Online Educational Activity of Pupils who Prefer the Smartphone as a Tool for Solving Educational Tasks *

Svetlana Bezgodova
s.a.bezgodova@gmail.com

Polina Rumyantseva
polinarum@gmail.com

Herzen State Pedagogical University of Russia,
St. Petersburg, Russian Federation

Abstract

This article presents the results of an empirical study aimed in researching the online activity of pupils who prefer a smartphone as a tool for solving educational tasks (n=582). It shows that the online learning activity of 6th – 9th grades pupils who prefer a smartphone is less diverse, in comparison with those who prefer to use a computer or a laptop. Also pupils who use a smartphone for solving educational tasks are more likely to turn to ready-made answers.

Keywords: *smartphone, laptop/computer, online educational activity, educational task, pupils*

1 Introduction

A variety of technical devices is at the disposal of modern pupils, that they can use as an assess to educational resources of the Internet for solving a variety of educational tasks [Koroleva, 2016]. First of all, these are computers, laptops, tablets and smartphones with Internet connection. Many St. Petersburg pupils have several technical devices in their possession, so in the process of solving educational tasks they can choose the device that is most convenient for them [Bezgodova et al., 2020b]. It is known that different technical devices differ in their functional characteristics and, as a result, in the capabilities that they provide to users. For example, smartphones are smaller and possible to use in any place. They have many apps for quickly responses and ready answers. A computer or a laptop usually has a larger screen, which is comfortable for reading. It is better for preparing reports and writing course papers. Also it has complex software enabling modeling different cases in Physics, Chemistry and deciding difficult tasks in other subjects. It saves more information and has various opportunities to transform it.

Now, especially during the COVID-19 pandemic when regular using technical devices in different situation (including educational ones) became normal there are many studies in the field of psychological implications of using each of them.

Summarizing the results of numerous studies, it can be stated that the use of a smartphone is more consistent with the solution of communicative tasks and tasks, with the search for information that does not require significant understanding, while the functional capabilities of a computer, laptop and tablet are more relevant for solving educational tasks [Albo et al., 2019], [Andrew et al., 2018], [Bezgodova et al., 2020a], [Vazquez Cano et al., 2018]. Supposedly different opportunities the device provides are consistent with the different aims for their using. And these aims may demonstrate

---

pupils' attitude to their educational activity. The questions "how" and "why" are interconnected in this case. That's why the research question about the educational activity characteristics of pupils preferring different devices will be answered in the context of studying motivation and results of using a computer, laptop, tablet and smartphone.

2   Literature Review

The modern world is permeated with digital technologies. Even before the COVID-19 pandemic, people could not imagine their lives without smartphones, laptops and tablets [Yasakcı et al., 2019]. It seems that the children of generation Z are born with a smartphone in their hands. Since the beginning of 2010s preschool institutions using digital technologies for the education and development of children have appeared in different countries [Park et al., 2021], [Sørenssen et al., 2021]. If earlier it was recommended to use computers or laptops or tablets like educational tools but now smartphones are becoming learning tool everywhere [Vorley et al., 2016], [Jeong et al., 2017], [Bolliger et al., 2021]. Smartphones are more familiar, easier to use, faster and with more applications for learning [Barkley et al., 2021]. Smartphones are multi-tasking and that's why they can be used in different educational directions [Grinols et al., 2014]. They are suitable for a distance education, a personalizing education, group learning in classes [Annamalai et al., 2020]. The predictors of using smartphones as an educational tool are small effort, performance, social influence, perceived playfulness, self-management of learning [Anshari et al., 2017]. Sometimes teachers doubt whether pupils are looking for educational information or communicating in social networks by smartphone in classes. And parents tend to have the same concern at home. But pupils using smartphones as an educational tool feel themselves modern and socializing [Andrew et al., 2018], [Sari et al., 2020]. This situation gives any doubts about usefulness of smartphones as an educational tool [Moorleghen et al., 2019].

Some scientists argue that in some cases the smartphone education is more effective than the lecture learning [Kim et al., 2017], [Price et al., 2014], [Tossell et al., 2015]. Part of them explains it by the fact that to be effective education has to fulfill pupils' developmental and comfort needs [Williams et al., 2011]. For example, modern students are used to reading from laptop or smartphone screen [Bana, 2020], [Barkley et al., 2021]. But understanding information is better if it is given at a paper source [Ackerman et al., 2012], because nobody reads e-books or sites thoroughly [Noorhidawati et al., 2008]. Therefore, developers of websites and e-books are working on navigation systems so that only the necessary information can be read. Even though it is well-known that the integral perception of information to be read develops cognitive skills. The gamification of learning tasks in smartphone apps is new educational trend [Clayton et al., 2016]. No doubt, it increases positive emotional affect from task deciding and reduced subjective effort experienced by students [Bernecker et al., 2021], [Sumitra, 2019]. This and other upgrades led us from e-learning to m-learning as a more perspective [Wang et al., 2009], [Sykes et al., 2014].

But most researchers express concern about using smartphones as educational tools [Cordes et al., 2000]. These opinions are supported by the results of psychological studies of both normal and problematic smartphone use. Smartphones are becoming an extension or a part of the person [Park et al., 2019], [Ross et al., 2021]. It is the straight road to the digital person [Pancani et al., 2020]. It seems the human being is going away. The real emotions, talking "face to face" etc. concede to messengers, social network, digital games and entertainments [Verduyn et al., 2021]. The quality of real communication between lovers, friends and partners decreases at the moment smartphone presence with them [Amichai-Hamburger et al., 2016], [Misra et al., 2016]. It is shown, for example, that the simple presence of a smartphone may limit cognitive recourses and attention, necessary for any task solving, by a wish to check the device or trying to avoid it [Ward et al., 2017].

Now problematic smartphone use is worldwide known. Even preschool children (near 17%) have problematic smartphone use; they watch video, listen to music, take a pleasure and lose self-control

[Park et al., 2021]. Some changing appeared in preschool children cognitive skills connecting with using smartphones [Johnson, 2006]. For example, the selective attention is better developing than divided attention [Konok et al., 2021]. Negative effects of using a smartphone increase in school childhood. Researchers state that pupils using smartphone more than four hours a day have a low quality of sleep [Anshari et al., 2017]. Such changes in sleeping correlate with self-regulation low level appearing with non-control smartphone using. Reasons of problem smartphones using by adolescents are different: the boredom in free time is determined by a need in communication and a hedonistic motivation [Leung, 2020], conflicts with parents [Matthes et al., 2021], loneliness [Shen et al., 2019] and low level of subjective and psychological well-being [Horwood et al., 2019].

Also the problematic smartphone use is predictor of the academic procrastination [Aalbers et al., 2021] and academic stress [Anshari et al., 2017], [Akinci, 2021]. This is because adolescents use smartphones for entertainment and communication in social networks but not for educational tasks solving [Camerini et al., 2020]. The recreation motive of online activity leads to spending much more time using smartphone by adolescents [Camerini et al., 2020]. In this case, problematic smartphone using becomes negative predictor of the educational development [Akinci, 2021], [Verma et al., 2016]. But we argue that the same had been written about laptops and computers usage some years ago [Fried, 2008] and may be in two-three years problematic smartphone using will not be seen as a problem [Ellis, 2019]. Thus, the use of a smartphone as a tool for solving educational tasks is considered ambiguously. Both advantages and concerns are highlighted. However, there are almost no studies that clarify how the smartphone is used in educational activities when the pupils are not under the control of parents and teachers. Our research aims to fill this gap.

3   Materials and Methods

The study involved 582 teenagers aged 11-16 years (56.01 % of girls) enrolled in grades 5-9 of schools in St. Petersburg. The empirical data was collected through a survey conducted using the online tool "Google Forms". Pupils were asked to answer the questions presented in Table 1, which suggested the following possible answers: "Never" (0 points), "Rarely" (1 point), "Sometimes" (2 points), "Often" (3 points).

In addition to these questions, the questionnaire included items on the availability of various technical devices (smartphone, tablet, laptop/computer) for solving educational tasks, as well as on the preferences in using a particular technical device in educational activities. Based on the responses received, the sample was divided into three subgroups: those with a preference for a smartphone (n=338), a laptop or computer (n=99), and a tablet (n=12). The last subgroup was excluded from the analysis due to its small number, as well as students who reported that there was no possibility to choose a technical device (n=133).

The results were computed by "Statistica 12.0" software package. Statistical processing included frequency analysis, average value analysis, criteria analysis (Fischer * criteria), factor analysis.

Table 1: Questionnaire structure

Category	Question Specification
How often do you use the Internet:	- for recreation and entertainment - for communication - for study - to search for non-academic information - for shopping
How often do you:	- look for ready-made solutions and answers to training tasks on the Internet - look for additional information that is not in the textbooks - look for reference information (dictionaries, reference books, etc. - watch video tutorials on school subjects - watch art and popular science films that you need for your studies - use online tests and simulators for self-testing, preparing for exams and test papers - use online simulation of experiments - use the Internet for additional classes (for example, with tutors via Skype, Zoom, etc.) - take part in online subject Olympiads
How often do you use it for your studies:	- specialized (intended for study) sites that are recommended by teachers - specialized (intended for study) sites recommended by parents - specialized (intended for study) sites that are recommended by friends - specialized (intended for study) sites that you found yourself -regular search engines (Google, Yandex, etc.)

4 Results

The results we obtained indicate that the preference of a smartphone as the main tool for performing educational tasks is not connected with the place of study in the structure of pupils' online activity, which is quite significantly inferior to communication, recreation and entertainment using of the Internet. It can be noted that students who prefer a smartphone, report a slightly higher Internet activity in all areas, in comparison with students who mainly use a laptop or a computer for educational purposes, but these differences do not reach the level of statistical significance (see Figure 1).

Further analysis showed that online learning activity of secondary school students, regardless of the preferred technical device, is dominated by the search for additional and reference information, as well as, to a slightly lesser extent, the use of online tests and online simulators for self-testing and preparation for certification activities (see Figure 2).

At the same time, it was found that schoolchildren who prefer smartphones are significantly more likely to use such a method of educational tasks fulfilling as searching for ready-made answers, ready-made papers or ready-made homework, and at the same time significantly less likely to use the subject-specific educational opportunities of the Internet, in particular, modeling experiments, as well as the possibility of participating in online subject Olympiads.

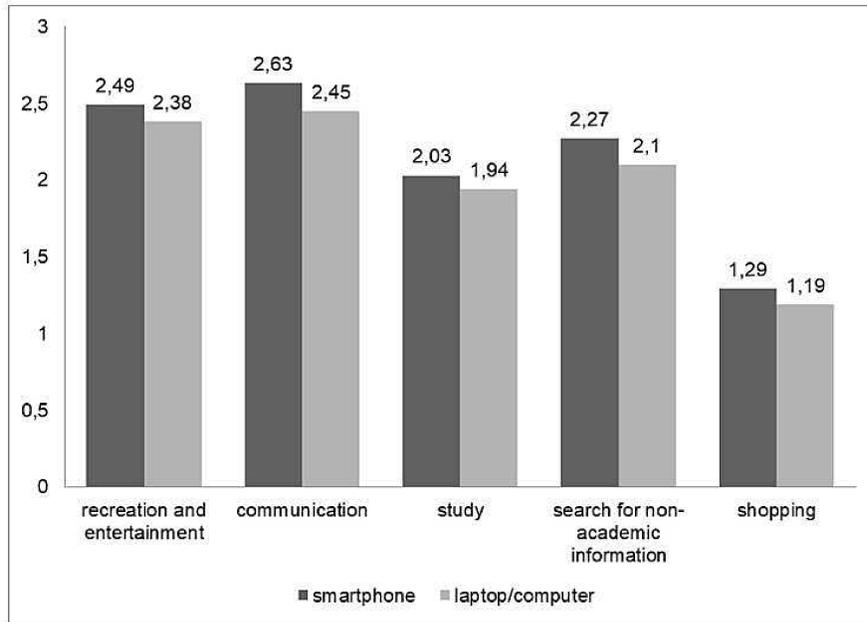It should be noted that students are much more likely to use conventional search engines for

Figure 1: The intensity of various forms of Internet activity of pupils who prefer a smartphone or laptop / computer as a tool for solving educational problems

educational purposes, in comparison with specialized sites designed to solve a variety of educational tasks. Adults (teachers and parents) become sources of information about the educational opportunities of the Internet relatively rarely. At the same time, those students who prefer a smartphone are significantly more likely to turn to specialized sites recommended by friends, which is much less typical for those who use mainly a laptop or tablet (see Figure 3).
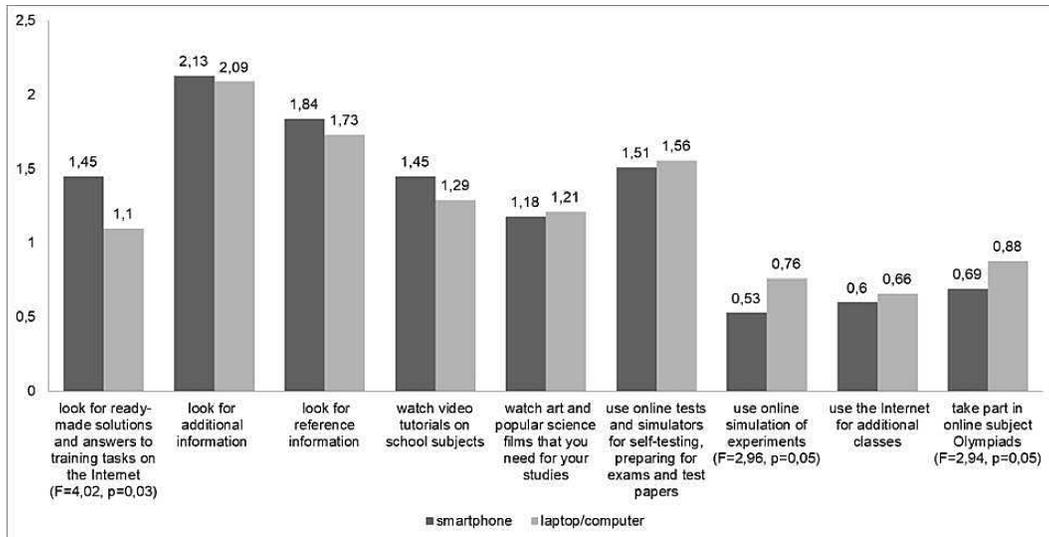
Figure 2: The intensity of the use of various educational opportunities of the Internet by schoolchildren who prefer a smartphone or a laptop / computer as a tool for solving educational problems
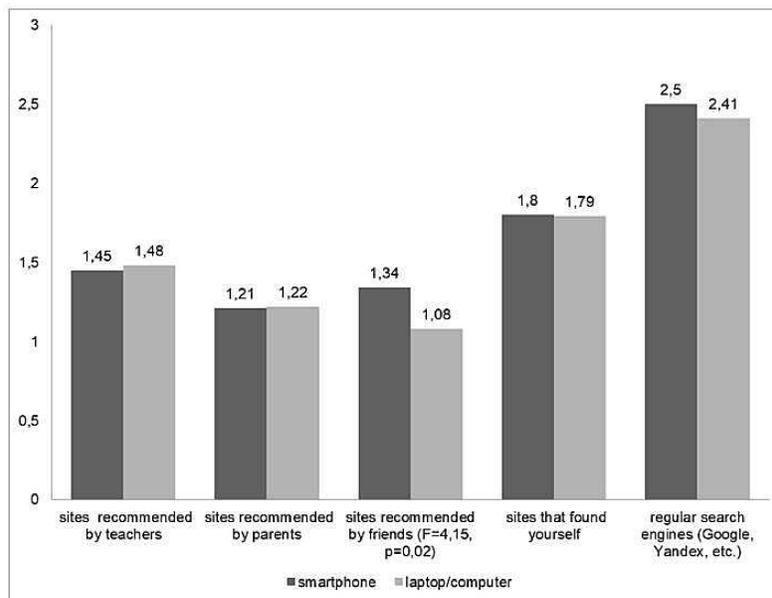

Figure 3: Intensity of use of various types of resources (according to the source of information) by schoolchildren who prefer a smartphone or laptop / computer as tools for solving educational problems

Factorization of the data (see Table 2) allowed us to note that the online learning activity of those students who prefer a smartphone is less diverse than those who prefer a computer or a laptop.

Table 2: Factor analysis results

Parameters for evaluating online learning activity	smartphone		computer or laptop		
	F*1	F2	F1	F2	F3
Search for ready-made solutions, ready-made homework assignments	-0,29	0,46	-0,07	-0,09	0,72
Search for additional information	0,40	0,30	0,43	0,58	0,01
Search for reference information	0,50	0,19	0,52	0,54	-0,11
Viewing video tutorials	0,60	0,22	0,38	0,38	-0,06
Viewing of feature and popular science films necessary for studying	0,71	0,07	0,79	0,09	-0,01
Tests-simulators for preparing for tests and exams	0,59	0,27	0,68	0,17	-0,05
Simulation of experiments	0,58	0,00	0,62	0,09	0,42
Classes with tutors (using Skype, etc.)	0,47	0,01	0,48	0,07	0,41
Participation in subject Olympiads	0,52	0,11	0,68	0,01	0,10
Sites recommended by teachers	0,56	0,34	0,48	0,23	-0,10
Sites recommended by parents	0,58	0,32	0,13	0,60	0,25
Sites recommended by friends	0,33	0,70	0,08	0,41	0,72
Sites found independently	0,21	0,76	0,04	0,79	0,10
Search engines (Google, Yandex, etc.)	-0,04	0,71	0,02	0,71	0,17
Prp.Totl	0,24	0,16	0,22	0,19	0,11

In the group of students who preferred smartphones, specialized online learning activity was associated with information about the educational opportunities of the Internet reported by adults (Factor 1, the contribution of the factor to the variance of variables 24%), while information received from friends, as well as their own search efforts, was primarily associated with the search for ready-made solutions (Factor 2, the contribution of the factor to the variance of variables 16%). Students who prefer to use a laptop or a computer turn to the use of ready-made materials, primarily on the advice of friends (Factor 3, the contribution of the factor to the variance of variables 11%), use specialized educational sites following their teachers advice (factor 1, the contribution of the factor to the variance of variables 22%), look for additional information independently or with the help of parents (factor 2, the contribution of the factor to the variance of variables 19%).

5   Discussion

According to our study results pupils of grades 6-9, regardless of the device used, give a greater preference in Internet activity to extracurricular activities: entertainment and communication in social networks. This distribution of activity is quite natural for teenagers and corresponds to age norms. Many researchers note that the structure of the motivation also highlights the motives of communication with peers to a greater extent than one's own interest and orientation towards teachers and parents in all deals, including educational tasks [Anshari et al., 2017]. It should be also noted, that our study participants are ordinary schools students and, perhaps, gifted adolescents would demonstrate another rating of the Internet activities' preference. Also pupils preferring smartphone as the educational tool more often spend the time in the Internet, than their classmates preferring a computer or a laptop. The reason of such internet behavior may be explained in the context of coping strategy facing boredom during homework time. The similar fact is described by Barkley and Lapp [Barkley et al., 2021]. And we can suppose the pupils preferring smartphone are less interested in learning than teenagers preferring a computer or a laptop. It is confirmed by our other study where it was shown that pupils preferring smartphone have a lower academic success. If we compare both results, we can conclude that pupils preferring smartphone have not the high educational motivation. And we see the pupils preferring a smartphone significantly less frequently take part in subject Olympiads and simulate experiments but significantly more often search for ready-made solutions or

ready-made homework assignments than their peers preferring a computer or a laptop. We can also suggest, that students who prefer a computer or a laptop tend to be engaged in more educational activities directed to develop academic skills, such as using tests-simulators for preparing for tests and exams, classes with tutors, viewing of feature and popular science films necessary for studying. But this fact needs further exploration. Probably it demonstrates the pupils' interest in learning and their aspiration to achieve academic results and success by themselves. Pupils preferring smartphone search ready information for using and do not need for its additional transformation.

Adolescents rate referent groups for recommendations of educational information according their age-specific features. At the first place they value their own opinion and the ability to make their own choice about sites usage. It is reaction of emancipation which is typical for adolescence. Teachers occupy the next place because they are considered experts in the field of educational information. And then we see difference between adolescents preferring a computer or a laptop and their peers preferring a smartphone. Ones prefer parents' opinion but others - friends' advice. This result is interesting because friends' opinion is usually more important than parents' one for adolescents. However we note that pupils preferring a computer or a laptop have classes with tutors and use tests-simulators. These kinds of activity are impossible without parents' taking part, especially financial. And supposedly, parents do influence their children in the part of educational attitudes and motivation. The factor structure confirms our assumption: adolescents preferring a computer or a laptop ask for their parents advice in case of searching additional educational information. And only last of all they turn to friends who recommend them sites with a ready-made homework. Finally we see the distinct hierarchy of educational sources and activities of pupils preferring a computer or a laptop: at the first - expert information and developmental activities, then – additional information had chosen by parents' advices and at last – friends with their questionable recommendation. Pupils that prefer smartphones demonstrated the opposite features. They are friends and ready homework oriented. It seems normal for this age but it gives us some concern thinking about their future. We may suppose these adolescents are more separated from adults (teachers and parents) and satisfy their educational and communicative needs by smartphones.

Conclusions

The preference of the smartphone as the main tool for completing educational tasks is not reflected in the place of educational activities in the hierarchy of pupils' online activity. But it determines the content of educational online activity, in which the search for ready-made solutions on the Internet becomes more important, both independently and based on the significant others advice. We think that smartphone usage with educational reasons among school students has both positive and adverse sides regarding educational motivation and adolescence social and personal development in a broader sense. Future research should further examine smartphone usage among students both with educational and recreational purposes, we need to develop more specific measures for smartphone usage, and to form research based interventions to prevent problematic smartphone usage in the context of students' educational online activities.

Acknowledgements

References

[Aalbers et al., 2021] Aalbers, G., vanden Abeele, M. M. P., Hendrickson, A. T., de Marez, L., & Keijsers, L. (2021) Caught in the moment: Are there person-specific associations between momentary procrastination and passively measured smartphone use? Mobile Media & Communication. doi:10.1177/2050157921993896

[Ackerman et al., 2012] Ackerman, R., and Lauterman, T. (2012). Taking reading comprehension exams on screen or on paper? A metacognitive analysis of learning texts under time pressure. Computers in Human Behavior, 28(5), 1816–1828. doi: 10.1016/j.chb.2012.04.023

[Akinci, 2021] Akinci, T. (2021) Determination of Predictive Relationships between Problematic Smartphone use, Self-regulation, Academic Procrastination and Academic Stress through Modelling. International Journal of Progressive Education, 17(1), 35-53. doi: 10.29329/ijpe.2020.329.3

[Albo et al., 2019] Albo, L., Hernandez-Leo, D., Moreno, O. V. (2019) Smartphones or laptops in the collaborative classroom? A study of video-based learning in higher education. Behaviour & Information Technology, 38 (6), 637-649. doi: 10.1080/0144929X.2018.1549596

[Amichai-Hamburger et al., 2016] Amichai-Hamburger, Y., and Etgar, S. (2016). Intimacy and smartphone multitasking- a new oxymoron? Psychological Reports, 119(3), 826. doi:10.1177/0033294116662658

[Andrew et al., 2018] Andrew, M., Taylorson, J., Langille, D. J., Grange, A., Williams, N. (2018). Student attitudes towards technology and their preferences for learning tools/devices at two universities in the UAE. Journal of Information Technology Education: Research, 17, 309-344. doi: 10.28945/4111.

[Annamalai et al., 2020] Annamalai, N., and Kumar, J. A. (2020). Understanding Smartphone use Behavior among Distance Education Students in Completing their Coursework in English: A Mixed-Method Approach. Reference Librarian, 61(3/4), 199–215. doi:10.1080/02763877.2020.1815630

[Anshari et al., 2017] Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., and Huda, M. (2017). Smartphones usage in the classrooms: Learning aid or interference? Education and Information Technologies, 22(6), 3063-3079. doi: 10.1007/s10639-017-9572-7

[Bana, 2020] Bana, A. (2020). Students' Perception of Using the Internet to Develop Reading Habits: A Case Study at the English Education Department of Universitas Kristen Indonesia. Journal of English Teaching, 6(1), 60–70.

[Barkley et al., 2021] Barkley J. E., Lepp A. (2021) The effects of smartphone facilitated social media use, treadmill walking, and schoolwork on boredom in college students: Results of a within subjects, controlled experiment. Computers in Human Behavior, 114, 106555. doi:10.1016/j.chb.2020.106555.

[Bernecker et al., 2021] Bernecker, K., Ninaus, M. (2021) No Pain, no Gain? Investigating motivational mechanisms of game elements in cognitive tasks. Computers in Human Behavior, 114, 106542, doi:10.1016/j.chb.2020.106542.

[Bezgodova et al., 2020a] Bezgodova S.A., Miklyaeva, A.V., Yumkina, E. A. (2020) Smartphone as a learning tool: Psychological analysis. Herzen Readings: Psychological Research in Education, 3, 81-91. doi: 10.33910/herzenpsyconf-2020-3-41(In Rus).

[Bezgodova et al., 2020b] Bezgodova, S.A., Miklyaeva, A.V., Nikolaeva, E.I. (2020) Computer vs smartphone: how do pupils complete educational tasks that involve searching for information on the internet? In: T. Noskova, X. Piotrowska (eds.) Ceur Workshop Proceedings. Proceedings of the XV International Conference (NESinMIS-2020). CEUR-WS, 2020, 52-62.

[Bolliger et al., 2021] Bolliger, D. U., McCoy, D., Kilty, T., Shepherd, C. E. (2021) Smartphone use in outdoor education: a question of activity progression and place. Journal of Adventure Education & Outdoor Learning. 21 (1), 53-66. doi: 10.1080/14729679.2020.1730204.

[Camerini et al., 2020] Camerini, A.-L., Gerosa, T., and Marciano, L. (2020) Predicting problematic smartphone use over time in adolescence: A latent class regression analysis of online and offline activities. New Media & Society. doi:10.1177/1461444820948809

[Clayton et al., 2016] Clayton, K. & Murphy, A. (2016). Smartphone Apps in Education: Students Create Videos to Teach Smartphone Use as Tool for Learning. Journal of Media Literacy Education, 8(2), 99-109. Retrieved 6/5/ 2021, from https://www.learntechlib.org/p/192600/.

[Cordes et al., 2000] Cordes, C., Miller, E. (2000). Fool's gold: A critical look at computers in childhood. College Park: Alliance for Childhood. 105 p. Retrieved 10/4/2020, from: https://eric.ed.gov/?id=ED445803

[Ellis, 2019] Ellis, D. A. (2019) Are smartphones really that bad? Improving the psychological measurement of technology-related behaviors, Computers in Human Behavior, 97, 60-66. doi:10.1016/j.chb.2019.03.006.

[Fried, 2008] Fried, C. B. (2008) In-class laptop use and its effects on student learning. Computers & Education, 50(3), 906–914. doi:10.1016/j.compedu.2006.09.006

[Grinols et al., 2014] Grinols, A. B., & Rajesh, R. (2014) Multitasking with smartphones in the college classroom. Business and Professional Communication Quarterly, 77(1), 89–95. doi:10.1177/2329490613515300

[Horwood et al., 2019] Horwood, S., Anglim, J. (2019) Problematic smartphone usage and subjective and psychological well-being, Computers in Human Behavior, 97, 44-50, doi:10.1016/j.chb.2019.02.028.

[Jeong et al., 2017] Jeong, S., Cha, C. and Lee, J. (2017) 'The effects of STI education on Korean adolescents using smartphone applications', Health Education Journal, 76(7), 775–786. doi: 10.1177/0017896917714288.

[Johnson, 2006] Johnson, G. M. (2006). Internet use and cognitive development: A theoretical framework. E-Learning, 3(4), 565-573. doi: 10.2304/elea.2006.3.4.565

[Kim et al., 2017] Kim, S.-J., & Cho, H. (2017) The Effect of Smartphone-Delivered Emergency Preparedness Education on Coping Knowledge Among Fifth- and Sixth-Grade Elementary Schoolchildren in South Korea. The Journal of School Nursing, 33(6), 434–445. doi:10.1177/1059840516680267

[Konok et al., 2021] Konok, V., Liszkai-Peres, K., Bunford, N., Ferdinandy, B., Jurányi, Z., Ujfalussy, D. J., Réti, Z., Pogány, A., Kampis, G., Miklósi, A. (2021) Mobile use induces local attentional precedence and is associated with limited socio-cognitive skills in preschoolers, Computers in Human Behavior, 120. 106758. doi:10.1016/j.chb.2021.106758.

[Koroleva, 2016] Koroleva, D. O. (2016) Always online: the use of mobile technologies and social networks by modern teenagers at home and at school, 1, 205-224. doi: 10.17323/1814-9545-2016-1-205-224. (In Rus).

[Leung, 2020] Leung, L. (2020) Exploring the relationship between smartphone activities, flow experience, and boredom in free time, Computers in Human Behavior, 103, 130-139, doi:10.1016/j.chb.2019.09.030.

[Matthes et al., 2021] Matthes, J., Thomas, M. F., Stevic, A., Schmuck, D. (2021) Corrigendum to "Fighting over smartphones? Parents' excessive smartphone use, lack of control over children's use, and conflict." Computers in Human Behavior, 120, 106764. doi:10.1016/j.chb.2020.106618

[Misra et al., 2016] Misra, S., Cheng, L., Genevie, J., & Yuan, M. (2016). The iPhone effect the quality of in-person social interactions in the presence of mobile devices. Environment and Behavior, 48(2), 275–298. doi: 10.1177/0013916514539755

[Moorleghen et al., 2019] Moorleghen, D. M., Oli, N., Crowe, A. J., Liepkalns, J. S., Self, C. J., Doherty, J. H. (2019) Impact of automated response systems on in-class cell phone use. Biochemistry And Molecular Biology Education: A Bimonthly Publication Of The International Union Of Biochemistry And Molecular Biology, 47 (5), 538-546. doi: 10.1002/bmb.21257

[Noorhidawati et al., 2008] Noorhidawati, A., and Gibb, F. (2008) How students use e-books - reading or referring? Malaysian Journal of Library and Information Science, 13(2), 1-14.

[Pancani et al., 2020] Pancani, L., Preti, E., & Riva, P. (2020) The Psychology of Smartphone: The Development of the Smartphone Impact Scale (SIS). Assessment, 27(6), 1176–1197. doi:10.1177/1073191119831788

[Park et al., 2019] Park, C. S., & Kaye, B. K. (2019) Smartphone and self-extension: Functionally, anthropomorphically, and ontologically extending self via the smartphone. Mobile Media & Communication, 7(2), 215–231. doi:10.1177/2050157918808327

[Park et al., 2021] Park, J. H., & Park, M. (2021) Smartphone use patterns and problematic smartphone use among preschool children. PLoS ONE, 16(3), 1–12. doi:10.1371/journal.pone.0244276

[Price et al., 2014] Price, S., Davies, P., Farr, W., Jewitt, C., Roussos, G. and Sin, G. (2014) Mobile application to foster geospatial thinking in science. Br J Educ Technol, 45: 160-170. doi:10.1111/bjet.12000

[Ross et al., 2021] Ross, M. Q., and Bayer, J. B. (2021) Explicating self-phones: Dimensions and correlates of smartphone self-extension. Mobile Media & Communication. doi:10.1177/2050157920980508

[Sari et al., 2020] Sari, A. I., Suryani, N., Rochsantiningsih, D., Suharno, S. (2020) Digital Learning, Smartphone Usage, and Digital Culture in Indonesia Education. Integratsiya obrazovaniya = Integration of Education, 24(1), 20-31. doi: 10.15507/1991-9468.098.024.202001.020-031

[Shen et al., 2019] Shen, X., Wang, J-L. (2019) Loneliness and excessive smartphone use among Chinese college students: Moderated mediation effect of perceived stressed and motivation. Computers in Human Behavior, 95, 31-36. https://doi.org/10.1016/j.chb.2019.01.012.

[Sørenssen et al., 2021] Sørenssen, I. K., and Bergschöld, J. M. (2021) Domesticated Smartphones in Early Childhood Education and Care settings. Blurring the lines between pedagogical and administrative use. International Journal of Early Years Education, 3, 1–14. doi:10.1080/09669760.2021.1893157

[Sumitra, 2019] Sumitra, N. (2019) Extended Study of Undergraduate Students' Usage of Mobile Application for Individual Differentiation Learning Support of Lecture-based General Education Subjects. International Journal of Interactive Mobile Technologies, 13 (9), 99-112. doi: 10.3991/ijim.v13i09.10558.

[Sykes et al., 2014] Sykes, E.R. (2014) New Methods of Mobile Computing: From Smartphones to Smart Education. Techtrends Tech Trends, 58, 26–37. doi:10.1007/s11528-014-0749-2

[Tossell et al., 2015] Tossell, C.C., Kortum, P., Shepard, C., Rahmati, A. and Zhong, L. (2015) Smartphone use in higher education. British Journal of Educational Technology, 46, 713-724. doi:10.1111/bjet.12176

[Vazquez Cano et al., 2018] Vazquez Cano E., Sevillano-Garcia M.L. (2018) Ubiquitous Educational Use of Mobile Digital Devices. A General and Comparative Study in Spanish and Latin America Higher Education. Journal of New Approaches in Educational Research, 7 (2), 105-115. doi: 10.7821/naer.2018.7.308

[Verduyn et al., 2021] Verduyn P., Schulte-Strathaus, J. C.C., Kross, E., Hülsheger, U. R. (2021) When do smartphones displace face-to-face interactions and what to do about it? Computers in Human Behavior, 114, 106550. doi: 10.1016/j.chb.2020.106550

[Verma et al., 2016] Verma, A., Jha, M., & Mitra, M. (2016) Digital Awareness and Internet Usage by School Students. Journal of Psychosocial Research, 11(2), 259–270. Retrieved 8/5/2021, from .

[Vorley et al., 2016] Vorley, T. and Williams, N. (2016) "Not just dialling it in: Examining cognitive-based approaches in enterprise education using a smartphone application"Education + Training, 58 (1), 45-60. doi: 10.1108/ET-01-2015-0010

[Wang et al., 2009] Wang, Y., Wu, M., & Wang, H. (2009) Investigating the determinants and age and gender differences in the acceptance of mobile learning. British Journal of Educational Technology, 40(1), 92–118. doi:10.1111/j.1467-8535.2007.00809.x.

[Ward et al., 2017] Ward, A. F., Dyke, K., Gneezy, A., Bos, M. W. (2017) Brain Drain: The mere presence of one's own smartphone reduces available cognitive capacity. Journal of the Association for Consumer Research, 2 (2), 140-154. doi:10.1086/691462.

[Williams et al., 2011] Williams, A. J., & Pence, H. E. (2011) Smart phones, a powerful tool in the chemistry classroom. Journal of Chemical Education, 88(6), 683–686. doi:10.1021/ed200029p

[Yasakcı et al., 2019] Yasakcı, A., Özdal, H. (2019) An Evaluation of the Problems Encountered by Elementary School Students While Using Internet. International Journal of Emerging Technologies in Learning. 14 (22), 204-219. doi: 10.3991/ijet.v14i22.11731.