PRIMARY SCHOOL STUDENTS' NATURAL SCIENCE DIGITAL LITERACY COMPETENCE IN DIGITAL LEARNING ENVIRONMENTS

Polona Legvart, Metka Kordigel Aberšek, Maja Kerneža
University of Maribor, Slovenia
E-mail: polonca.legvart@guest.arnes.si,
metka.kordigel@um.si, maja.kerneza1@um.si

Abstract

This study describes a research focused on primary teachers' evaluation of their students' digital literacy as a basic competence in the structure of natural science literacy of research and comprehension competence. With the term, primary teachers we mean teachers of first three grades of compulsory school. The comparison of basic computer skills between Generation Z and Generation Alpha revealed, contrary to expectations, a very small progress. The consequence of this circumstance are the problems associated with the implementation of natural science curricular goals in digital environments of remote teaching in school closure period. A questionnaire given to 176 primary teachers, revealed which digital learning environments could be chosen for science lessons and which curricular goals could/could not be achieved with this level of Generation Alpha students' digital literacy competence.
The results showed that the digital environment is more problematic and unfavorable for Generation Alpha in the field of natural science, as teachers showed a higher frequency of avoiding natural science goals than social science content.
Keywords: *distance learning environment, generation Alpha, natural science digital literacy competence, natural science education*

Introduction

Since the beginning of the third millennium, it had been clear that learning environments at all levels of the educational system would (and must) change, as a consequence of the digitalization process in professional and personal lives and as a consequence of the changes that this shift in communication from analogue to digital had made in the human brain. But no one had imagined that the shift from traditional to digital would happen in an instant, for all levels of education, for all students, and for all teachers – as it did with the closure due to COVID–19 lockdown all around the world.

Well, this change in learning environments took place in different contexts: There were countries (regions) that were technologically prepared. Their internet connections could handle multiple users per time, their students were equipped with computers and tablets, their teachers were digitally competent to teach in digital environments and, the students were already digitally competent to participate in the process of distance

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learning in digital learning environments. It is assumed that all these factors occur simultaneously, and they usually do, but in the case of primary level of education, the last-mentioned factor – students' digital literacy – is a constant problem even in digitally advanced technological and digital learning environments.

In the context of natural science didactics in digital learning environments, the crucial question of primary level natural science education – besides the basic literacy problem – is students' natural science digital literacy competence. Previous research on students' digital competence for learning in digital environments points in two directions: Previous studies assumed that "digital natives" already enter school digital competent. Even more: Their digital competence is so far developed that they have nothing more to learn from their teachers, "digital immigrants" (Prensky, 2011; Spiro, 2004). Later studies (Cornu, 2011; Sadler, 2011; DeStefano&LeFevre, 2007; Kordigel Aberšek et. al., 2015), which measured the relationship between learning in digital environments and learning outcomes, noticed a remarkable difference between students with relatively high level of digital pre-knowledge and those with weak pre-knowledge. Meanwhile the generation changed. The primary grade students do not belong to the millennium generation, or, as they were called: Generation Y, anymore. They belong to Generation Alpha – they are children of Millennials and younger siblings of Generation Z. Generation Alpha is a generation born in (or after) 2010, the year the iPad was launched, and Instagram was created. Not only were their parents constant users of smart devices themselves (unlike the parents of Millennials, who struggled with new technologies), they used smart devices as pacifiers, entertainers, and educators, as screens were put in front of their children at the youngest possible age (McCrindle & Fell, 2020a). The consequence of a different digital environment in early childhood could lead to significantly higher level of (at least basic) digital competence at the age when children – Generation Alpha – enter school, which would enable them to successfully participate in digital learning environments (McCrindle & Fell, 2020b). This optimistic speculation usually overlooks what is expected of learning environments in the 21st century (DuMond & Instance, 2010). For natural science teaching/learning, the learning environment should provide the opportunity for a *social-constructivist* approach to learning, where learning/teaching takes place in the interaction between learners and their contextual situation, with learners actively constructing their knowledge and skills. Learning in such learning environments is/should be *self-regulated,* with active use of learning strategies, it should be situated in context and not abstracted from the environment, and it should be collaborative - not a solo activity (De Corte, 2010).

The Aim of the Study

The first aim of the research was to find out if and to what extent the digital literacy of Generation Alpha is advanced in comparison to the digital literacy of Generation Z. The second aim was to find out whether the digital literacy of primary students, age 6 – 8, reaches the level that can be used in the context of natural science digital competence for successful participation in social-constructivist based natural science class.

To find the answer to this central research question, the following research questions were formed:

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1. According to the teachers' assessment, how high is the level of primary students' basic computer literacy – the basic competence of natural science literacy of research and comprehension competence?
2. What digital learning environments did teachers use for science teaching during school closure in Slovenia?
3. How many natural science curricular goals were reached in these digital learning environments?
4. What natural science curricular goals were not reached in the digital learning environments and what are the reasons why teachers did not choose them during distance learning in the digital learning environments?

Research Methodology

The research background for establishing the difference/progress of digital literacy of Generation Alpha compared to the previous generation (Generation Z) was the study conducted in Slovenia in spring 2015, which examined compulsory and secondary school natural science teachers' assessment of their students' *new natural science literacies of online research and comprehension competence.*

Sample Selection

A sample were primary school teachers in Slovenia. Why in Slovenia? As mentioned above, four main factors influence students' performance in digital environments:

- technological factors (accessibility and quality) of internet connections,
- students' equipment with computers and tablets,
- teachers' digital competence to teach in digital environments and
- the fact that students were already digitally competent to participate in the process of distance learning in digital learning environments.

These four factors usually occur together, but not in Slovenia: In Slovenia both technology factors were solved very quickly, teachers were prepared to use digital learning environments in many projects.

Consequently, Slovenian primary school teachers are a reliable sample to find answers to the listed research questions. Our sample consisted of two sets of data. 135 teachers assessed their students' basic online skills, while 183 teachers responded to the questions about teaching in digital learning environments. The sample was random selected. Participants were not asked to give the sociodemographic data, because the research was not focused in interconnectedness between teachers' gender/the length of their teaching experience and the natural science teaching practice in distance teaching period, but in their evaluation of students' digital competence and in their teaching practice, connected with natural science curricular goals.

Ethical Procedures

Participants' approval was obtained in research in line with the voluntary principle. All participants were informed about the purpose of the research. At all stages, the identities of the participants were kept, and the codes, given to the participants were used when quoting raw data texts.

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Instrument and Procedures

The first set of data was collected using a 5-point Likert scale questionnaire, consisted of 21 items. The instrument was adapted from the TICA checklist, developed as part of the Teaching Internet Comprehension Skills to Adolescents project, which focused on learning skills, essential for online reading comprehension (Leu et al., 2008). The original TICA online reading comprehension checklist included items from five areas necessary for online reading comprehension: understanding and developing questions, locating information, critically evaluating information, synthesizing the information, and communicating the information. The adaptation used for our study focused on computer basics (Appendix A in the original survey), and the number of items was reduced – from 29 to 21 in the computer basics checklist.

The second set of data was collected through the online questionnaire *Learning environment for the first three grades in the time of remote teaching,* which contained 52 questions regarding teachers' experiences after COVID–19 school closure (11 weeks in Slovenia).

Data Analysis

Quantitative data from primary school teachers were collected. After verifying that the data were free of errors, quantitative analyzes were conducted and analyzed according to the following stages, or by encoding, defining, and organizing the data and interpreting the results. For the statistical processing of the data an IBM SPSS program was used. For basic statistical interpretation of the results, number, structural percentage, mean and standard deviation of the data were used.

Research Results

The findings ascertained from this research are presented in two parts. The first part presents data of primary school teachers' judgement of their students' computer basic skills, their web searching basics and general navigation basics, skills that are the basement of digital competence, needed for participation in digital learning environments. The second part presents data about natural science education in the period of school lock down, implementation of natural science curricular goals and reasons, why certain natural science curricular goals were not chosen for didactic units in digital learning environments.

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Table 1
Primary School Teachers' Ratings of Their Students' Basic Online Skills

Basic online skills	Generation Z (2015)		Generation Alpha (2021)	
	M	*SD*	*M*	*SD*
1. Computer Basics				
Turn a computer on/off	4.41	1.07	4..6	0.89
Use the mouse/track pad	4.35	0.91	4.29	0.83
Follow classroom and school rules for computer use	3.47	1.14	3.70	0.91
Open programs and files using icons and/or the Start Menu (PC)	2.88	0.82	3.32	0.91
Create/open a new folder/file	1.94	0.95	2.05	0.89
Launch a word processor	2.06	0.84	2.16	1.00
Open a word processing file	1.88	0.97	2,15	1.02
Type a short entry in a word processing file	2.00	0.83	1.89	0.95
Copy text	1.76	1.23	1.97	0.95
Cut text	2.24	1.04	2.35	1.11
Past text	1.82	1.01	1.95	0.90
Name a word processing file and save it	1.71	0.97	1.90	0.99
Open a new window	2.24	1,13	2.36	1.11
Open a new tab	1.65	0.87	1.59	0.79
2. Web Searching Basic				
Locate and open a search engine	2.00	0,85	3.35	1.27
Type key words in the correct location of a search engine	2.71	0.91	3.06	1.24
Use the refresh button	1.94	1.14	2.25	1.10
Use the “BACK” and “FORWARD” buttons	2.65	0.82	2.84	1.12
3. General Navigation Basic				
Maximize/minimize windows	2.18	0.7	2.48	1.08
Open and quit applications	2.76	0.81	3.26	1.18
Toggle between windows	2.00	0.89	2.58	1.03

Comparison of the results shows that basic computer competence in Generation Alpha developed less than expected in the context of the digital stimulating environment from the earliest age. Over the last 6 years, the results have changed only slightly. Generation Alpha enters the school hardly computer literate. Almost all of them can turn the computer on and off and use the mouse/trackpad, which they had probably learned while using digital devices for play/fun and perhaps socializing, but a large majority of them do not have other 21 basic computer skills that they would have needed to participate in the educational process in digital learning environments.

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Table 2

Learning Environments for Teaching Science in the Distance-Learning Period

		Videoconference	Email	Online learning environment	Social networks	Phone calls	Other*	Other
1	*f*	2	32	66	149	79	104	51
	f %	1.14	18.18	37.50	84.66	44.89	59.08	80.95
2	*f*	3	14	4	6	23	13	1
	f %	1.70	7.95	2.27	3.41	13.07	7.39	1.59
3	*f*	0	7	1	1	22	17	1
	f %	0.00	3.98	0.57	0.57	12.50	9.66	1.59
4	*f*	13	35	6	9	26	24	3
	f %	7.39	19.88	3.41	5.11	14.77	13.64	4.76
5	*f*	61	30	6	5	17	11	3
	f %	34.66	17.05	3.41	2.84	9.66	6.25	4.76
6	*f*	97	58	93	6	9	7	4
	f %	55.11	32.96	52.84	3.41	5.11	3.98	6.35
Total	*f*	176	176	176	176	176	176	176
	f %	100.00	100.00	100.00	100,00	100.00	100.00	100.00
SD		5.4	4.1	3.9	1.5	2.5	2.1	1.7
Mean		0.9	1.9	2.4	1.3	1.6	1.6	1.6

Note: Other* – Mentimeter, BookCreator, Padlet, Plickers, Quizlet, Kahoot, Thinglink ...; 1 – Never, 2 – Once a month, 3 – Once every two weeks; 4 – Once a week, 5 – Up to 3 times a week, 6 – Daily

Students' limited basic computer skills did not prevent teachers from using digital learning environments under distance learning conditions during the COVID–19 closure. The results in Table 2 show that more than half of them used video conferencing (Zoom, Teams, Meet, etc.) almost daily, a similar percentage used Moodle, Mahara, 0386, Seesaw, Google classroom, classroom e-assistant Xooltime (online learning environment), only one third used email connection. These results can be explained in the context of parents' complaints about being overloaded with teachers' expectations for participation in primary students' homeschooling during the COVID–19 school closure.

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Table 3

Science Curricular Goals Reached during the Remote Teaching Period

	f	*f%*
One fifth of curricular goals and less	2	1.30
A quarter of curricular goals	4	2.60
One third of the curricular goals	13	8.44
Half of the curricular goals	21	13.64
Two-thirds of the curricular goals	19	12.34
Three-quarters of the curricular goals	41	26.62
Almost all or all curricular goals	54	35.06
Total	154	100.00

Table 3 shows that only a little over one-third of the teachers managed to reach all of the science curricular goals according to the annual plan, they prepared before the October closure. A quarter (25, 98 %) of the teachers admitted that they were only able to achieve half or even less of the science curricular goals. These results urge us to seek the answer to the question presented in Table 4: What science curricular goals teachers decided to teach/not to teach in digital learning environments.

Table 4

Curricular Goals, for which Primary Teachers Decided that They Are/Are Not Achievable in Digital Learning Environments

	Achievable goals						**Unachievable goals**									
	Goal 1		**Goal 2**		**Goal 3**		**Goal 1**		**Goal 2**		**Goal 3**		**Goal 4**		**Goal 5**	
	f	***f%***	***f***	***f%***	***f***	***f%***	***f***	***f%***	***f***	***f%***	***f***	***f%***	***f***	***f%***	***f***	***f%***
Social sciences	14	40.00	13	61.90	8	42.11	6	37.50	5	41.67	0	0.00	1	50.00	0	0.00
Biology	10	28.57	4	19.05	5	26.32	4	25.00	4	33.33	1	16.67	1	50.00	2	100.0
Physics	11	31.43	4	19.05	6	31.57	6	37.50	3	25.00	5	83.33	0	0.00	0	0.00
Total	35	100.0	21	100.0	19	100.0	16	100.0	12	100.0	6	100.0	2	100.0	2	100.0

The results in Table 4 show that most of the achievable goals are from the field of social sciences, while several goals for which primary school teachers decided they are not achievable in digital learning environments derives from the field of physics and biology. These results initiated the next research question: which were the reasons for teachers, not to choose the curricular goals from the fields of natural sciences to engage with in the digital environment.

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Table 5

Reasons for Not Selecting Natural Science Curricular Goals in the Digital Learning Environment

	1		2		3		4		5		6		7		Total	
	f	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*	*f*	*f%*
Goal 1	2	4.35	1	2.17	9	19.57	4	8.70	20	43.47	7	15.22	3	6.52	46	100.00
Goal 2	2	9.09	1	4.55	2	9.09	2	9.09	10	45.45	3	13.64	2	9.09	22	100.00
Goal 3	1	9.09	0	0.00	1	9.09	0	0.00	5	45.46	3	27.27	1	9.09	11	100.00
Goal 4	1	25.00	0	0.00	1	25.00	1	0.00	2	50.00	0	0.00	0	0.00	4	100.00
Goal 5	0	0.00	0	0.00	0	0.00	1	33.33	2	66.67	0	0.00	0	0.00	3	100.00

Note: 1 – Students were not present, 2 – The curriculum is overloaded, 3 – The goal is too demanding, 4 – No digital learning resources available, 5 – Distance learning requires a different didactic approach, 6 – Limited students' digital competence, **7** – My limited digital competences.

In the field of natural sciences (goals 1, 2 and 3), teachers mostly decided not to teach in digital learning environments because *distance learning requires a different didactic approach*, followed by *the goal is too demanding* and *limited student' digital competence* (Table 5).

Discussion

The results from our research are consistent with previous results, gained in a meta-analysis by Delgado and his team (Delgado et al., 2018). As we, they expected newer generations to achieve better learning outcomes in digital environments than older ones. In their meta-analysis, which included studies from 2000 to 2017 with a sample of 171.055 participants, they examined, whether the publication date of the study »reveals a decreasing advantage of paper in recent years due to greater exposure to technology than in earlier years« (p.7). Contrary to expectations, the meta-analysis showed that earlier (and longer) exposure to digital media has a diametric effect (Duncan et al., 2015; Pfost et al., 2013): Not only were there no differences between age groups across the years, but the results also obtained later show poorer reading and learning outcomes in digital environments. This is consistent with our findings showing that, contrary to expectations, primary students – Generation Alpha – do not have sufficiently developed digital competence to participate effectively in digital learning environments – which presents a major challenge for primary teachers, as our research has shown, how to perform the natural science class.

Conclusions

In conclusion, a call is needed for researchers, policy makers, and educational experts to develop methods that support effective digitally based natural science teaching and learning in digital learning environments for very young Generation Alpha students,

who have very limited digital literacy skills in addition to their still emerging general literacy skills.

Declaration of Interest

Authors declare no competing interest.

References

Cornu, B. (2011). *Digital Natives: How do They Learn? How to teach them?* UNESCO Institute for Information Technologies.

DeCorte, E. (2010). *Historical developments in the understanding of learning. The Nature of Learning: Using to Inspire Practice*. OECD Publications.

Delgado P., Vargas C., Ackerman R., & Salmeron L. (2018). Don't throw away your printed books. A meta-analysis on the effects of reading media on reading comprehension. *Educational research Review 25*, 23–25. https://doi.org/10.1016/j.edurev.2018.09.003

Duncan, L. G., McGeown S. P., Griffiths Y. M., Stothard S. E., & Dobai A. (2015). Adolescent reading skill and engagement with digital and traditional literacies as predictor of reading comprehension. *British Journal of Psychology*, *107*, 209–238.

Dumont, H., & Instance, D. (2010*). Analyzing and designing learning environments for the 21st Century. In: The Nature of Learning: Using to Inspire Practice*. OECD Publications.

DeStefano D. & Le Fevre, J. A. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior, 23*(3), 1616–1641.

Kordigel Aberšek, M., Dolenc, K., Flogie, A., & Koritnik, A (2015). The new literacies of online research and comprehension: To teach or not to teach. *Journal of Baltic Science Education*, *14*(4), 460–473.

Leu, D. J., Jr., Coiro, J., Castek, J., Hartman, D. K., Henry, L. A., & Reinking, D. (2008). Research on instruction and assessment of the new literacies of online reading comprehension. In C. C. Block, S. Parris, & P. Afflerbach, (Eds.), *Comprehension instruction: Research-based best practices.* Guilford Press.

McCrindle, M., & Fell, A. (2020a*). Understanding generation alpha*. McCrindle Research Pty.

McCrindle, M., & Fell, A. (2020b). *Understanding the Impact of COVID-19 on the Emerging Generations*. McCrindle Research Pty.

Pfost, M., Dofler, T., & Artelt, C. (2013). Students' extracurricular reading behavior and the development of vocabulary and reading comprehension. *Learning and Individual Differences*, *26,* 89–102.

Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9(5)*, 1–6.

Sadler, C. R. (2011). *Comprehension strategies for middle grade learners: A handbook for content area teachers* (2nd ed.). International Reading Association.

Spiro, R. J. (2004). Principled pluralism for adaptive flexibility in teaching and learning. In Ruddel, R. B. & Unrau, n. (Eds.), *Theoretical models and processes of reading* (5th ed., 654-659). International Reading Association.

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