ANALYSIS OF SELF-REGULATED LEARNING APPLICATIONS BASED ON VISUAL APPEARANCE AND FREQUENCY OF USE

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Abstract: *The choice of the appropriate visual design for each mobile application has a significant impact on the perception of information. This is also of the utmost importance when acquiring or communicating educational content. In the field of e-learning, there is an increasing number of mobile applications that enable efficient teaching and learning. Our study analyses different applications for e-learning that are frequently used by Slovenian high school students. Based on a literature review, an introduction to the field of application design is given and criteria that influence the selection of appropriate graphical elements when creating an application in general are presented. With the survey, we compared the five most widely used applications for self-directed learning on the basis of their visual design. Our aim was to collect data on the effectiveness of the graphic elements that influence the choice of an application and to identify students' habits in terms of self-regulated learning (type of tool used, learning time, learning circumstances). In addition, the learning habits of students from a suburb were compared with students who live in the city. Based on the data collected, we provide guidelines for selecting the most appropriate graphic elements for designing an effective application as a learning and teaching tool. The research showed differences in the use of applications for learning or entertainment depending on the type of school the students attend (vocational, secondary school and high school students). The study also determined how much time per day students use digital tools for learning or entertainment and, more importantly, which media. Another important finding was that students still mainly rely on traditional learning methods, i.e. textbooks and notebooks, to complete their homework for school. Differences in the popularity of applications between suburban and urban students were found in only two of the five applications analysed.*

Key words: user interface, mobile applications, self-regulated learning, visual appearance, study habits

1. INTRODUCTION

In formal secondary education, new, more modern forms of teaching, including information and communication technologies (Gramma et al., 2020), are being sought to accommodate students as "digital natives" (Prensky, 2001) in a time of rapid technological development. M-learning, i.e. teaching and learning using mobile technologies, enables in addition to the use of teaching materials and applications field learning, the preparation of materials with mobile devices (images, audio recordings, etc.) and communication and collaboration with teachers and other people (Bregar, Zagmajster & Radovan 2021). For learning through the screen, microlearning or learning in smaller content assemblies is very suitable. Giurgiu (2017) states that it is easier for learners to absorb and retain learning content that is divided into smaller learning sections. The most suitable teaching tools for microlearning are mobile tools. With the use of smartphones, m-learning has become learning that is independent of time and space as it enables instant communication and data sharing. Mobile devices with loaded tools or applications allow access to learning content, communication, the use of video camera and sound. Particularly with mobile applications that are intended for learning, great attention should be paid to the design of the user interface. Namely, visualization for effective learning is based on images, infographics and animations. At the same time, visualization is a powerful didactic tool the use of which must be motivated, pedagogically appropriate and methodically supported (Delil, 2017; Alwadei, 2023). A study by Gramma et al. (2020) examined the technical requirements of mobile phones, didactic methods of m-learning, the use of mobile applications and the organization of student education by surveying 79 students over a period of five years. The research results showed, among other things, that it is very important for learning purposes that the user interface is user-friendly (including the visual design, including typography, buttons, and content layout) with clear interaction rules. High-quality interfaces further support learning, expressive aesthetic features of the design stimulate interests to engage in the learning topic, and the aesthetic experience caused by interfaces influences deep perceptual processes such as emotions and cognitive stimulation (Ruf et al., 2022). Planned and well-thought-out graphic visuals contribute to better understanding, ease and simplicity. By graphically

representing information with symbols, icons, etc., it is easier to understand and manipulate them (Smrdel et al., 2017). Even the name and logo of the application can significantly influence the choice of a particular application for self-study. In a study on digital game advertising involving 293 people, it was found that people generally remember brand logos faster and more strongly than brand names (Ghosh, Sreejesh & Dwivedi, 2022).

The purpose of this study was to examine the frequency of use and the type of digital devices that secondary school students use for learning. In addition, we want to investigate which of the five most frequently used self-regulated learning applications selected among the highest rated international solutions for digital learning is the most visually pleasing to students in three different secondary schools (professional school, vocational school, and gymnasium). All analysed applications had in common the possibility of creating and discovering learning content and sharing learning resources. The focus was to collect data of the likability of the graphic elements of visual design (application name and logo, icons, typography, colour scheme, visibility, and arrangement of graphic elements) that influence the choice of an application and identify students' habits in terms of self-regulated learning (type of tool used, learning time, learning circumstances). Before we began our research, we set five hypotheses: H1: We assume that students use digital media mainly for independent learning at home. H2: We hypothesize that students spend significantly more time using digital media/mobile phones for entertainment than for learning. H3: We assume that there is a difference among students from different schools in terms of preference for applications. H4: We hypothesize that there is a difference between students who are drivers and those who are not in terms of preference for apps. H5: We assume that students find the same independent learning application visually attractive based on individual characteristics (name, colour scheme, typeface colour, visibility, arrangement of graphic elements, icons and logo).

2. METHODS

2.1 Research Instrumentation

An anonymous survey of the target group was conducted using printed copies of the questionnaire, which were given to the students by their teachers. Students completed the online survey voluntarily and after daily school learning obligations from 10th to 20th May 2022. 45 students between the ages of 14 and 18 took part in the study. In the first part of the survey, the students provided their demographic data: gender, age, type of school and whether or not they're drivers. In the second part of the survey, students answered questions about how much time they spend using digital tools for learning and how much time for entertainment and which media they use for independent learning. In the third part of the survey, the students completed the evaluation form for each individual application with the help of a pictorial representation of the respective mobile application. On a 5-point Likert scale (1 - I don't like at all; 2 - I don't like, 3 - I don't like so much; 4 - I like it; 5 - I really like it), the students express their opinion about visual design of the five most used mobile self-regulated learning applications: Khan Academy (2022), GoConqr (2022), Kahoot (2022), Anki (2022) and SoloLearn (2022), presented in Figure 1. The visual graphic elements were: colour scheme, typeface colour, visibility and layout of the graphic elements, icons and logotypes. Beside the graphic elements students evaluated also the name of which application is closest to them. We also determined whether there is a difference in preferring a specific application between students who commute to school from the suburbs of the cities (therefore school locations) and those who live close to schools with no need to take a public transport.

2.2 Statistical Analysis

Transferring the empirical data to the IBM SPSS Statistics program enabled us to carry out a statistical analysis. We analysed the characteristics of the variables (name, colour scheme, typeface colour, visibility, arrangement of graphic elements, icons and logo of the app; type of tool used, learning time, learning circumstances) together with the frequencies (professional school, vocational school, and gymnasium). The statistical results are only given descriptively in the text and numbers in this paper. The Cronbach's alpha test of measurement reliability showed that the internal correlation of the variables of all individual factors is appropriate, as the value of the Cronbach's alpha test is greater than 0.70 for all factors. The measurement characteristics were tested on the entire sample examined (N = 145). Descriptive statistics were calculated for all variables. The Pearson correlation coefficient, the χ^2 test for independent samples and the Mann-Whintey (M-W) test were used to determine differences regarding the liking of individual

applications among types of secondary schools and between drivers and non-drivers. For statistically significant values, we considered differences at the level of 5% and lower risk ($p \leq 0.050$).
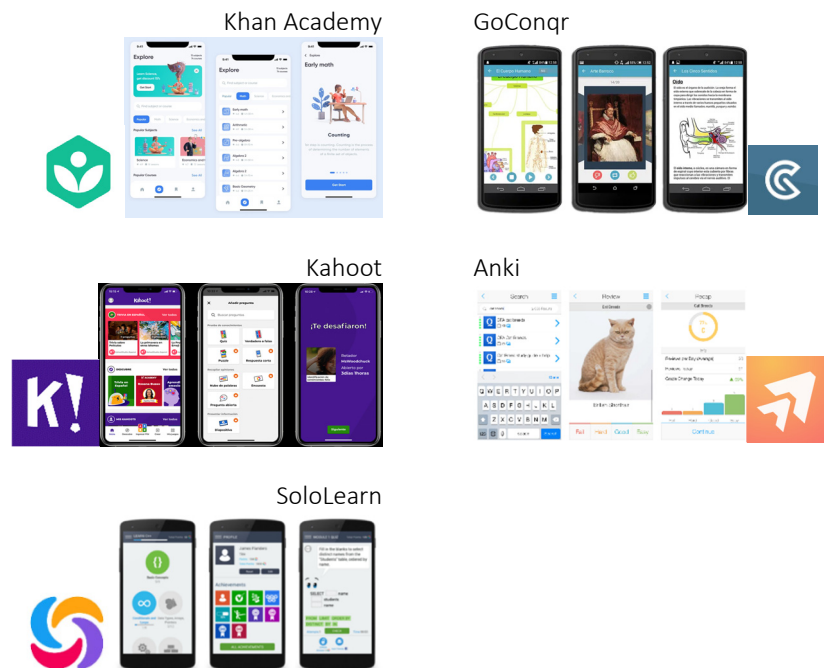
Khan Academy

GoConqr

Kahoot

Anki

SoloLearn

Figure 1: Logo and visual appearance of a self-regulated learning mobile application Khan, GoConqr, Kahoot, Anki and SoloLearn

3. RESULTS

Results showed that 145 students involved in the study could be divided into two groups, i.e. into those who go to school by public transport (spend significantly more time on the way where they can use mobile technologies) - 82%, and those who do not use public transport to access school - 18%. From the questionnaires it was found out that students from gymnasium (48 students), vocational school (49 students) and technical school (48 students) were included in the study. The schools differ in vocational focus, complexity of the general education program and different interests of the students in general. The sample consisted of 18.6% male, 79.3% female students and 2.1% students who described themselves as other.

Figure 2 shows how much time students at different types of secondary school spend each day using digital devices for homework and how much for entertainment, and which media they use at home for homework.
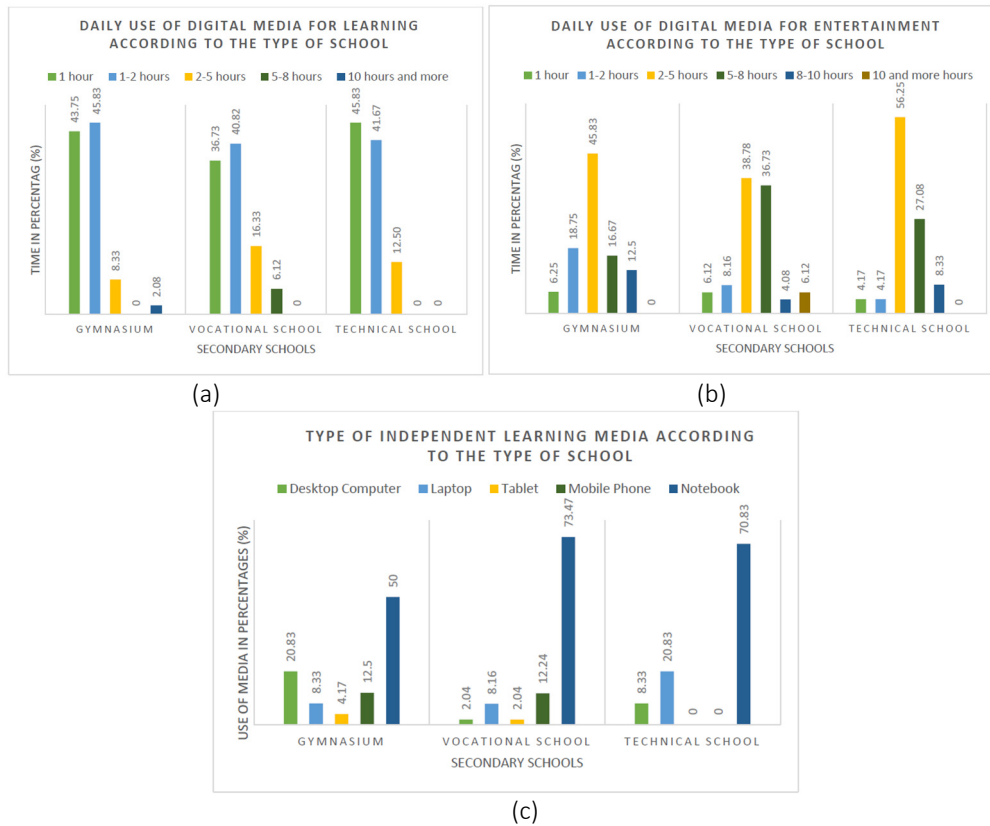
Figure 2: Daily use of digital media for learning (a) and entertainment (b), type of independent learning media (c) according to the type of school (N = 145)

Table 1 presents the results of the percentage of responses of students from all schools (sum) combined regarding the liking of the visual features of Khan, GoConqr, Anki and SoloLearn.

Table 1: The percentage of responses of students from all schools (sum) combined regarding the liking of the visual features of analysed applications

App	Charact.	I don't like it at all (%)	I don't like it (%)	I don't like it so much (%)	I like it (%)	I really like it (%)
Khan	Logo	1	8	17	28	46
	Visibility	6	19	32	30	14
	Name	12	23	38	19	8
GoConqr	Name	17	19	35	2	6
	Colour	7	22	38	23	10
	Visibility	8	19	41	21	10
	Icon	7	25	31	29	8
	Logo	6	16	29	28	21
Anki	Graphics	6	12	36	36	10
	Logo	8	12	34	31	14
	Colour	5	14	41	30	9
	Typeface	4	13	45	27	11
SoloLearn	Colour	5	14	41	30	9
	Typeface	4	13	45	27	11

4. DISCUSSION

Figure 2a and b shows that students at all three types of secondary school use digital media for learning for roughly the same amount of time per day. That is 1 to 2 hours per day. From Figure 2b, we can see that students of vocational school use digital media for entertainment significantly more time than technical school students and students of gymnasium. The results of the χ^2 test for checking the association of factors

268

type of school and daily time spent studying with digital tools showed that the factors type of secondary school and time spent using digital media for entertainment are statistically associated. Figure 2c shows that most students do their homework using a notebook (50% gymnasium students, 73.47% vocational school students and 70.83% technical school students), followed by laptops and desktop computers. Mobile phones are only used by gymnasium (12.5%) and vocational school (12.24%) students. Tablets are also only used by gymnasium (4.17%) and vocational school (2.04%). For homework and work, students at the technical school only use a notebook (70.83%), a laptop (20.83%) and a desktop computer (8.33%). The results of the χ^2 test to examine the correlation between the factors school type and daily time spent learning with digital tools confirm that the factors school type and type of digital media for learning are statistically related.

We created descriptive statistics of the individual mobile applications for self-learning and compared the results with each other. The results obtained with the Likert scale were added for each group, the arithmetic mean and the statistical deviations were calculated. It was found that the visual characteristics of the Kahoot application achieved the highest value in relation to the group with the same characteristics (colour: M = 3.8, SD = 1.2; typeface: M = 3.9, SD = 2.0; visibility: M = 4.0, SD = 1.0; graphic elements: M = 4.0, SD = 2.0; icons: M = 4.0, SD = 1.1; logo: M = 3.9, SD = 1.1 and name: M = 3.8, SD = 1.2). The GoConqr application achieved the lowest value for visual features (colour: M = 4.0, SD = 2.0; typeface: M = 3.0, SD = 0.9; visibility: M = 4.0, SD = 2.0; graphical elements: M = 3.2, SD = 2.0; icons: M = 4.0, SD = 1.1 and name: M = 40, SD = 2.0) and the Anki app (logo: M = 3.3, SD = 1.1). Only statistically relevant results of the analysis about the students' opinion (for all three types of secondary school) regarding the individual design element of the visual design of tested mobile applications for self-regulated learning are presented in Table 1. The χ^2 test of the association among the responses of students from different secondary schools and the factors of visual appearance of various mobile applications for self-study showed that there are statistically significant differences in the following application variables: Khan, GoConqr, Anki, and SoloLearn.

Statistically significant differences showed that: Secondary school students like the logo and name of the Khan application the most, the visibility of this application is most appealing to vocational students. Gymnasium students like the logo, visibility, icons, and colour scheme of the GoConqr application the most, while these students like the name the least. Technical school students like the logo and graphic elements of the Anki application the most, while vocational school students like the logo the least. Gymnasium students like the colour scheme of the SoloLearn application the most, while the typeface of this application is the most attractive to students from a professional school.

The result of the Mann-Whintey (M-W) test related to students who go to school by public transport and those who do not, in relation to the individual factor of the visual appearance of different mobile applications for independent learning, showed that it is not possible to detect differences between the visual characteristics of each application. A statistically significant difference was seen only in one application and its visual characteristics, the self-study application Khan. The results showed that students who do not use public transport are more likely to approve of the colour scheme of this application (p = 0.026). In terms of visibility (p = 0.060) and logo (p = 0.056), we found a trend difference between the two groups of secondary school students and the visual characteristics of each application. In both cases, this tendency is expressed in favour of the Khan application.

5. CONCLUSIONS

The results of the study showed that the application that students from three schools liked best was also the most visually appealing. According to the Centre for Learning Performance Technologies (2021), the Kahoot application also ranks high on the list of the world's best educational platforms and tools. As part of the research, we also found out how much time per day students use digital tools for learning or entertainment and which media. This is an important starting point for further research. One important piece of information we gained from the study is that they still use the traditional learning method for schoolwork: textbook and notebook. This is probably the result of the way they work at school, as teachers mainly teach with the help of exercise books and textbooks and, in line with this way of working, also give the students instructions for completing the tasks at home. We have refuted hypothesis 1 that secondary school students use the digital medium the most for learning. Students still use the traditional notebook method and textbooks for independent learning at home. We confirmed hypothesis 2, as students of different secondary school types spend significantly more time using digital media/mobile phones for entertainment than for learning. We confirmed hypothesis 3 that there are statistically significant

differences among students from vocational school, professional school and gymnasium in terms of preference for individual visual features of applications. We were able to partially confirm hypothesis 4 that there is a statistical difference between students who take public transport to go to school and those who are not in terms of preference for apps. Differences are only found for 1 out of 4 apps. We partially confirmed hypothesis 5, namely that students find the same self-regulated learning application, i.e. Kahoot, visually attractive based on individual studied characteristics.

In further research, more attention should be paid to the graphic design of digital and analogue learning materials, as the development of learning and teaching should be supported by the design of learning content. Teachers and lesson planners should design and follow the rules of a multimedia approach to learning and encourage students to discuss and critique approaches to learning models found in textbooks, digital learning environments and virtual technology trends in education (Güney, 2019).

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