Does Daily Use of Digital Technologies Influence the Reading and Information Literacy of 15-year-old Students?

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***Abstract* - This paper focuses on the impact of out-of-school and in-school use of digital technologies on the reading and information literacy skills of 15-year-old Slovenian students who participated in the PISA 2018 study. For our study, we selected PISA 2018 variables related to the use of digital technologies in school or outside school. The sample (N = 2612) consists of 50.8% girls and 49.2% boys. Part of the questionnaire refers to the use of digital technologies outside school: for entertainment and practical information purposes, for school purposes, and time spent with digital technologies. Part of the questionnaire refers to the use of digital technologies in school: for various purposes, for learning or teaching, and the time spent using digital technologies in class. The results show that the constructs of using digital technologies in school or out of school are strongly related but have a very low/insignificant impact on reading literacy and information literacy.**

Keywords* - *digital technologies, secondary education, information literacy, reading information literacy, PISA 2018.

I. INTRODUCTION

The development of information and communication technology (ICT) has brought many changes and challenges to our lives and has a great impact on education. Many believe that information literacy is an important skill in the modern world. Those who have information literacy, must be able to obtain, evaluate, and use information from a variety of sources. The OECD [1] stated that digital technologies and the Internet enhance children's learning experiences and promote different learning methods. Digital technologies are also present in individuals' daily lives and leisure time. However, new services and knowledge requirements are emerging every day that demand digital and information literacy from users [1].

Most of the revised elementary school curricula promote students' digital literacy by researching databases and information bases, searching, selecting, processing, analysing and critically evaluating the acquired information. It is important to view digital technologies as a tool that students can use to help themselves fulfil their academic and many others responsibilities. Modern educational reforms expect teachers to support students in formal and non-formal learning with digital technologies, in school and at home [2]. Learning science and biology using digital technology as a learning tool can be as motivating as teaching with active teaching methods [3]. The teacher's task is to stimulate students' curiosity for independent and lifelong learning using modern digital technologies [4].

Even though digital technologies are mostly seen as something positive [5], students' recreational use of digital technologies also poses risks and is a cause of concern for parents and policy makers [6]. Inappropriate or unsafe internet use can expose students to harmful content or cyber-bullying. Students are also exposed to an enormous amount of information online, which can help them develop online reading skills, but can also have negative effects if students are unable to distinguish facts from fake news and check their sources. Additional risks, such as excessive use of video games and compulsive use of social media, can have serious physical, social, psychological, and cognitive consequences [1,7].

We already know that time spent in front of screens outside of school has a small impact on better information literacy. We also know that the information literacy of Slovenian students is far from excellent [8, 9, 10]. Much less is known about how the time spent in front of screens in a school for learning and teaching affects information literacy. Even less is known about how much time students spend using digital technologies in class in different subjects and how much time is spent outside of class on the requirements of school work in schools. Therefore, we are interested in whether time spent in front of screens for schoolwork has a greater impact on information literacy of 15-years old adolescents than time spent in front of screens for entertainment.

The aim of the research was to answer the six research questions, which can be considered as hypotheses H1 - H6:

- Does the frequency of using digital technologies outside of school for entertainment and practical information purposes have an impact on reading and information literacy? (H1)
- Does the frequency of use of digital technologies outside school for school purposes has an impact on reading and information literacy? (H2)
- Does the amount of time digital technologies are used outside of class (at home or at school) have an impact on literacy and information literacy? (H3)

- Does the frequency of using digital technologies in school for different purposes have an impact on reading and information literacy? (H4)
- Does the timing of digital technologies use in the classroom has an impact on reading and information literacy? (H5)
- Does the use of digital technologies for learning or teaching in the classroom have an impact on literacy and information literacy? (H6)

At this point in the research, we did not look for differences based on personal characteristics and traits and socio-demographic factors. The reason for this was not that such information was unimportant, but that we were looking for robust models in the first phase.

II. MATERIALS AND METHODS

To obtain answers to these research questions, the authors analyse data of interest collected in the PISA 2018 survey to find patterns that were not included in the final PISA 2018 report.

The research is based on publicly available databases provided by the OECD, PISA [11]. The data were filtered to the Slovenian sample and the items of interest were identified from the manuals and code tables. The data were transferred to Excel files and cleaned of missing and incomplete data that were not suitable for the planned analyses. Statistical analyses were performed using IBM SPSS 27 and AMOS 27 software.

A. Sample and sampling

The PISA 2018 survey was conducted in Slovenia in March and April 2018 and followed international protocols. For the current study, Slovenian data from PISA 2018 were transferred to the local drive. The target group of the survey was 15- and 16-year-old students participating in various educational programs. The interested reader can find information about the Slovenian school system on the websites of (Eurydice, Ministry). 6401 pupils/students from 302 secondary education programs, 43 elementary schools, and two adult education institutions participated in the survey. More than 90% were enrolled in the 1st year of lower-secondary school programs at the time of the survey. The sample was representative of a population of participants in all Slovenian formal education programs. The total number of births in this calendar year is 17501 (Statistical Office). Only records without missing data were used for further analysis. This sample (N = 2612) consists of 50.8% girls and 49.2% boys.

B. Instrument

Question ST 166 (Student Questionnaire) from the ST knowledge test and six questions from the IC questionnaire - ICT Familiarity Questionnaire (IC008, IC010, IC011, IC150, IC151, IC152) from the Slovenian Pisa 2018 study [12] were selected for the study.

ST166 [12] was considered a reading and information literacy task as an outcome (latent) variable. The instructions were as follows:

"*You have received a message in your inbox from a well-known mobile phone operator telling you that you are one of the winners of a smartphone. The sender asks you to click on the link to fill out a form with your data so they can send you the smartphone. In your opinion, how appropriate are the following strategies in reaction to this email?"*

Students could indicate how much they agreed with the opinion on the 6-point Likert scale in each of the 5 rows (Table 1), where 1 means – not appropriate and 6 – very appropriate.

We selected tasks IC008, IC010, IC011, IC150, IC151, and IC152 [12] as predictors of reading and information literacy. Part of the questionnaire relates to collecting data on the frequency and time spent using electronic devices and digital technologies outside school for entertainment and practical information purposes (IC008), using digital technologies outside school for school purposes (IC010), and using digital technologies in school for various purposes (IC011). We also selected the question where students indicate how much time they spend using digital devices and digital technologies in class during a normal school week (IC150), for 9 school subjects. This is followed by questions in which participants indicate how much time they spend using digital technologies outside of class (at home or at school) for 9 school subjects (IC151) and how much time they spend using digital technologies for learning or teaching in class for 9 school subjects (IC152).

Items on frequency and time spent using electronic devices served as predictors of reading literacy. We selected questions IC008, IC010, and IC011, which asked respondents to indicate how often they used electronic devices outside of school (IC008 and IC010) or in school (IC011) for various purposes. In each row, students choose a response on a 5-point scale indicating how much they agree with the opinion, where 1 means – never or almost never and 6– every day.

Question IC150 asks students how much time they spend using digital devices during class in a typical school week. Question IC151 asks students how much time they spend using digital devices outside of class in each of the nine school subjects listed. Students were asked to choose one answer on the 5-point scale in each row, where 1 means – no time, 2 means – 1-30 minutes per week, 3 means – 31-60 minutes per week, 4 means – more than 60 minutes per week and 5 means – not in this subject. The school subjects listed in the questionnaire were: Slovenian language, Mathematics, Science, Foreign language, Social sciences, Music, Physical education (Sport), Performing arts, and Visual arts.

Question IC152 asks students whether they have used electronic devices for learning or used in teaching during lessons in different subjects in the last month. The

questionnaire covers the same school subjects as question IC151 previous item Students choose one answer on the 5-point Likert scale in each row, where 1 means – Yes, both the teacher and the students used it, 2 means - Yes, but only the students used it, 3 means - Yes, but only the teacher used it, 4 means – No and 5 means - I do not in this subject.

C. Statistical analyses

The statistical procedure was carried out in several steps. In the first step, data from two databases (IC - ICT Familiarity Questionnaire and ST - Student Questionnaire) were merged into a single SPSS file, based on the students' code ID. This procedure resulted in a sample of 6410 students. The data were reviewed, and cases with missing data were deleted from the file. This left 2612 cases that could be included in the modelling.

Each selected variable was analysed for frequency of responses (F%), mean, median, mode, and standard deviation (SD).

Each construct (latent variable) was examined. Cronbach's alpha was calculated to assess the reliability of the construct. To assess the unidimensionality of the constructs, Principal Component Analysis (PCA) was conducted with Direct Oblimin rotation. Previously, KMO and Bartlett's tests for sphericity were performed to assess the fit of the matrices.

It was found that the construct ST has two components, that explain 68.9% of the variance. Since knowledge can be considered summative, the sums of all items forming the ST construct were later used in the models [13].

III. RESULTS

A. Task to check reading and information literacy

Examination of the unidimensionality of the construct revealed that two components were extracted, explaining 68.9% of the variance. All items loaded above the 0.4 level, so they were included in the analyses. We note that the task of assessing reading and information literacy can be divided into two components: Curiosity (PC1) and Caution (PC2). We can explain 40.7% of the variance with the first component (Cronbach's alpha = 0.67). The first component consists mainly of curiosity attitudes: *"Reply to the email and ask for more information about the smartphone."* and *"Click on the link to fill out the form as soon as possible."* The second component (Cronbach's alpha = 0.53) explained 28.2% of the variance and included three items of caution: *"Check the sender's email address," "Check the mobile operator's website to see if the smartphone offer is mentioned"* and *"Delete the email without clicking the link."* According to the results respondents think that the least appropriate response to a message in their inbox from a well-known mobile phone provider telling them that they are one of the winners of a smartphone is to click on the link and fill out the form as soon as possible. However, most agree that it is appropriate to check the sending email address.

B. Frequency of use of digital technologies outside school for entertainment and practical information purposes (IC008) and for school purposes (IC010)

Response frequencies and descriptive statistics for questions IC008 and IC010 (*How often do you use digital devices for the following activities outside of school?* N = 2612). Respondents outside school never or once play online games via social networks (e.g., Farmville®, The Sims Social) and never or once using social networks for communication with teachers (e.g., Facebook, MySpace). These results were relevant before the SARS-CoV-2 pandemic. It would be good to know the current situation, because majority Slovenian teachers and students in period SARS-CoV-2 use social networks even daily for communication. Students still almost daily they use social networks to communicate with other students about schoolwork (e.g., Facebook, MySpace), to chat online (e.g., MSN®), to participate in social networks (e.g., Facebook, MySpace), and to surf the Internet for fun (e.g., to watch videos, e.g., YouTube™). A review of the use of digital technologies outside of school for cutting-edge entertainment and practical purposes helps us to show that technologies are rapidly being integrated into everyday life and the available evidence [14] points to an increase in the use of digital technologies particularly during adolescence. 86.7% of young people in this survey agree that they really enjoy using digital devices. The results of this research show that Slovenian 15 - year - old outside the school most often use digital technology for online chatting, for participating in social networks and for browsing the internet for fun, but not for playing online games via social networks. For school purposes outside of class, they most often use social networking sites to communicate with other students about schoolwork (e.g., Facebook). It has already been noted that the impact of using digital technologies based on social media outside school varies depending on the use and type of social networks. The results and models show that out-of-school digital technology use is related to other constructs. It is most strongly related to the construct IC010 (Using digital technologies outside school for school purposes). However, it has a very small statistically insignificant impact (0.06) on reading and information literacy.

When asked how much time they spend on digital technology outside of school per week for different subjects, they answered that they spend most of their time, i.e., up to 60 minutes per week, on music, art and foreign language. In other subjects, they do not use digital technology outside class or spend at most 30 minutes per week. They spend the least time in front of screens for sport and mathematics. The results and models show that time to using digital technologies outside of class is related to another construct. It is most strongly (0.40) related to the construct IC150 (Time of using digital technologies in the class). However, it has a very small statistically insignificant impact (0.05) on reading and information literacy. In particular, recreational use of email, reading online news for pleasure, and surfing the Internet for pleasure (e.g., watching YouTube) were positively correlated with students' digital reading achievement from PISA 2009 to PISA 2018, which partially confirmed [15] findings that online social activities play a role in explaining adolescents' digital

reading achievement, but contradicted Lee and Wu's [16] findings that social entertainment activities negatively influence adolescents' reading achievement.

The various effects of out-of-school digital technology use have shown either positive effects [17] or negative effects [18, 19, 20] on students' reading achievement.

C. Frequency of use of digital technologies in school for different purposes

The reliability of the questionnaire about use of digital technologies in school for different purposes is very good, the Cronbach's alpha 0.93 determined. Students in school never or almost never use them to post work on school websites, to do homework on school computers, they almost never use computer simulations in school. However, they are more often used to surf the Internet for schoolwork and to chat online at school.

With the two remaining components, 76.3% of the variance can be explained. All items had a loading value above 0.4 and were therefore included in the analyses.

With the first component, we can explain 53.2% of the variance (Cronbach's alpha 0.95). The items included in this component were student's minority use ICT for school work, such as use of ICT to post work on school websites, to do homework on school computers, or use computer simulations in school: *"Downloading, uploading or browsing material from the school's website (e.g.)."*, *"Using school computers for group work and communication with other students."*, *"Practicing and drilling, such as for foreign language learning or mathematics."*, *"Using learning apps or learning websites."*, *" Posting my work on the school's website."*, *"Playing simulations at school."*, *"Doing homework on a school computer."*

Three items of second component explains 23.1% of the variance (Cronbach's alpha 0.76), where students ICT mostly use for communication via email or online chatting and *"Browsing the Internet for schoolwork."*, *"Using email at school."* and *"Chatting online at school."*, fall into the second component, which explains 23.1% of the variance (Cronbach's alpha 0.76).

D. Time of using digital technologies in the class

The reliability of the questionnaire is very good, the Cronbach's alpha 0.86 determined. The results show that they do not use electronic devices in physical education (sports) and mathematics classes at school. More frequently i.e., 1-30 minutes in a typical school week in school, they are used in visual arts, music and performing arts. With the two remaining components, 65.4% of the variance can be explained. All items had a loading value above 0.4 and were therefore included in the analysis. With the first component, we can explain 40.7% of the variance (Cronbach's alpha = 0.88). The first component includes school subjects where electronic devices are not used. There are Sport, Social sciences, Foreign language, Mathematics, Science, and Slovene. The second component (Cronbach's alpha= 0.79) explains 25.0% of the variance and includes three school subjects' Visual arts, Music, and Performing arts. In these school subjects, electronic devices are used up to 30 minutes per week.

E. Use of digital technologies for learning or teaching in the class

The reliability of the questionnaire is very good, which determines Cronbach's alpha 0.93. The results show that in the last month only teachers in the following subjects used electronic devices for teaching: Foreign language, Slovene, Science, Social sciences, Mathematics, Visual arts, and Sport. No electronic devices were used in the subjects of music and Performing art in the last month.

With the two remaining components, 75.7% of the variance can be explained. All items loaded above the 0,4 level therefore they were included for analyses.

We can explain 42.4% of the variance with the first component (Cronbach's alpha = 0.92). The first component includes the school subjects Mathematics, Slovene, Social sciences, Foreign language, and Science. The second component (Cronbach's alpha = 0.87) explains 33.3% of the variance and includes the four school subjects Visual arts, Sport, Music, and Performing arts.

The results show that young people are also use social networks and digital technologies very frequently at school, especially for online chats, using emails and surfing the internet. However, digital technology is almost never used at school for completing homework on the school computer. The results and models show that time spent using digital technology in class is related to other constructs. It is most strongly related (0.40) to the construct IC151 (Time of using digital technologies outside of school). However, it has a very small statistically insignificant impact (0.05) on reading and information literacy. The use of digital technology for learning or teaching in different subjects also has a very small and statistically non-significant impact on digital and information literacy (0.13). Other authors [17, 18, 19, 20] found that the use of digital technology in school for extracurricular purposes has a negative impact on literacy and information literacy. These findings were also confirmed by a secondary longitudinal study with the results from PISA [21]. The statistically insignificant effects in our study can be explained by the fact that the use of digital technologies for extracurricular purposes robs students of a lot of time that could be spent focusing on school work. It is also known that the use of digital technologies in school quickly diverts students' attention from school work [22]. It is believed that the use of digital technologies in school under the supervision and guidance of a teacher would reduce disruption and overuse of social networks in the classroom [23] and potentially have a greater impact on information literacy.

F. Hypothetical and final model

Although there are correlations within the constructs, in Figure 1 we only show the effects of the constructs on information literacy to test the hypotheses. With Hypothesis 1, we tested whether there is a statistically

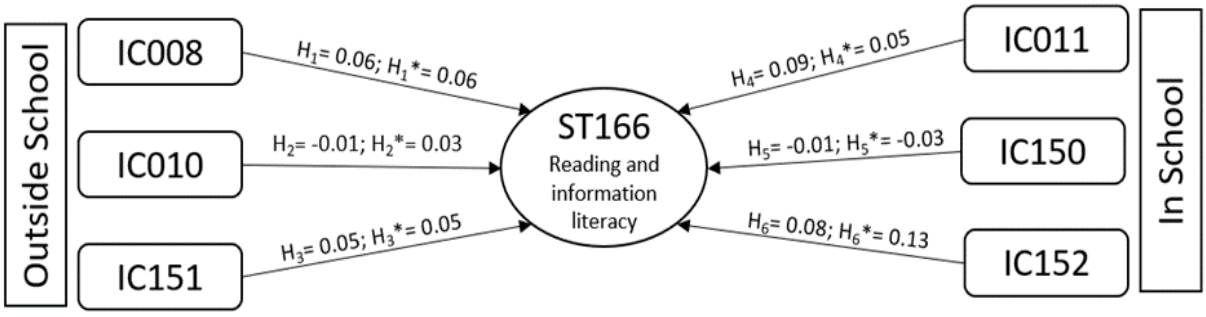

Figure 1. Hypothesis testing model (*Result for Final model).

significant relationship between the frequency of using digital technologies outside school for entertainment and practical information purposes to reading and information literacy. We checked the correlation between the variable and found that there was no statistically significant correlation.

There was also no statistically significant difference in the testing of Hypothesis 2, in which we examined the correlation between the frequency of using digital technologies outside of school for school related purposes to reading and information literacy. In Hypothesis 3, we were interested in the correlation between time to using digital technologies outside of class to reading and information literacy. We found that there was no statistically significant correlation. With Hypothesis 4, we wanted to test the correlation between frequency of using digital technologies in school for different purposes to reading and information literacy. With Hypothesis 5, we tested whether there is a statistically significant relationship between the time of using digital technologies in the class to reading and information literacy. Also, there was no statistically significant correlation. There was also no statistically significant difference in the testing of Hypothesis 6, where we chose to look at the relationship between using of digital technologies for learning or teaching in the class. We were also unable to find a statistically significant relationship among these hypotheses. We conclude that no construct of using digital technologies for school work or leisure purposes has a statistically significant impact on reading and information literacy.

IV. CONLUSION

Using a step-by-step analysis of data from 2612 students from 347 Slovenian educational programs, the current cycle of the 2018 PISA Digital Reading Study reveals the impact and timing of digital technology use on 15-year-olds' reading achievement. The factors that impact the use of digital technologies on digital literacy and information literacy have been poorly explored in previous literature. The results of this study are based on 6 different aspects of the use of digital technologies for in-school or out-of-school purposes, and results reveal whether the time spent in front of digital technology screens for school purposes influence students' information literacy. Based on the results of the secondary analysis of the data from questionnaire of PISA 2018, we can answer the research questions about the influence on reading and information literacy. To test reading and information literacy, we selected a task from the PISA 2018 questionnaire that tests students' confidence in receiving unsolicited text messages designed to motivate a person to enter sweepstakes and provide personal information in order to receive a prize - a smartphone.

Most 15-year-olds agree that it is inappropriate to click on a link to such a message and to reply to messages containing personal information. According to Cheshire, Antin and Churchill [24], in interaction with internet systems, individuals develop implicit or explicit attitudes about the risks and uncertainties in online environments, a finding which relates to our results; most students agree that it is appropriate to check the sender's email address. As expected, the students' responses split into two components. One group is curious, and the other is cautious. Both groups of 15-year-old students mostly agree (86.7%) or strongly agree that they enjoy using digital devices.

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