Information Overload, Information Literacy and Use of Technology by Students

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Abstract—The development of web technologies and mobile devices makes creating, accessing, using and sharing information or communicating with each other simpler every day. However, while the amount of information constantly increasing it is becoming harder to effectively organize and find quality information despite the availability of web search engines, filtering and indexing tools. Although digital technologies have overall positive impact on students' lives, frequent use of these technologies and digital media enriched with dynamic hypertext and hypermedia content, as well as multitasking, distractions caused by notifications, calls or messages; can decrease the attention span, make thinking, memorizing and learning more difficult, which can lead to stress and mental exhaustion. This is referred to as "information overload", "information glut" or "information anxiety". Objective of this study is to determine whether students show signs of information overload and to identify the possible predictors. Research was conducted using a questionnaire developed for the purpose of this study. The results show that students frequently use technology (computers, gadgets and digital media), while they show moderate level of information literacy. They have sometimes experienced symptoms of information overload. According to the statistical analysis, higher frequency of technology use and lower level of information literacy are correlated with larger information overload. The multiple regression analysis has confirmed that the combination of these two independent variables has statistically significant predictive capacity for information overload. Therefore, the information science teachers should pay attention to improving the level of students' information literacy and educate them about the risks of excessive technology use.

Keywords—Information overload, technology use, digital media, information literacy, students.

I. INTRODUCTION

SINCE the World Wide Web was invented, it has become the primary information and communication medium for a large number of users throughout the world [2], [8]. The development of broadband Internet access and mobile devices (notebooks, smartphones, tablets and other gadgets) have enabled an abundance of information available from anywhere and at any time. The mentioned technologies allow fast and efficient communication and collaboration all around the world, as well as simpler re-use, create, share and distribution of information. The Internet offers tools for searching, filtering and indexing; it offers catalogues and databases of scientific journals, repositories of educational resources and e-courses that make it easier for students to find quality and

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reliable content. On the other hand, the appeal of Wikipedia, blogs and other unreliable web sources is a part of students' daily life [5]. A continuous flow of fresh information 24/7 from different places, devices and applications (email, social networks, blogs, IM services, RSS feeds…) offers the possibility of being informed in real time, thus making the online presence an imperative for young people. But this does not necessarily mean that they are better informed, better educated or more efficient in solving problems.

Digital technologies and the Internet are not just communication channels or media that provide us with information, they also change information consumption patterns and shape thought processes [2]. According to a research conducted by Small et al., the daily use of computers, smartphones, search engines and other digital media stimulates alteration of brain cells and release of neurotransmitters, thus gradually straightening new pathways in our brains while weakening old ones, such as those active when we read books [2]. Digital, dynamic information content enriched with hyperlinks, multimedia and interactivity often causes distraction from the actual content because of its mental stimuli; text abstracts and summaries are preferred, as well as superficial and "shallow" reading which is additionally disrupted by new posts, statuses, messages, notifications, chat invites, cellphone ringing or multitasking [2]. Despite the vast amount of easily accessible information on the Web, people often find themselves lost in that sea of information, i.e. there is a big gap between information and knowledge [4]. If such situations are frequent and are preventing a person from efficiently processing, organizing, remembering and using the information, then that person is experiencing information overload. "Information overload", "information glut" or "information anxiety" can be described as a syndrome of "apathy, indifference, or mental exhaustion arising from exposure to too much information, esp. (in later use) stress included by the attempt to assimilate excessive amount of information from the media, the Internet or at work" [4]. Information overload is the inability to process everything one hears or sees, the availability or supply of too much information, or a state of stress which results [9].

The empirical part of this paper focuses on symptoms of information overload in students and on identifying possible predictors. Special emphasis is put on those factors that can be improved through information science education, such as raising information literacy of students and responsible use of technology.

II. Understanding Information Overload

We live in an age of rapid growth of information on a daily basis with easy access to them, what someone calls a "tsunami of information" [11]. Human beings now produce more than five exabytes worth of recorded information per year: documents, e-mail messages, television shows, radio broadcasts, Web pages, medical records, spreadsheets, presentations, and books" [11]. According to [8], interactive digital technology and digital media change people's behavior and help develop new skills, particularly in the case of young people, thus turning the personalized digital devices (like smartphone) into an extension of the young people themselves. While some authors consider that changes to be good, others offer facts that indicates the opposite [2], [8].

There are many definitions of information overload. Information overload happens when a person receives too much information and the information load confuses them, affects their ability to set priorities, or makes prior information harder to recall; which is represented by the inverted U-curve [3], [7]. When the quantity of relevant and potentially useful information exceeds personal information processing capacity and becomes a load rather than a boon, we are talking about information overloading. Information overload often causes the decrease of decision accuracy [10]. As the role of information grows beyond anyone's reckoning, it grows to be too much (TMI, "too much information"), so people deal with information fatigue, anxiety or glut, which is contrary to the meaning of information as a measure of organization and order, but very close to the meaning of entropy [4]. Different authors talk about a variety of factors that cause information overload and the most frequently mentioned are:

- personal features of the subject receiving the information (experiences, education, information processing capacity, self-confidence, attitudes, the level of information understanding, their personal traits etc.);
- the characteristics of the information (e.g. quantity, frequency or intensity, ambiguity, diversity);
- process complexity and the amount of time available to complete the task;
- organizational design (how information flows and how it is organized);
- information technology (the technology used to get the information) [3], [7], [10].

Due to the abundance of information all around us, we have developed shorter attention spans, shallow thinking, memory difficulties and multitasking; and that doesn't always increase our productivity [2], [5]. Students have to study and perform tasks which require critical thinking and creativity, do their homework and research, cooperate, communicate and share information which is easy to do with Web 2.0 tools. Today's students are connected to information and each other all day via their smartphones, tablets and notebooks. When reading a text on the screen, they skim through it quickly in a pattern that roughly resembles the letter "F" (like fast), spending on average less than 30 seconds on a page, which decreases the concentration required for the reading of longer texts and their consequent understanding because their brains have become used to digital media stimuli [2]. We can talk about reactive and proactive solutions of information overload [7]. Raising information literacy is example of proactive solution, hence students have to learn how to spend time on Internet and effectively use the information technology, how to filter, select and evaluate information relevant for solving problems, how to organize all needed information and utilize them in a constructive way. Those knowledge and skills known as information literacy are important not only for the completion of their studies, but also for their future job performance and life-long learning [6]. Without diminishing the importance of other teachers, information science teachers are the most competent to develop the students' skills necessary for the information age.

III. Methodology

The methodology used in this research is explained through the description of research objective and hypotheses, research design, research sample and results analysis. The research was conducted in December 2015.

A. Research Objective and Hypotheses

The objective of this study is to determine whether students show signs of information overload and to identify the possible predictors. The research question is as follows: Is it possible to predict the predisposition to information overload based on the frequency of use of computers and mobile devices and the level of information literacy? Also, this research seeks to determine if there is a correlation between demographic variables, such as gender, age or student status (full-time or part-time student) and information overload. Therefore, the following hypotheses have been proposed:

H1. There is a statistically significant positive correlation between the frequency of use of technology and information overload.

H2. There is a statistically significant negative correlation between information literacy and information overload.

H3. There is a statistically significant difference in the information overload signs, considering of gender, age, and student status.

B. The Questionnaire

In order to address the research objectives a questionnaire was developed. Since most of the available research on information overload focuses on work environment and productivity, this paper focuses on information overload as it has been described by the authors mentioned in the theoretical part of this paper, with the emphasis on the learning process and memorization, which is important for students. The questionnaire was created using Google Forms, distributed online and participation was anonymous and voluntary.

The questionnaire had 22 questions grouped into 4 parts. The first part consisted of demographic questions (gender, age, and student status). The second part contained 7 questions to determine use of computers, mobile devices and digital media. While answers on these 5 questions used a 4-grade frequency scale (1=never; 2=rarely; 3=sometimes; 4=often),

other 2 questions were multiple answer questions (used for quality analysis only). The third part of the questionnaire consisted of 4 questions about information literacy and the last part had 8 questions about information overload symptoms. For answers on those questions a 4-grade frequency scale has been use, except in the case of computer literacy assessment, where a different 4-grade frequency scale was used (1=I have poor computer and Internet skills; … 4=I have excellent computer and Internet skills).

C. The Sample

Students of one higher education institution in Rijeka, Croatia, with undergraduate and graduate studies (3+2 years) were the target population. Link to the questionnaire was distributed via mailing lists and the Facebook page of that institution. Therefore, 153 completely filled out questionnaires and 24 incomplete questionnaires were collected.

The sample consisted of 31% male and 69% female participants. In terms of age, most participants were 18–21 years old (39%), followed by those in the 22–25 age group (29%), and those in the age of 30+ (20%). The 26-29 age group had the lowest percentage of participants (12%). The sample had a higher percentage of part-time students (53%) than those who studying full-time (47%).

D. Results Analysis

The collected data were analyzed using the Statistica 13 Trial Version Software. Data analysis included descriptive statistics, correlation and multiple regression analysis for first the and second hypotheses and nonparametric tests (Mann-Whitney U-test and Kruskal-Wallis ANOVA & Median test) for the third hypothesis. The multiple regression analysis was used to examine the relationship between a single dependent variable „Information overload" and the combination of the two predictors, the independent variables „Information literacy" and „Technology use". These three variables were a linear composite variable. In order to test the reliability of items forming dependent variable "Information overload", Cronbach's alpha coefficient of internal consistency was used.

IV. RESULTS ANALYSIS AND INTERPRETATION

A. Technology Use

According to the questionnaire results, 22% of students often use more computers or mobile devices, sometimes do that 36% of students, rarely 22%, while 12% of them never use more than one computer or mobile device. Fig. 1 shows the use of computers and mobile devices based on the type of device, and the results indicate that smartphones (33%) and notebooks (31%) are the most used devices among students, while the other gadgets are the least used (6%).

The students spend on average 6 hours a day using the aforementioned devices and gadgets. They use them mostly for acquiring information and for communication (26.5% in both cases), education (23%), entertainment (14%), and socializing (10%).

Only 17% of students often simultaneously use more computers or gadgets, 29% of them do it sometimes, most

students do that rarely (44) and 10% of them never. While using the mentioned devices 31% of the students spend more than 4 hours online a day, and only 17% of them spend less than 1 hour online.
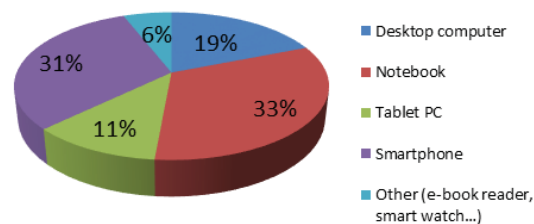

Fig. 1 Use of Computers and Mobile Devices by Type

To stay informed on a daily basis, most of the students use more media: 24% of them often use more media, sometimes do that 38% of them, 30% rarely and 8% never use more media because they use only one media. Fig. 2 shows that the most favorite source of information is Web, followed by the social media and television. This means that the commonly used media by students are digital and interactive media which can disperse attention to multiple stimuli.
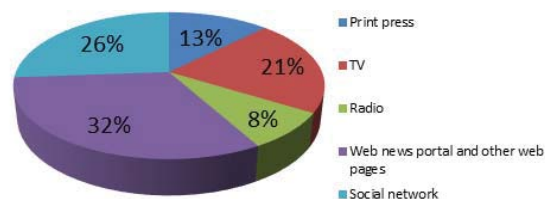

Fig. 2 Use of Media for Acquiring Information

B. Information Literacy

Table I shows descriptive statistics of answers to questions about information literacy. A 4-grade scale was used for all questions/answers. Based on the arithmetic mean of all answers, students showed moderate level of information literacy. The best result students showed for assessment of their computer literacy. They rarely use techniques of effective information organization and management. Sometimes they have problems with finding the relevant and necessary information, and sometimes are able to recognize quality and reliable information (with highest standard deviation).

TABLE I
DESCRIPTIVE STATISTICS FOR INFORMATION LITERACY

Items	Mean	SD
How often do you have problems finding relevant, necessary information?	2,81	0,83
How often are you able to recognize quality, reliable, trustworthy information?	2,59	0,95
How often do you use some techniques for better information management?	2,14	0,73
How would you assess your computer literacy?	3,52	0,66

As in [6], while students frequently use of digital technologies and digital media, their information literacy competencies (especially information management) are not at

the high level. In [5], they confirmed that today's students "are surprisingly lacking in their online search skills".

C. Information Overload

In order to identify information overload, 8 questions with answers on a 4-grade frequency scale were given. Descriptive statistics of answers can be seen in Table II.

TABLE II
DESCRIPTIVE STATISTICS FOR INFORMATION OVERLOAD

Items (How often...)	Mean	SD
Does the notification of a new message, status, post, etc.; distract you from your previous activity?	2,80	0,93
Do you feel like you're going to miss something important if you are not always online?	2,36	1,03
Do you write/read messages or "surf" on your mobile device when it is not appropriate (e.g. during class, at the movies, etc.)?	2,59	0,91
Do you feel like you're receiving more information than you are able to process?	2,92	0,90
Do you feel that you miss important information because of the abundance of information you're exposed to?	2,54	0,92
Do you have problems concentrating and/or remembering content?	2,64	0,97
Do you have problems in decision making or problem solving because of so much available information?	2,29	0,95
Do you only run through text, catching the key words when reading content online?	3,10	0,83

The arithmetic mean for majority of those questions shows that students have been sometimes in situations that indicate the information overload. Furthermore, students have a tendency to fly through the content they are reading online, 'catching' only the key words sometimes. They rarely feel like they are missing out on something if they are not online, which is highly commendable, and they rarely have difficulties in decision making, or solving problems because of lots of available information. Although, it is should be pointed out that there is a high standard deviation in almost all answers. According to [8] the young, when faced with many possible choices, make their decisions easily and show no signs of anxiety because they have previously informed themselves; i.e. looked into all the possibilities of choice online.

High Cronbach's alpha coefficient ($\alpha=0,77$) indicates that items in composite variable "*Information overload*" have a high level of reliability.

D. Testing the Hypotheses

Spearman's rank correlation coefficient indicates statistically significant and positive correlation between the frequency of technology use and information overload ($r_s=0,23$; $p<0,05$). Frequently use of digital devices and media is correlated with higher level of information overload, so the hypothesis H1 is accepted.

The second hypothesis (H2) was also tested using Spearman's rank correlation, which result indicated statistically significant and negative correlation between information literacy and information overload ($r_s= -0,33$; $p<0,05$). A higher level of information literacy is correlated with lower level of information overload. Hypothesis H2 is also accepted. The correlation between information literacy and information overload has also been confirmed by other researchers [3].

Seeing as the independent variables were intercorrelated with each other and both were correlated with „*Information overload*", it was justified to conduct a multiple regression analysis. The relationship between the combination of independent variables in the model and dependent variable "*Information overload*" is statistically significant and moderate (R=0,49). The model as a whole has statistically significant predictive capability ($F(2,150)=24,05$; $p<0,00$) and with combination of information literacy and frequency of technology use we can explain 24% of variance in information overload ($R^2=0,24$).

The hypothesis H3 is rejected because the application of the appropriate nonparametric tests has not confirmed statistically significant difference of the information overload signs, considering of gender, age, and student status. Some earlier research determined the difference between the information selection strategies and the way information overload is manifested in terms of age and gender – older people and women are more susceptible to information overload [1].

V. CONCLUSION

Digital technology, as well as digital media, influence how we are informed, educated, how we spend our free time and how we act. The information society is based on the quick flow of information. The Web 2.0 technology enables simple and easy creation, copying, mixing, sharing and distribution of information. It enables people to interact with the content and members of virtual communities. Mobile devices and computer networks are also helping by allowing access to those information and contacts at any time and place. This means that every person is surrounded by the abundance of information, a lot more than they is able to process. Due to the fact that we are constantly surrounded by information coming to us from multiple sources, there is an increased possibility of information overload which consequently decreases productivity, memory skills, learning abilities and deep information processing. Despite the fact that we have tools for searching, filtering, indexing and cataloging content, a certain level of information literacy is still necessary in order to use them effectively.

The results of a research conducted on a sample of 153 students, show that they frequently use computers, mobile devices and digital media while the demonstrated level of information literacy is moderate. The students have sometimes been in situations of information overload. The tested model has shown that the combination of frequency of technology use and information literacy has statistically significant predictive capacity for the dependent variable "information overload". Therefore, for taking proactive solutions of information overload, it is necessary to improve information literacy in students and develop skills that will help them to take full advantage of digital technologies, and at the same time reduce possibility of information overload.

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