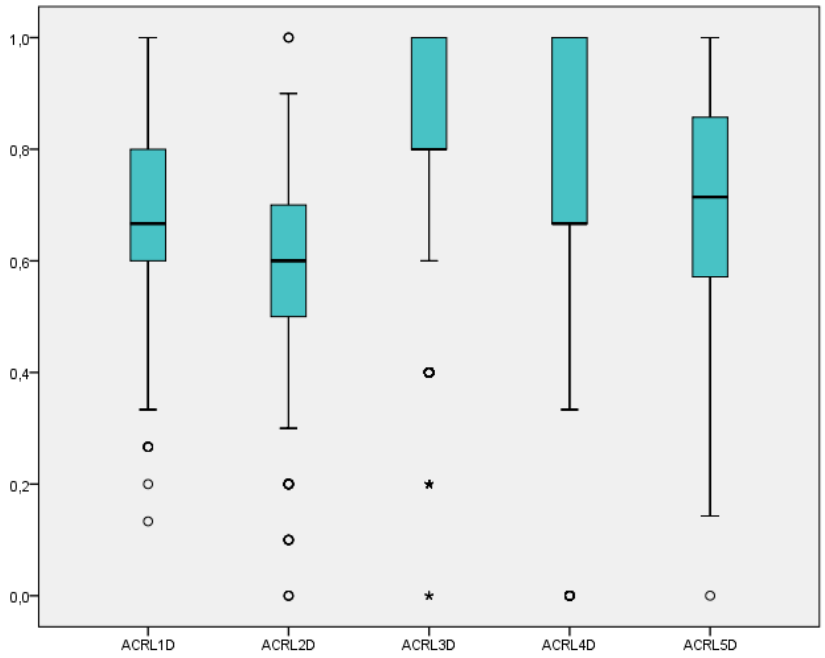

Figure 2: ILT achievements in individual groups of IL according to ACRL.

The analysis of IL skills shows that students have different levels of skills on individual topics of IL–ACRL. The highest level of IL skills is observed in ACRL3 (critical evaluation and use of information and its sources) and ACRL4 (uses information for problem-solving individually or as

a group), with ACRL3 having the smallest variability in data. The level of IL skills is the lowest in ACRL2 (effective and efficient access to information). The understanding of economic, legal, and social issues surrounding the access and use of information (ACRL5) shows the largest variability.

Our aim is to identify some individual factors which could, in addition to the proposed components, influence the IL of students.

4.1 ICT usage questionnaire analysis

Analysis of the ICT use revealed that the most frequently used ICT device is the smartphone, followed by the portable computer (laptop); 90% of students use smartphones more than several times per week, and 85% of students use portable computers more than several times per week.

While there are no statistically significant differences in the frequency of smartphone and tablet usage, female students (M = 0.899, SD = 0.302) use portable computers more often than their male counterparts do (M = 0.745, SD = 0.437); t(332.335) = -4.868, p = 0.000. In contrast, as presented in Figure 2, male students (M = 0.565, SD = 0.497) use desktop computers more often than their female counterparts do (M = 0.329, SD = 0.470); t(424.294) = 6.101, p = 0.000).

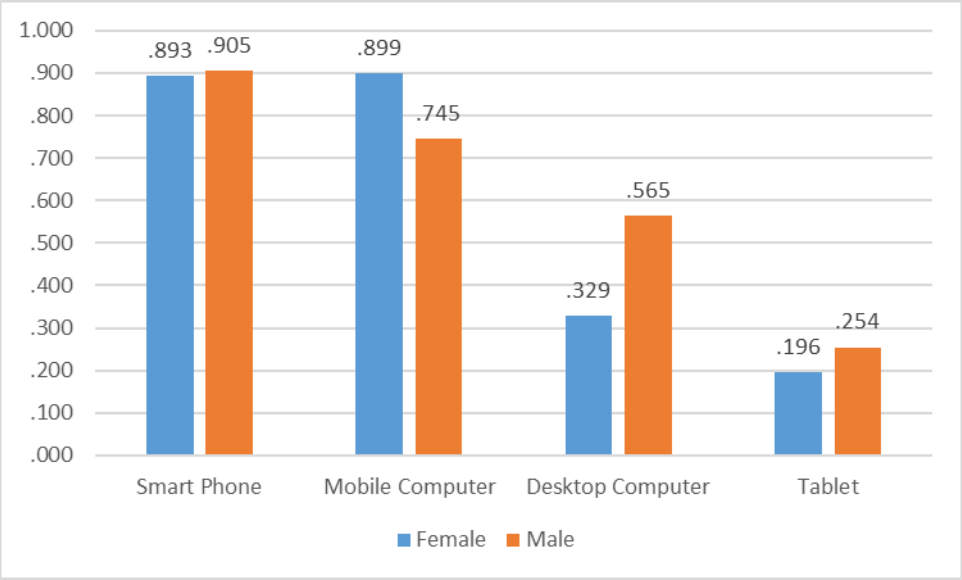

Figure 2: Daily usage of ICT devices.

The average levels of ICT application usage organized according to the proposed latent constructs are presented in Table 2.

Latent construct	Item	Mean	SD
Application usage for learning	Using bibliographic databases (e. g. Cobiss, Scopus, Web of Science, EBSCO)	2.15	.730
	Prepairing seminar and project works	2.33	.639
	Reading e-books and scientific papers	2.25	.885
	Working with office tools (MS Office, Open Office)	2.81	.974
Application usage for searching and communication	Searching for information (e. g. Google)	4.48	.708
	Watching videos (e. g. YouTube)	3.87	.951
	Communication (e-mail, MSN, Skype)	3.82	1.010
	Using web maps (e.g. Google Maps, Google Earth)	2.67	.835
	Reading newspapers and daily news at the Internet portals	3.23	1.090
	Using social networks, forums and blogs (e. g. Facebook, Twitter)	4.23	1.010
	Using e-learning materials and e-textbooks	3.18	.950
Professional advanced application usage	Programming	1.53	.886
	Designing web pages	1.30	.625
Freetime advanced application usage	Editing and processing photos (e. g. Picasa, Photoshop)	1.96	.899
	Editing and processing videos and animations	1.54	.723
Other	Playing games	2.20	1.155

Table 2: Descriptive statistics for Items of latent constructs describing application usage.

According to the results presented in Table 2, students rarely spend time using advanced applications, either for professional or personal (free time) use. The average frequency is slightly higher when playing games or individual application usage for learning. Moreover, students spend most of the time using applications for searching and communicating on the web.

The ratio of courses that promote individual ICT usage ranges from 19% to 50% at individual faculties. The ratio of courses in which ICT usage for interaction with lecturers is promoted is the highest at the Faculty of Organizational Sciences (80%), where half of the study process is performed as e-study. For the same reason, the ratio of ICT usage for individual seminar work reaches the highest value at Faculty of Organizational Sciences (57%). The highest share of the courses that require specialized search in different databases is at the Faculty of Organizational Sciences (33%).

Self-confidence when working on the internet was measured with 10 items. Results of mean values and SD are given in Table 3.

Item	Mean	SD
Because I know that I can find any information on the Web without the help of others.	4.09	.864
Because I know that I can solve problems by finding help on the discussion forums on Internet	3.34	1.108
When I need to present my own solutions and opinions to the others on the Web.	3.20	1.026
When I must learn new skills to work with new programmes.	3.61	1.039
By participating in forums and Web communities deling with professional and scientific issues.	3.05	1.016
When communicating in Web communities and social networks.	3.94	.948
In solving problem that can emerge when working on the Internet.	3.43	1.002
Using information searching strategies on Web search engines such as Google, Yahoo, Bing, etc.	4.19	.845
Using searching strategies within local e-libraries and bibliographic databases.	3.73	1.005
Using searching strategies within international bibliographic databases, such as Web of Science and Scopus	2.89	1.132

Table 3: Descriptive statistics for Items describing self-confidence when working on the WWW.

The results indicate that students feel most self-confident when using web search engines, such as Google, Yahoo and Bing, while the case is the opposite regarding search strategies in bibliographic databases.

5 Conclusions and proposal for future work

This research addresses the problem of stimulating information literacy by employing problem-based learning in an e-learning environment. For this purpose, we have developed and assessed an IL test and ICT use questionnaire, which were administered in a natural experiment with students at seven Slovene faculties. A preliminary investigation on IL and ICT use based on a pretested group of students is presented. Since we have identified several statistically significant differences among faculties in IL skills, we wanted to identify the factors influencing the IL of students. According to our tentative assumptions and confirmed with EFA, several latent constructs were proposed as ICT usage indicators.

To obtain the first insight into the proposed latent constructs, the skewness and kurtosis for constructs and corresponding items had to be calculated. Following that, we were able to assess if the data are appropriate for Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM), while the absolute values of skewness and kurtosis up to 2.3 are, according to Lei and Lomax (as cited in (Lee & Lehto, 2013)), not problematic.

The sample size of 750 is sufficient to achieve the statistical power necessary for SEM with three or more measured items per latent variable. The sample size also clearly satisfies Loehlin's rule of thumb (Siddiqui, 2013), which states that the sample size should be at least 50 more than eight times the number of measured items in the model (which is equal to 290 in our case). Our sample size also meets the criterion that an ideal sample size-to-parameters ratio would be 20:1 (Kline, 2011); it is 25:1 in our case. Since the project of IL assessment is ongoing, we can even expect to obtain at least an additional 50 responses to the questionnaire.

In the next stage, when all the responses will be available, the internal reliability of the constructs will be further investigated with CFA. The component validity of each scale will be assessed using CFA, and it will be evaluated through the convergent validity and the discriminant validity.

The convergent validity should be examined based on three concepts (Fornell & Larcker, 1981; Koufteros, 1999):

- Estimates of standardized factor loadings should exceed 0.5 (or even 0.7), or absolute values of corresponding z-values (which are calculated as the ratio of the non-standardized factor loading to its standard error) should be greater than 2 or 2.576 to be considered as significant at the 5% or 1% significance level, respectively.
- Composite reliability (CR) for each latent variable should exceed 0.7.
- Average variance extracted (AVE), which measures the amount of the common variance between the indicators and their construct in relation to the amount of variance attributable to measurement error for each latent variable, should exceed 0.5.

To investigate the discriminant validity of the measurement model, the square root of the AVE of each latent variable will be compared to the correlations between the latent variables, where values of the square root of AVE for the corresponding latent variable have to be greater than the corresponding correlations between latent variables to confirm discriminant validity. In addition, to confirm that the two scales do not correlate, the correction of attenuation of the correlation due to measurement error will be calculated (Crocker & Algina, 2008), where (according to the rule of thumb) values below 0.85 indicate that discriminant validity exists between two scales. In the final step, SEM will be used to test the predicted relationships among the components and factors that influence the IL of students.

By defining the influencing factors and by gaining a comprehensive understanding of the IL problem, curriculum and courses can be enhanced to encourage students' IL literacy skills.

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