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Non-ICT Students' Familiarity with Basic Computer Concepts at the Faculty of Philosophy at the University of Novi Sad

As a continuation of our previous paper, the aim of this research was to determine the level of familiarity of the freshmen at the Faculty of Philosophy, University of Novi Sad, Novi Sad, Serbia, with the basic concepts related to computers. The sample included the same 568 respondents as in our first study, and the same two control groups. Familiarity was analysed with 14 questions from the field of computer literacy, both at the level of individual questions and in relation to the total number of correct answers. The results were also analysed in relation to the condition of passing the test from the appropriate European Computer Driving Licence module. No student answered all the questions correctly, which clearly indicates the need to educate students on basic concepts related to computers. The obtained results can be used to better adapt teaching to the students' needs and their prior knowledge.

Keywords: *computer and information literacy, digital literacy, students*

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1. Introduction

Today, both in literature and in educational practice, the need for digital or computer literacy as the most important “functional” literacy is no longer questioned and such literacy is now considered essential in modern society. Today, “digital competences, computer skills, information literacy and related abilities represent a crucial element in ICT education (Information and Communication Technologies)” (Stopar and Bartol 2019, 479). Many authors, including Bernd W. Becker (2018), still debate whether digital and information literacy are the same, or whether digital literacy (DL) has emerged as a separate consideration out of information literacy. After considering different approaches to this debate, Becker concluded that “digital literacy and information literacy cannot exist without one another” and that “we might consider grouping students and patrons by how ready they are to embrace digital literacy skills” (Becker 2018, 2).

Many authors define DL in a similar way. Spante et al. stated that “In more recent publications, definitions of DL point towards cognitive skills and competences” (Spante et al. 2018, 7). This indicates how much the topic of defining the field covered by the term “digital literacy” is still essential and relevant. In the present paper, we single out two prototypical definitions: one where “…digital literacy emphasizes reading, writing, understanding, evaluating, communicating, and using the information in different formats” (Dewi, Pahriah, and Purmadi 2021, 88), and another where “Digital Literacy is the awareness, attitude and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyse and synthesize digital resources, construct new knowledge, create media expressions, and communicate with others, in the context of specific life situations, in order to enable constructive social action; and to reflect upon this process” (Martin and Grudziecki 2006, 255). These definitions indicate that DL is a very complex set of skills and knowledge, and that approaches to mastering those skills must be based on clear insights into the level of freshmen’s prior knowledge, which should be identified by empirical research. Indeed, only digitally literate students, as many authors have noted, can be successful students in study programmes in various disciplines of higher education today, including social-humanistic fields.

A specific level of DL as such is not an end in itself. Cadiz-Gabejan and Takenaka showed in their study how important DL is for students’ overall success in studying: “The findings of the study revealed that the students needed to enhance the extent of their computer literacy in the areas of word processing, spreadsheet, presentation, and general computing. The results also signified that the greater the extent of their computer literacy in said areas, the higher their academic performance” (Cadiz-Gabejan and Takenaka 2021, 29). They indicated how important computer training courses are for students by stating that “an intervention program is imperative to enhance the extent of the students’ computer literacy, especially that they felt some constraints with it” (Cadiz-Gabejan and Takenaka 2021, 42).

Another heavily debated subject is the tension “between the theoretical conceptualizations of DL as a multidimensional construct and empirical studies reporting unidimensional DL scores. Also, little is known about how DL may vary among different age cohorts, and whether and at which age do performance gaps emerge with respect to gender" (Jin et al. 2020, 1).

In recent years, there has been a lot of empirical research on the level of DL among different target groups. In a previous paper (Gellér et al. 2021), we reported on the familiarity of freshmen at the Faculty of Philosophy at the University of Novi Sad, Novi Sad, Serbia, with the basic concepts of the Internet. This follow-up paper focuses on their prior knowledge in basic computer literacy. The presented results are based on the same analysis carried out at the beginning of the winter semester of 2019 as in our previous study.

Research carried out by Rizal et al., which used a very similar methodology and target group to ours, showed that "the mean of student's digital literacy was 50 with a low category. Three digital literacy competency areas owned by students show that the mean literacy competency of information and digital data is 36 (low category), the mean of communication and collaboration competency is 68 (medium category), and the mean of digital content creation is 47 (low category)" (Rizal et al. 2020, 1).

Reddy et al. focused on an identical target group as in our research in their study. In an effort to assess the DL of first-year students at a regional university in the South Pacific, they concluded that "…the students who join higher education are digitally literate. However, students are not competent in all aspects of digital literacy. Therefore, educators need to design and develop appropriate interventions and training programs which comprise all aspects of digital literacy" (Reddy et al. 2020, 5).

Another research study on the DL of students led by Hina Amin confirmed that "digital literacy is a multi-dimensional construct and requires a comprehensive theoretical background that should include all major elements of digital literacy that one should possess to thrive in the digital world" (Amin, Abid Malik, and Akkaya 2022, 37). This research also tested students' DL competency and knowledge based on a "Digital Literacy Scale (DLS) based on Chen's (2015) theoretical framework which includes nine dimensions: communication, collaboration, critical thinking, creativity, citizenship, character, curation, copyright, and connectedness" (Amin, Abid Malik, and Akkaya 2022, 24). Their conclusion was that this technique is very useful for testing the level of DL not only among students but also the general population.

The study presented by Tham et al. considered the way students think about their digital knowledge and skills, stating that "student perceptions of their own digital literacy (and instructor's awareness of such) are informed by prior experiences by means of metaphors and mental models. These conceptualizations can shape how they learn with technology" (Tham et al. 2021, 14). In concluding their paper, the authors recommended that "Instructors should incorporate a variety of digital technologies into coursework that allow students to practice multidimensions of digital literacy" (Tham et al. 2021, 15).

All the above-mentioned reports spoke about the need to empirically investigate the level of students' knowledge in the field of DL, which was also the subject of our study, to verify the opinion that the new generations of students are already sufficiently digitally literate by themselves and that they do not need additional courses in that field to succeed in their studies.

The rest of the paper is organised as follows: the next section describes the study sample and the methodology used, while the third section is dedicated to a detailed analysis and statistical comparison of the students' answers, and finally the last section presents a discussion of the results.

2. Study Sample and Methodology

The study aimed to analyse the familiarity of freshmen at the Faculty of Philosophy (FF) at the University of Novi Sad, Novi Sad, Serbia, with basic computer concepts. The study sample comprised 522 students from 13 out of 17 study programmes (subgroups) at the FF (programmes with a small number of students were not included). The research also included two control groups: one from the Faculty of Technical Sciences (FTN), comprising 29 students, and one from the Faculty of Management (FAM), comprising 17 students. The total number of student participants in the study sample was thus 568. The distribution of students by study programmes is shown in Figure 1. For a clearer presentation of the results, instead of the full names of the (sub) groups, we henceforth use their abbreviations given in Figure 1.

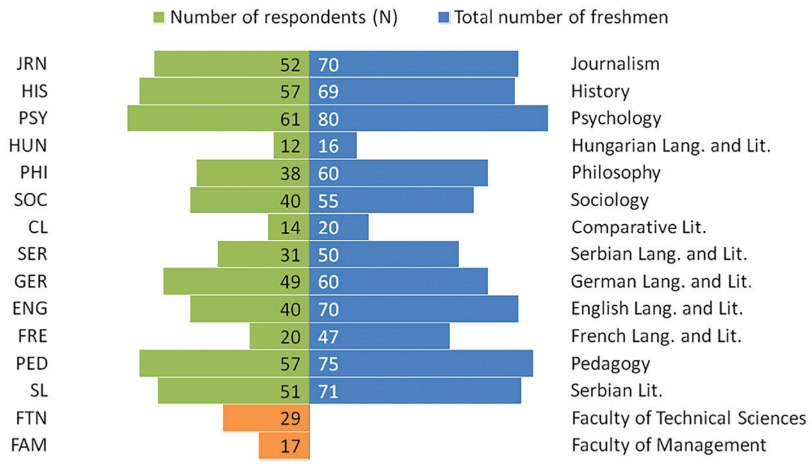

Figure 1. Study programmes and the numbers of respondents. (self-edited)

The knowledge test applied here was based on a questionnaire composed of 22 close-ended questions, with 4 answers possible per question. The questions were selected from a set of questions used in the final tests in the subject of *Computer Literacy* at the FF. Here, 8 questions referred to the basic concepts of the Internet and 14 questions to computer-related concepts. We presented an analysis of students' answers to the questions related to the basic concepts of the Internet in our earlier study (Gellér et al. 2021). The current paper focuses on the analysis of the students' answers to the 14 questions related to the use of computers.

The testing was conducted anonymously; the students had 15–20 minutes to complete the test in a printed paper form.

2.1. Data analysis

The familiarity of the freshmen of the FF with basic computer concepts was analysed both at the level of the individual questions and in relation to the total number of correct answers, and was compared with the results from the control groups. The scores of the FF students as a whole (i.e. for all the subgroups together) were examined, as well as the scores of the individual subgroups too.

The percentages of different answers to the individual test questions are shown graphically. Pearson's $\chi 2$ test and Cramer's V coefficient were used to assess the statistical significance of the connections among the different faculties and individual subgroups within the FF based on their numbers of correct answers. Distributions of correct answers, measures of central tendency, and the variability among the control groups and individual FF subgroups were examined as well. The students' results were analysed in relation to the requirements of passing the test from the appropriate European Computer Driving Licence (ECDL) module (Computer Essentials) and in relation to how many of them would get a negative grade on the exam at the respective faculties.

Examination of differences in the results of the students of the FF and the control groups was done using the Kruskal–Wallis test, with multiple comparisons of the average ranks performed using the Bonferroni-adjusted z-test.

The interconnectedness of the individual test questions with respect to the number of correct answers was checked by calculating the phi correlation coefficients between the questions.

3. Results

The presentation of the research results starts with a review of the questions and answers, with graphical displays showing the shares of the different answers to the individual test questions. The abbreviations in parentheses after the ordinal numbers of the questions are later used in the tables and charts to increase their readability. Note, "X" in the figures refers to students who "did not answer the question".

3.1. Overview of the students' answers

Q1 (OS). One of the basic tasks of operating systems is to manage computer resources, such as the RAM, processor, input, and output devices. The first question tested whether first-year students recognise this task. When asked: "What is the software called that manages computer resources?", the students were offered the following answers (note, "3. operating system" is the correct answer):

1. application software
2. antivirus program
3. operating system
4. BIOS

Figure 2 shows that the vast majority (80.8%) of first-year students at the FF answered this question correctly and that they were more successful than both the control groups: FTN (72.4%), FAM (41.2%).

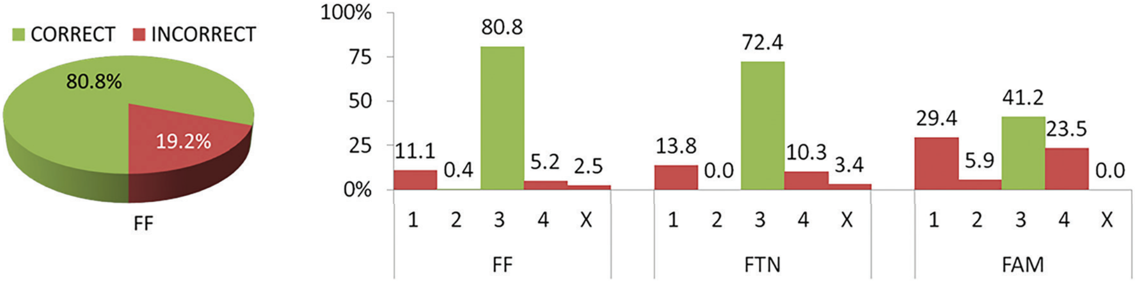

Figure 2. Q1 (OS) – share of different answers (self-edited)

Among the wrong answers, the most common one was "application software" in all three groups: FF (11.1%), FTN (13.8%), and FAM (29.4%).

Q2 (EXE). The general form of file names is NAME.EXT, where the extension determines the type of file and indicates its purpose. In the Windows OS, programs are stored in executable files with the EXE extension. The aim of the second question was to determine whether the respondents could recognise the correct extension for executable files among the following options (note, "2. EXE" is the correct answer):

1. DAT
2. EXE
3. HTML
4. PNG

Less than half of the FF students chose the correct answer (47.9%, Figure 3). The general-purpose extension DAT, which does not belong to any well-known file category, was chosen by almost one-quarter of the students (24.9%), and the HTML extension representing web pages by one-fifth (20.9%). The PNG extension, which relates to images, was chosen by only 18 out of the 522 FF students (i.e. 3.4%).

In terms of the control groups, there were visible differences in the student responses. While a large percentage of the FTN respondents (82.8%) answered the question correctly, the percentage of correct answers among the FAM students (17.6%) was significantly lower than among the FF students. More than half of the FAM group students (58.8%) put DAT as the correct answer.

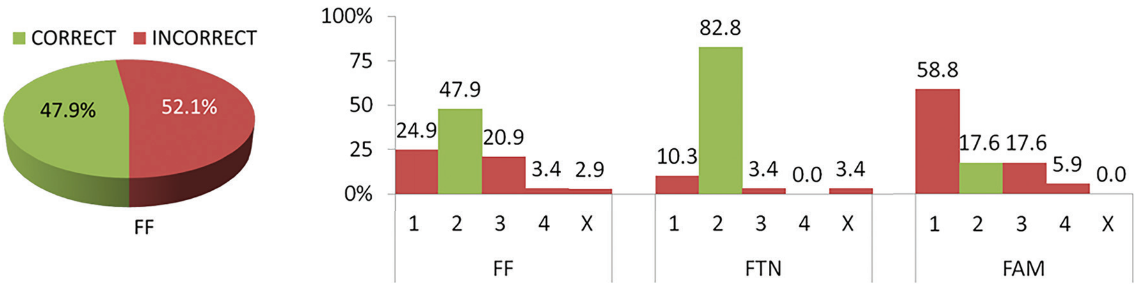

Figure 3. Q2 (EXE) – share of different answers (self-edited)

Q3 (RAM). The third question examined whether the freshmen could recognise the acronym that stands for the main memory in a computer (note, "4.RAM" is the correct answer). The following options were offered:

1. GPU
2. ROM
3. CPU
4. RAM

GPU stands for Graphics Processing Unit and refers to the graphics processor in charge of creating the images that are displayed on a computer monitor. ROM stands for Read Only Memory and refers to the non-volatile memory in a computer whose contents cannot be changed, only read. CPU stands for the Central Processing Unit and refers to the central processor of a computer that executes programs loaded into its main memory (RAM: Random Access Memory) whose content can be changed, not just read as in the case of ROM.

Based on Figure 4, it is clear that recognising the acronym of the main memory did not present a problem for the vast majority of students (FF: 86.4%, FTN: 86.2%, FAM: 100%). Moreover, the FF students achieved the best result for this question among all the questions.

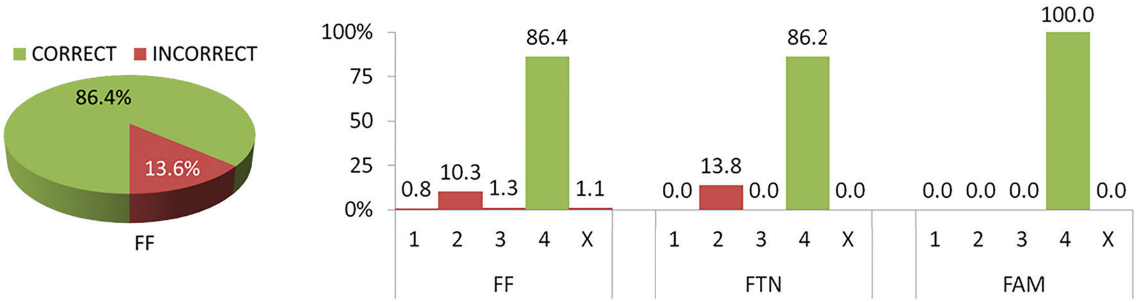

Figure 4. Q3 (RAM) – share of different answers (self-edited)

Q4 (KGT). As knowledge of units of measurement is crucial in so many fields, including when working with files and folders, the fourth question was focused on the names and relationships between the standard units in computing. The task for the students here was to choose the correct sorting (in ascending order) of the names of the data measures (note, "1. kilobyte, gigabyte, terabyte" is the correct answer):

1. kilobyte, gigabyte, terabyte
2. megabyte, kilobyte, gigabyte
3. byte, bit, kilobyte
4. gigabyte, terabyte, kilobyte

When it came to the FF students, based on Figure 5, it can be seen that the correct sorting of data measures was a problem for 40.8% of the respondents. Almost one-quarter of the students (23.8%) mistakenly thought that a kilobyte was a larger unit than a megabyte, and 12.1% of them did not notice the correct relationship between bit and byte.

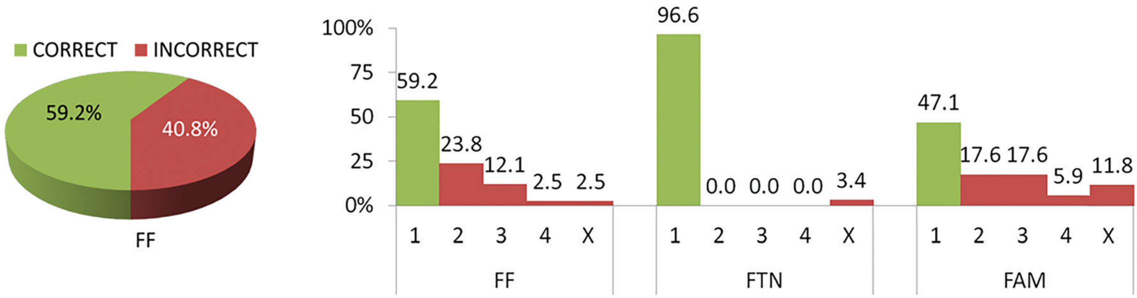

Figure 5. Q4 (KGT) – share of different answers. (self-edited)

For comparison, in the FTN group, all the students who answered this question chose the correct answer, while less than half of the respondents in the FAM group selected the correct sorting (47.1%).

Q5 (PC). In modern society, most people use various smart devices, especially smartphones and tablets. With the fifth question we wanted to examine whether students know that tablets belong to the family of personal computers. When asked what a tablet is, the following answers were offered (note, "1. personal computer" is the correct answer):

1. personal computer
2. super computer
3. mainframe computer
4. a program that loads before the operating system

From Figure 6, it can be seen that more than half of the respondents from all three faculties chose the correct answer. The percentage of correct answers was the highest in the FAM group (76.5%), but the lowest in the FTN group (51.7%), with the FF group in between these (65.7%).

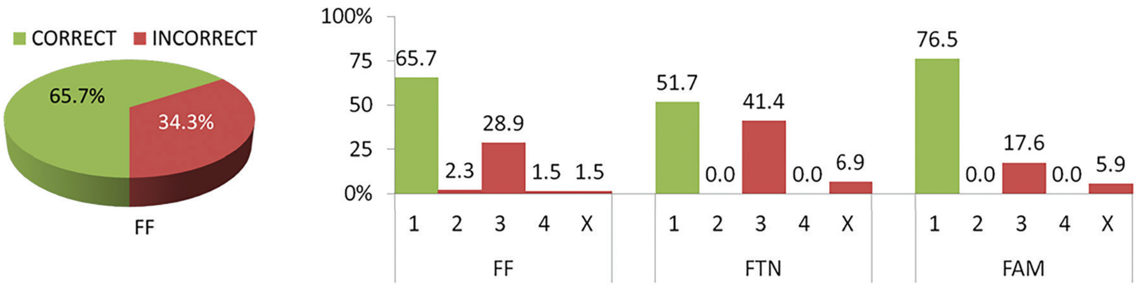

Figure 6. Q5 (PC) – share of different answers (self-edited)

It was also evident that the students who answered this question incorrectly almost exclusively identified tablets as being associated with mainframe computers. However, they could clearly distinguish the term supercomputer from the term tablet.

Q6 (BS). When naming files and folders, special care must be taken to avoid using characters that have a special role within the file system (like "/", which is separator in the OS) and their use is generally prohibited. For instance, the file management program that is an integral part of the Windows OS does not allow the usage of "/" in file and folder names. However, not all programs are so strict and some of them allow the use of "/" when naming files, which can lead to unexpected results. With this in mind, we asked students why the name "Domaći zadatak 2014/2 Excel.7z" (Homework 2014/2 – Excel.7z) is not allowed for Windows files. The possible answers were as follows (note, "4. contains a slash "/"" is the correct answer):

1. the extension must be XLS or XLSX
2. contains spaces
3. contains the letter "ć"
4. contains a slash "/"

In the example name in the question, 7z is a legal extension that indicates a compressed file, while the spaces and the letter "ć" are allowed to be used in both file names and folder names.

The results in Figure 7 show that more than two-thirds (71.6%) of the FF students either did not recognise the use of "/" as the reason why the stated name was not allowed for files or did not answer the question, with36.2% of the respondents thinking that the problem was in the file extension, 17.6% an error in the spaces, and 14.4% the use of the letter "ć".

In the control groups, the percentage of correct answers was even lower: 17.2% (FTN) and 23.5% (FAM). A significantly higher percentage of FTN students (55.2%) noted the extension as the reason for the bad file name compared to respondents from the FF (36.2%) and the FAM (35.3%) groups.

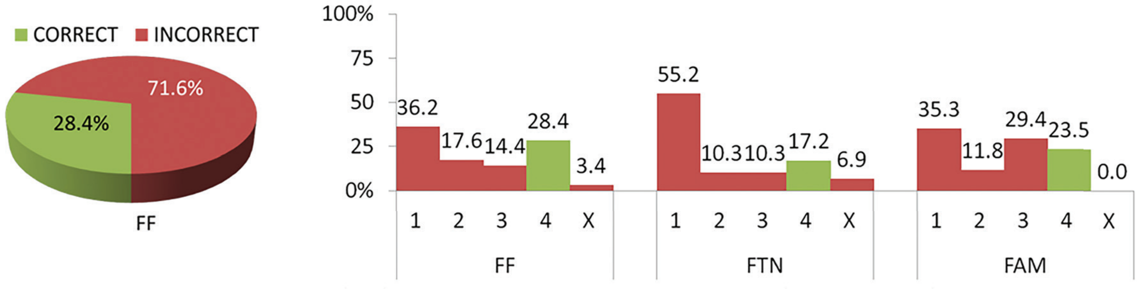

Figure 7. Q6 (BS) – share of different answers (self-edited)

Q7 (MB). This question investigated whether the freshmen knew which of the following parts of the computer connects its various components and enables communication between them (note, "3. motherboard" is the correct answer):

1. processor
2. network card
3. motherboard
4. RAM memory

The task of the processor is to execute programs loaded into the RAM of the computer, while the network card allows communication between networked computers.

The percentage of students in the FF group who answered correctly was 50.2% (Figure 8), which was slightly less than in the FAM group (52.9%) and significantly less than in the FTN group (69%).

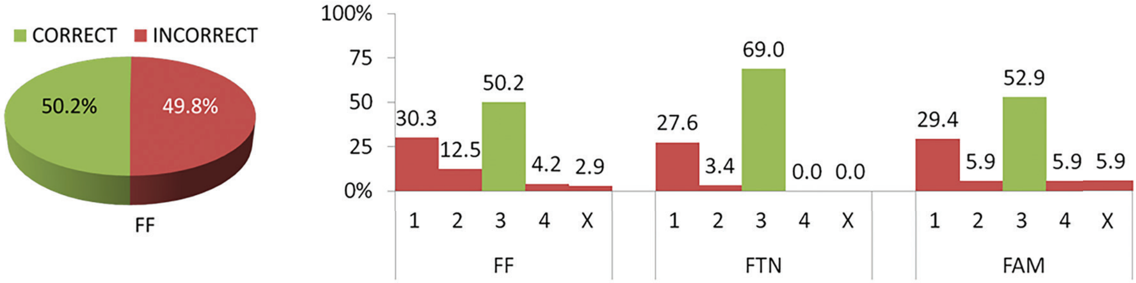

Figure 8. Q7 (MB) – share of different answers (self-edited)

Nearly one-third (30.3%) of the respondents in the FF group marked the processor as the correct answer. This was also the most common among the incorrect answers in the control groups.

Q8 (SCR). In this question, we were interested in whether students knew what the screen resolution is (note, "1. number of points on the width and height of the monitor" is the correct answer):

1. number of points on the width and height of the monitor
2. number of open windows
3. number of different colours on the screen
4. the size of the icons on the screen

Based on Figure 9, it can be seen that the percentage of correct answers was very high, both among the FF students (85.2%) and in the control groups: 93.1% (FTN) and 76.5% (FAM).

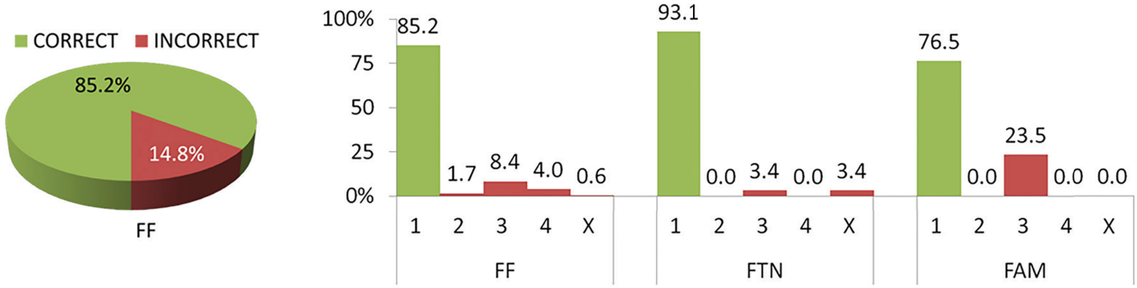

Figure 9. Q8 (SCR) – share of different answers (self-edited)

Q9 (IN). The ninth question asked respondents to identify input devices among the following pairs of computer components (note, "1. scanner and microphone" is the correct answer):

1. scanner and microphone
2. printer and speakers
3. sound and graphics card
4. processor and motherboard

Figure 10 shows that many of the FF students confused the terms input and output devices: most of them (34.5%) chose the second option. There was a significant number of those who considered the third option gave the input devices (76 out of 522, i.e. 14.6%) and almost every tenth (50 out of 522, i.e. 9.6%) respondent chose option 4. Also, the percentage of students who did not answer this question was the highest among all the questions (7.9%, i.e. 41 out of 522).

While the majority of the students in the FTN group accurately identified the input devices (75.9%), close to two-thirds of the FAM group chose output devices instead of input devices (64.7%).

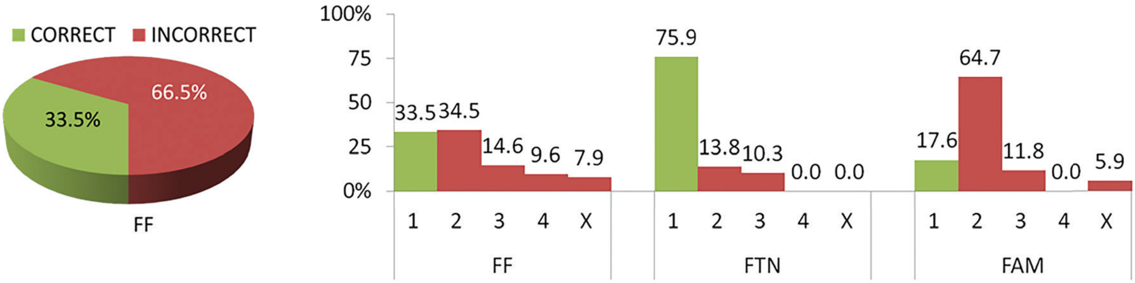

Figure 10. Q9 (IN) – share of different answers (self-edited)

Q10 (DIR). At the top of the hierarchical structure of the file system are storage devices, on which data are stored in files organised into folders. Folders can contain files and other folders called subfolders. The tenth question was about what folders can contain (note, "4. files and folders" is the correct answer):

1. only files
2. only subfolders
3. discs and files
4. files and folders

As can be noticed from Figure 11, this question was not a problem for most students. The percentage of correct answers was the highest in the FAM group (100%), followed by the FTN group (96.6%), and finally the target group of this study (FF, 86%).

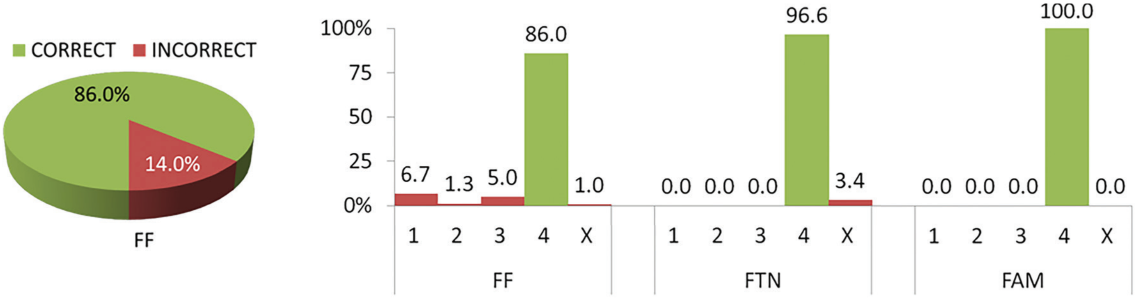

Figure 11. Q10 (DIR) – share of different answers (self-edited)

Q11 (SBY). By applying the "Sleep" command, a computer will enter standby mode with reduced power consumption, while programs and data remain in the main memory. By moving the mouse or pressing a key on the keyboard, the computer will wake up and resume normal operation. When asked what the "Sleep" command allows, the possible answers were (note, "2. activating standby mode" is the correct answer):

1. locking the computer
2. activating standby mode
3. shutting down the computer
4. starting a drawing program

Just over the half of the FF students gave the correct answer (55.7%, Figure 12), while 28.4% (148 out of 522) of respondents in the FF group chose the first option, and 12.5% (65 out of 522) thought that the "Sleep" command was used to turn off the computer.

The percentage of correct answers was much higher in both the control groups: 86.2% (FTN) and 70.6% (FAM).

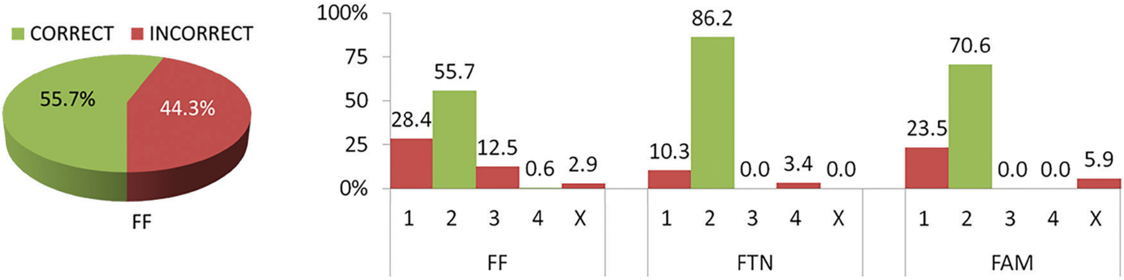

Figure 12. Q11 (SBY) – share of different answers (self-edited)

Q12 (APP). Application software includes programs that are designed for specific user needs, such as word processing, image processing, spreadsheets, audio and video playback, and others. The task of the respondents in this question was to choose which of the following programs is application software (note, "3. Photoshop" is the correct answer):

1. Linux
2. BIOS
3. Photoshop
4. Android

Here, Photoshop is a well-known image processing program, while Linux and Android are operating systems, and BIOS (Basic Input / Output System) is the computer basic input output system.

Figure 13 indicates that recognising the application software presented a difficulty for the FF students, and more than two-thirds (70.7%) of respondents answered incorrectly. Indeed, more students (37.2%) chose Android than those who answered correctly (29.3%). One in five respondents (20.5%) chose the Linux OS, while many others (9.4%, i.e. 49 out of 522) opted for BIOS.

In the FTN group, the percentage of correct answers was visibly higher (48.3%), but the percentage of those who chose Android was also slightly higher (41.4%) compared to the results of the FF students. In this group, only two respondents (out of 29) selected Linux as the answer, while no-one chose BIOS.

The percentage of correct answers was the lowest in the FAM group (23.5%), in which the share of students who did not answer the question was the highest (23.5%, i.e. 4 out of 17 students). It is also interesting to note that Android was chosen by only one respondent in this group and that the percentages of responses related to Linux and BIOS were higher than in both the FTN and FF groups.

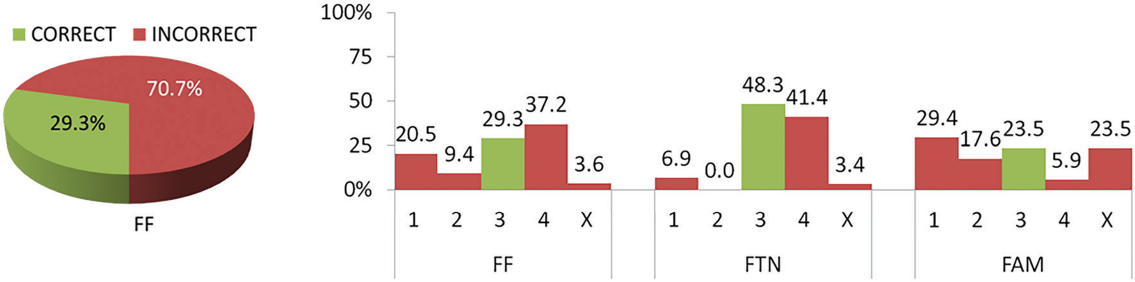

Figure 13. Q12 (APP) – share of different answers (self-edited)

Q13 (SHR). Software refers to programs that run on computers, while hardware refers to the physical components of a computer. Programs that can be used for free without restrictions are known as freeware, while shareware represents programs that can be used for free but have a time and/or functional limitation. In this question, we asked students to choose the category of programs that can be used for free with some restrictions (note, "4. shareware" is the correct answer):

1. software
2. freeware
3. hardware
4. shareware

This question seems to be one of the most difficult for all the students to answer, regardless of faculty. None of the respondents in the control groups answered this question correctly (Figure 14), while in the target group (FF), only approximately every tenth answer was correct (11.1%).

The majority of respondents chose the category of programs that can be used free of charge without any restrictions (Freeware).

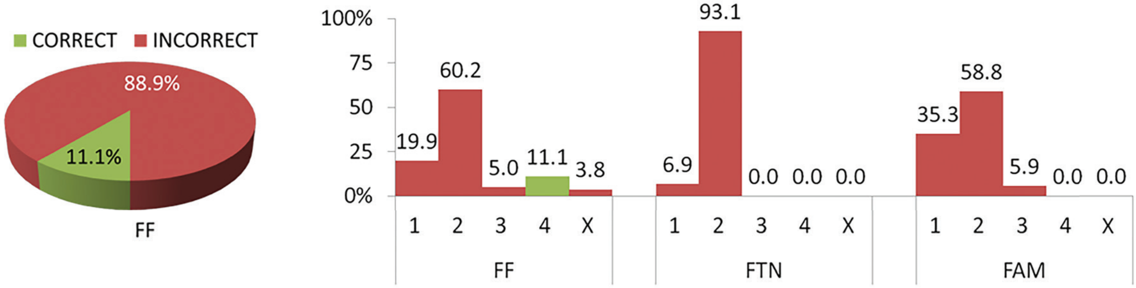

Figure 14. Q13 (SHR) – share of different answers. (self-edited)

Q14 (FN). With the last question, we wanted to examine whether the students could recognise the Hungarian scientist John von Neumann, who is credited with setting up the basic architecture of modern computers. The alternative answers were other well-known names in computer science and informatics, specifically Steve Jobs (one of the founders of Apple), Mark Zuckerberg (co-founder of the Facebook), and Alan Turing (one of the fathers of computer science) (note, “4. John von Neumann” is the correct answer):

1. Steve Jobs
2. Mark Zuckerberg
3. Alan Turing
4. John von Neumann

It can be seen from Figure 15 that the name of John von Neumann was not known among most the FF students. As many as 40.8% of them indicated that the architecture of modern computers originated from Steve Jobs, while approximately one-third thought that it was Alan Turing.

Similar results were observed in the FAM group, where Alan Turing was picked by slightly fewer students (23.5%), while the percentage of students who thought that basic computer architecture came from the founder of Facebook corresponded to the same percentage of students who marked John von Neumann as the correct answer (17.6%).

In the FTN group, 20 out of 29 respondents answered correctly (69%), while Steve Jobs was chosen by 4 students (13.8%), and Mark Zuckerberg and Alan Turing by 2 each (6.9%).

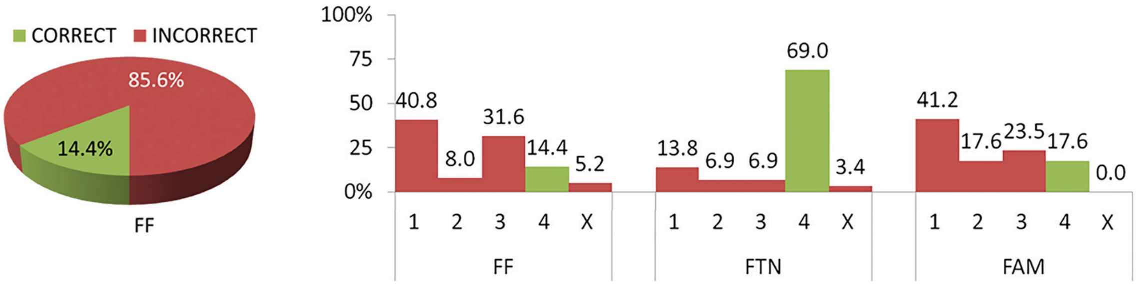

Figure 15. Q14 (FN) – share of different answers. (self-edited)

3.2. Percentages of correct answers

An overview of the percentages of correct answers by study programmes (rows) and by questions (columns) is given in Table 1.

The best results of the study programmes are marked in bold, and the weakest are underlined. For example, students of journalism (JNR) achieved the best result in the case of the SCR question (92.3%), and the weakest in the case of the SHR and FN questions (9.6%). The cumulative results of the FF students are shown in the row

FF, and the cumulative results of all the participating students are given in the row marked as ALL.

	OS	EXE	RAM	KGT	PC	BS	MB	SCR	IN	DIR	SBY	APP	SHR	FN	TEST
JRN	75.0	50.0	80.8	69.2	59.6	17.3	40.4	**92.3**	26.9	88.5	48.1	30.8	9.6	9.6	49.9
HIS	63.2	50.9	**84.2**	59.6	57.9	22.8	66.7	82.5	29.8	**84.2**	54.4	17.5	5.3	19.3	49.9
PSY	85.2	59.0	**96.7**	59.0	78.7	32.8	52.5	83.6	50.8	93.4	68.9	36.1	16.4	14.8	59.1
HUN	**91.7**	33.3	83.3	66.7	**91.7** ●	41.7	25.0 ○	66.7 ○	25.0	83.3	83.3	8.3 ○	0.0 ○	25.0	51.8
PHI	71.1	50.0	89.5	52.6	68.4	21.1	44.7	**92.1**	34.2	89.5	55.3	42.1	10.5	21.1	53.0
SOC	87.5	45.0	**92.5**	47.5	65.0	27.5	47.5	77.5	42.5	80.0	50.0	27.5	12.5	12.5	51.1
CL	78.6	28.6	92.9	57.1	57.1	14.3 ○	50.0	78.6	28.6	**100** ●	64.3	42.9	0.0 ○	7.1	50.0
SER	83.9	38.7	90.3	71.0	51.6 ○	45.2 ●	51.6	**93.5**	22.6	90.3	58.1	19.4	9.7	12.9	52.8
GER	77.6	42.9	**85.7**	61.2	55.1	32.7	44.9	**85.7**	36.7	**85.7**	59.2	20.4	18.4	6.1 ○	50.9
ENG	87.5	85.0 ●	80.0	77.5	70.0	40.0	70.0 ●	**95.0** ●	65.0	92.5	70.0	50.0 ●	12.5	12.5	64.8
FRE	**95.0** ●	55.0	65.0 ○	70.0	55.0	15.0	40.0	90.0	25.0	90.0	65.0	20.0	20.0 ●	25.0	52.1
PED	**91.2**	36.8	82.5	38.6 ○	71.9	28.1	40.4	73.7	14.0 ○	71.9 ○	43.9	21.1	15.8	15.8	46.1 ○
SL	80.4	29.4	**90.2**	56.9	72.5	29.4	54.9	88.2	23.5	82.4	39.2 ○	37.3	2.0	13.7	50.0
FTN	72.4	82.8	86.2	**96.6** ●	51.7	17.2	69.0	93.1	75.9 ●	**96.6**	86.2 ●	48.3	0.0 ○	69.0 ●	67.5 ●
FAM	41.2 ○	17.6 ○	**100** ●	47.1	76.5	23.5	52.9	76.5	17.6	**100** ●	70.6	23.5	0.0 ○	17.6	47.5
FF	80.8	47.9	**86.4**	59.2	65.7	28.4	50.2	85.2	33.5	86.0	55.7	29.3	11.1	14.4	52.4
ALL	79.2	48.8	86.8	60.7	65.3	27.6	51.2	85.4	35.2	**87.0**	57.7	30.1	10.2	17.3	53.0
MIN	41.2	17.6	65.0	38.6	51.6	14.3	25.0	66.7	14.0	71.9	39.2	8.3	0.0	6.1	46.1
MAX	95.0	85.0	100	96.6	91.7	45.2	70.0	95.0	75.9	100	86.2	50.0	20.0	69.0	67.5

Table 1. Percentages of correct answers (self-edited)

Among the terms covered by the test, the FF students were best acquainted with the main memory (RAM, 86.4%), folders (DIR, 86%), screen resolution (SCR, 85.2%), and operating system (OS, 80.8%), while they had the most difficulties with recognising shareware (SHR, 11.1%), the name of the scientist who laid the foundation of modern computer architecture (FN, 14.4%), the use of the slash as an illegal character when naming files and folders (BS, 28.4%), application software (APP, 29.3%), and computer input devices (IN, 33.5%).

The best results by question in Table 1 are marked by the symbol ●, while the symbol ○ indicates the worst. For example, the best result in the case of the first question (OS) was for the FRE subgroup (95%), and the weakest for the FAM subgroup (41.2%). Summary results for all the test questions are given in the last column of the table, marked as TEST. In this category, the FTN group (67.5%) was the most successful, and the least successful was the PED subgroup (46.1%).

From the graphical representations of the percentages of correct answers in Figure 16, it is easier to see the mutual relations between the questions, individual study programmes, and different faculties.

The results for the FTN group were visibly better than for the other (sub)groups in the case of the EXE, KGT, IN, SBY, and FN questions (Chart A). Students in the HUN subgroup achieved significantly better results than the other subgroups in the case of the PC and SBY questions, but were noticeably worse in the case of the MB and APP questions. The FAM group was noticeably worse than the other (sub)groups in answering the OS and EXE questions, yet all the students in that group answered the

RAM and DIR questions correctly. The percentages of correct answers by the ENG subgroup were among the highest in the case of several questions: EXE, KGT, MB, SCR, IN, and APP.

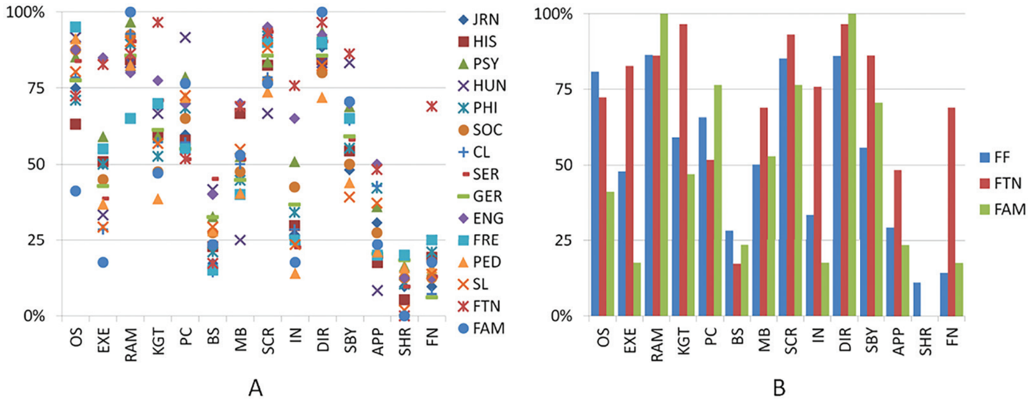

Figure 16. Graphical representation of the percentage of correct answers by study programme (A) and faculty (B) (self-edited)

The biggest differences among the accuracies of the group responses were observed in the recognition of the executable file extension (EXE) and computer input device (IN) terms. Looking at the performances per question, by ignoring 1–2 atypical values, two groups of questions with homogeneous results could be observed. The first group included questions with more than 70% correct answers by groups: the main memory (RAM), screen resolution (SCR), and folders (DIR). The second group consisted of questions with the lowest percentage of correct answers (less than 40%): slash as an example of an illegal character when naming files and folders (BS), shareware (SHR), and John von Neumann (FN).

Figure 16B indicates that the ratio of the percentage of correct answers of the students from different faculties varied from question to question.

The FTN group stood out for its significantly better results in identifying the executable file extension (EXE), proper sorting of data measures (KGT), application software (APP), and the role of John von Neumann in modern computing (FN). However, when asked what a tablet (PC) is and why the file name is incorrect (BS), they clearly gave less correct answers than the FF and FAM students.

The students in the FAM group achieved better results than the students in both the FTN and FF groups in recognising the acronyms of the main memory (RAM), determining what a tablet (PC) is, and choosing what folders can contain (DIR). However, their responses were clearly worse than those of the FTN and FF groups when it came to knowing the role of the OS and the file name extension EXE.

The FF students were slightly more successful than the students in both control groups in determining the OS roles, the cause of the file name incorrectness (BS), and the category of programs that can be used for free with some restrictions (SHR).

3.3. Statistical significance of the differences in the answers among the (sub)groups

Table 2 shows the results from testing the differences in the number of correct answers among the students of different study programmes within the FF (A) and among the students of different faculties, i.e. FF, FTN, and FAM (B).

Considering the level of significance α=0.05, the students in the FF study programmes differed in their success of answering most questions (OS, EXE, KGT, MB, SCR, IN, SBY, and APP). Significant differences were found between the students in the FF, FTN, and FAM in terms of their answers to the OS, EXE, KGT, IN, SBY, and FN questions.

As expressed by Cramer's V coefficient, the relationships between the test performances and study programmes were relatively mild in strength, even with the results that proved significant for interpretation.

The accuracy in answering the RAM, PC, BS, DIR, and SHR questions was not significantly related neither to the study programmes at the FF nor to the study programmes of the other two faculties. As can be seen in Table 1 and Figure 16, below are the questions that most students, regardless of study programme, answered correctly (RAM, PC, SCR, and DIR), or incorrectly (BS and SHR).

	A df=12, N=522			B df=2, N=568		
	χ^2	p	V	χ^2	p	V
OS	26.107	0.010	0.224	16.601	0.000	0.171
EXE	40.426	0.000	0.278	20.160	0.000	0.188
RAM	20.324	0.061	0.197	2.667	0.264	0.069
KGT	23.924	0.021	0.214	17.453	0.000	0.175
PC	19.703	0.073	0.194	3.334	0.189	0.077
BS	17.213	0.142	0.182	1.844	0.398	0.057
MB	22.273	0.035	0.207	3.896	0.143	0.083
SCR	21.181	0.048	0.201	2.475	0.290	0.066
IN	43.882	0.000	0.290	23.956	0.000	0.205
DIR	19.254	0.083	0.192	5.317	0.070	0.097
SBY	23.389	0.025	0.212	11.631	0.003	0.143
APP	27.947	0.006	0.231	5.056	0.080	0.094
SHR	17.098	0.146	0.181	5.692	0.058	0.100
FN	10.102	0.607	0.139	57.366	0.000	0.318

Table 2. Results from the χ2 tests and Cramer's V coefficients analyses of the relationships among the answer correctness and the study programmes at the FF (A) and among the included faculties (B) (self-edited)

3.4. Distributions of answers

Figure 17 shows the indicators of the central tendency and variability of the cumulative results on the tests for the individual study programmes at the FF, and for the FTN and FAM control groups.

Students of different FF programmes mostly performed slightly worse than the FTN students but better than the FAM students, getting approximately half the answers correct. ENG proved to be the most successful FF subgroup, in which, as in the FTN group, 50% of students had 9 or fewer correct answers, and the other 50% more than that. This was followed by the PSY subgroup, in which half the students successfully answered 8 or fewer questions, while the other half achieved more than that.

In the HUN, SER, GER, and FRE subgroups, the arithmetic mean was shifted to slightly lower values, as a probable consequence of the existence of less frequent lower results. Less successful were the PED subgroup, with about 6.5 correct answers on average, and the SL subgroup, with 50% correct answers to 6 or fewer questions.

None of the students, including those from the most successful (sub)groups, answered all the questions correctly.

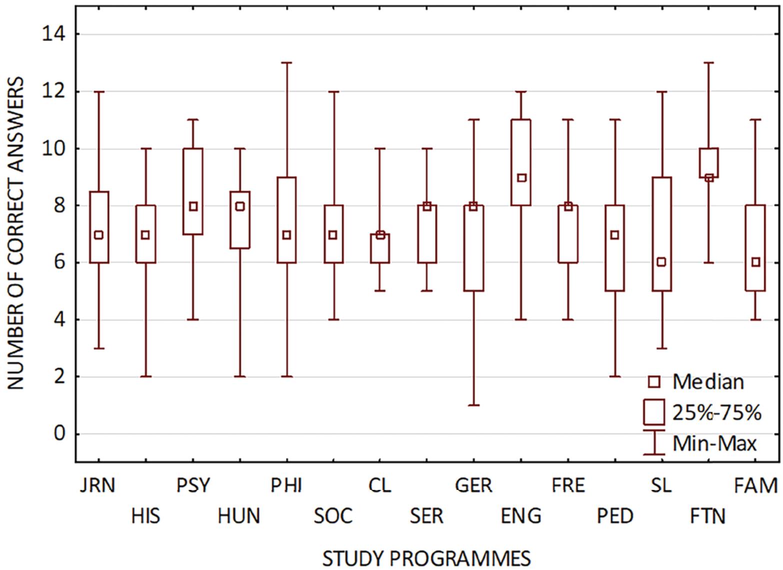

Figure 17. Measures of the central tendency and variability of the correct answers (self-edited)

Apart from the differences in average and mean values, the distributions of the correct answers of the individual (sub)groups also differed in terms of their variability.

In the relatively small CL subgroup, in which the largest number of students got about half of the answers correct, the differences in performance were small. In the other small HUN subgroup, however, individual differences in the number of correct answers were significantly larger.

The variability was low in the CL and FTN (sub)groups. The ENG and PSY subgroups, which proved to be approximately similarly successful as the FTN group, had increased variability due to there being a smaller number of low scores, and the distributions were somewhat asymmetric. A similar asymmetry characterised the HIS and HUN subgroups.

The Kruskal–Wallis test showed that the described differences in results among the students of the individual FF, FTN, and FAM groups could be considered statistically significant ($H(14, N=568)=83{,}894$, $p<0.001$). The applied z-tests showed that this result was a consequence of a higher number of correct answers by the FTN students compared to most of the students of the other (sub)groups; the more correct answers of the ENG students in relation to the SOC, GER, SL, HIS, JRN, FAM, and PED students; and the higher number of correct PSY student responses compared to those of the PED students.

3.5. Student's results in relation to the ECDL standard and the requirements for passing the exam

To get a clearer picture of how familiar the students were with the basic concepts of computing, we compared the number of correct answers by study programme, focusing on how well they would meet the test requirement from the appropriate ECDL module (Computer Essentials) and how many of them would fail the faculty exam (Figure 18).

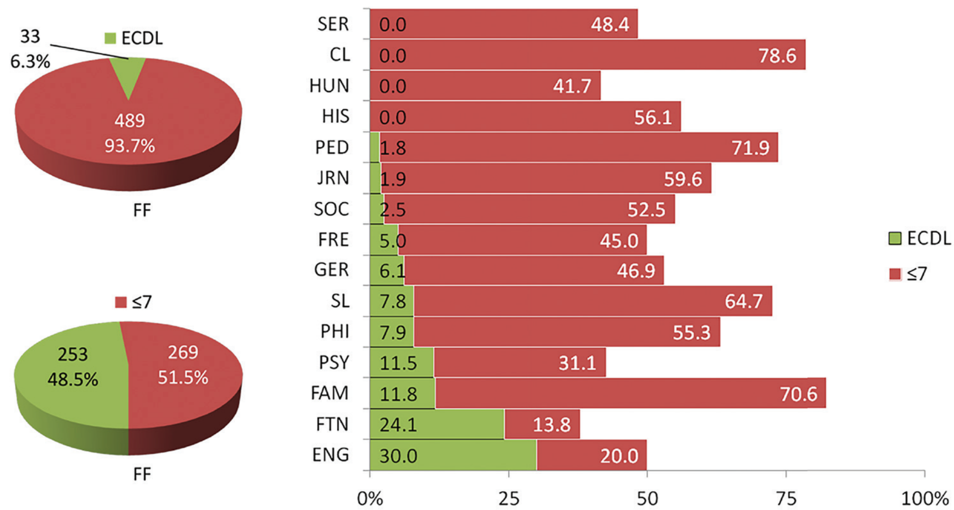

Figure 18. Percentage of students who meet the condition defined by the ECDL standard and answered correctly less than 51% of the questions (≤7) (self-edited)

Successful passing of the ECDL test requires 75% correct answers from each candidate. As our test contained 14 questions, this meant it was necessary to answer at least 11 questions correctly to pass the test. Out of a total of 522 FF freshmen who undertook the test, only 33 met this condition (6.3%). When the individual study programmes were observed, no-one in the SER, CL, HUN, and HIS subgroups reached this limit. In the other subgroups, the percentage of respondents who answered more than 10 questions correctly was less than 10%, with the exception of the PSY (11.5%, i.e. 7 out of 61) and ENG (30%, i.e. 12 out of 40) subgroups. According to this criterion, the most successful subgroup was ENG.

A positive grade requires at least 51% correct answers on the exam, which in the case of our test corresponded to 8 correct answers. Figure 18 shows that about half of the FF freshmen would have failed the exam (269 out of 522 students). For the individual study programmes, the percentages ranged between 20% (8 out of 40) in the ENG subgroup and 78.6% (11 out of 14) in the CL subgroup. While the best result was achieved in the FTN group (13.8%, i.e. 4 out of 29), the percentage of FAM group students who would fail the exam was among the highest, amounting to 70.6% (12 out of 17).

3.6. Correlations between the questions

Correlations between the accuracy of the answers to the questions on the total sample, expressed by phi coefficients showed very low correlations between the accuracies of the answers to the questions (Table 3). There was no strong regularity that if a student answered one of the questions correctly that she or he would then answer the other questions correctly as well. Somewhat higher though were the correlations between the following pairs of questions: EXE and KGT, EXE and SBY, RAM and DIR, and KGT and SBY. The heights of these correlations, however, did not exceed 0.22.

	OS	EXE	RAM	KGT	PC	BS	MB	SCR	IN	DIR	SBY	APP	SHR	FN
OS		0.039	0.044	-0.030	-0.054	-0.023	-0.005	0.046	0.050	0.021	0.001	**0.100**	0.044	0.004
EXE			-0.056	**0.193**	0.001	**0.090**	**0.156**	0.045	**0.144**	**0.085**	**0.200**	**0.097**	0.043	0.030
RAM				0.049	0.033	0.055	**0.140**	0.030	0.026	**0.204**	0.077	0.007	0.028	-0.001
KGT					-0.056	0.054	0.081	**0.116**	**0.178**	**0.117**	**0.217**	**0.127**	-0.003	0.062
PC						-0.062	-0.015	-0.019	-0.044	0.026	**-0.084**	-0.022	-0.060	-0.078
BS							-0.003	0.022	0.080	0.052	0.074	-0.011	-0.013	0.041
MB								**0.105**	**0.151**	**0.104**	**0.164**	**0.180**	0.027	-0.002
SCR									**0.107**	**0.092**	0.050	**0.119**	0.074	0.004
IN										**0.099**	**0.138**	**0.127**	0.007	0.024
DIR											**0.092**	0.037	-0.042	**0.094**
SBY												0.072	**0.088**	**0.089**
APP													0.070	0.005
SHR														-0.031
FN														

Note: Bold values are significant at the level 0.05

Table 3. Correlation coefficients among the individual questions for the total sample of respondents (self-edited)

A similar pattern of relationships among the answers was present within the largest observed group, i.e. the FF students.

Within the observed subsamples of FF and FAM students, the number of correlations that were significant for interpretation was smaller, due to the lower probability that the indicator would be significant with fewer measurements.

In the FTN group, a positive correlation was detected between the following pairs of questions: SCR and DIR, SBY and EXE; whereby, none of the students answered the SHR question correctly, but due to the lack of data variability, it was not possible to calculate the correlations between this question and the others.

There were no correct answers to the SHR question in the FAM group either; however, all of the students in that group answered the RAM and DIR questions correctly. In this group, a negative correlation was observed between the OS and SBY questions.

The higher correlations and their significance obtained in the FTN and FAM groups were possible consequences of random variations that are more likely with small samples.

4. Discussion

The assumption that today's generation growing up in the information age adopt knowledge in the field of computer and information literacy "on the go" and that they do not need formal education was not proved to be justified here. The total percentage of correct answers from FF students was 52.4%, which was only slightly better than the total percentage of their correct answers to questions in the field of Internet knowledge, which was 49.6% (Gellér et al. 2021).

Bearing in mind that the ECDL standard requires 75% of the questions to be correctly answered to obtain a certificate, only 33 (6.3%) of the FF freshmen would meet this criterion. More than one-third of these (12) were from the ENG subgroup, and there were some study subgroups (HIS, HUN, CL, and SER) in which no candidate achieved the required level of success. This result was significantly worse than the results related to the basic concepts of the Internet, where almost 20% of the FF participants would have met the ECDL requirement (Gellér et al. 2021).

The question that turned out to be the easiest for all students to answer was the one related to the objects that can be contained in folders (with a success rate of 87%), while the majority of FF students also recognised the acronym that denotes main computer memory (RAM) (86.4%). The most difficult question for all the students was to choose the program category that can be used free of charge with some restrictions (SHR) (11.1% among the FF students, and 10.2% of all students overall).

The students from the FTN control group performed better when it came to those questions that were "more technical" in nature (executable file extension (EXE), correct sorting of data measures (KGT), application software (APP), and the role of John von Neumann in modern computing (FN)), which could be explained by the prior knowledge of the students and their affinities that influenced their choice of faculty. What was surprising was the much worse answers to questions that were "more user" focused in nature, such as what is a tablet (PC) and why is the given file name incorrect (BS), because this group gave less accurate answers than the other (sub) groups of students.

The FF students showed somewhat worse results than those from the FTN group and somewhat better results than the ones from the FAM group. The most successful FF subgroup was ENG followed by PSY. No student of the FTN had less than 6 correct answers, and 50% of their scores between the first (Q1) and third (Q3) quarters were placed in the range between 9 and 10 points. In contrast, in the ENG and PSY subgroups, the minimum number of correct answers was 4 and the interquartile range was higher, which indicated that the knowledge of the FTN students was more homogeneous. Also, it is worth nothing that the two best-performing FF subgroups were the ones who had the most registered candidates for the entrance exam (and thus the strictest selection), and their results were likely a consequence of their better success during their high school education.

The fact that none of the 568 students answered all the questions correctly also underlines the need to better educate students on basic computer concepts.

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